

Room A

Session – 1

ICIM 2018

Capturing Value from Data Driven Online Platforms: Alliance Strategy of the Incumbents

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Abstract Platform business is considered as a competitive business model. Especially, the emergence of “data driven online platformers” represented by GAFA (Google, Apple, Facebook and Amazon) is challenging various industries including the incumbent platformers. This paper aims to reveal the way for incumbent platformers to deal with the situation by cooperating with the “data driven online platformers”. As a result of case study, new hypothesis was derived. Leveraged by its data centric structure, the essential function of “data driven online platform (DDOP)” was identified as an ability to create new value by interconnecting users in different platforms which made the network effect more multifaceted. Incumbent platformers can benefit from this multifaceted network effect by promoting platform alliance with DDOP. Creating “new adjacent market” which is sandwiched by both platforms seems to be key success factor for incumbent platformers in this alliance where further discussion is needed.

Keywords :online platform, platform alliance, multi-sided network effect, value creation

1 Introduction

Platform businesses are considered as a competitive business model. Microprocessor of Intel, operating system of Microsoft Windows or video game console of Nintendo Switch and Sony PlayStation is a type of platform called “industry platform,” that is a foundation upon which an array of firms can develop complementary products, technologies or services (Gawer, 2009). “Industry platforms” are highly competitive business model since their value can be leveraged by external innovation of complementary products or services, referred as “platform leadership” (Cusumano and Gawer, 2002). Some of industry platforms have come out of closed platform which is a common base utilized by limited members. Another type of platform is called “transaction platform” which facilitate transactions between different markets represented by credit card or shopping mall. This type of platform has “two-sided (multi-sided) market” which leverages network-effect (both direct and indirect) and leads to Winner-Take-All dynamics after reaching the critical mass. (Eisenmann et.al., 2006)

Today, incumbent platformers are facing considerable challenges of “data driven online platformers” represented by GAFA (Google, Apple, Facebook and Amazon). For example, Microsoft is facing challenge of Google. Since the device innovation and emergence of cloud computing is shifting the computing paradigm from on-premises PC software to mobile application services, Microsoft was forced to reshape their business model once established in the PC operating system and to re-create the competitive advantage in new business environment. Another case is the appearance of Apple's iPhone which totally changed the landscape of mobile phone market. According to (Van Alstyne et al, 2016), five major mobile-phone manufacturers collectively controlled 90% of the industry's global profits in 2007 but the situation has changed in a few years and iPhone generated 92% of global profits by 2015.”(Van Alstyne et al, 2016) Data driven online platformers seems to be gobbling the market of former incumbents by redesigning not only industrial but also societal landscape. How could incumbent platformers survive these circumstances? Is there a way for incumbent platformers to capture value from online platforms?

2 Literature Review

2.1 Online platforms

Online platforms cover wide range of activities including online marketplaces, social media and creative content outlets, application distribution platforms, price comparison websites, platforms for the collaborative economy as well as online general search engines. (European Commission, 2016) It is said that online platforms inherit the characteristics of “industrial platform” and “transaction platform” at the same time which is referred as “hybrid model.” (OECD, 2016b) However, this is not enough to explain what online platforms are. Recent study of OECD revealed the existence of two user feedback loops named “data driven network effect.” One is “user feedback loop” which is an accumulation of user data enables to improve the quality of service and contribute to acquire new users. The other is “monetization feedback loop” utilizing the accumulated user data for monetizing by providing services such as ad targeting and invested to improve the quality of service to attract more users. (OECD, 2016a) Iansiti and Lakhani suggested that digital technology enable to spread value across the economy, but value capture is getting more skewed and concentrated which is explained as “digital domino effect.” (Iansiti & Lakhani, 2017) These effects, accompanied with a large customer base, act as barriers for new entrants. In this study, this type of platform is named as “data driven online platform (hereafter, DDOP)” and is defined as a “hybrid model” platform providing service based on processing and editing large amounts of data (European Commission, 2016) which were collected via internet. “Incumbent platform” is defined as a foundation upon which an array of organization (external firms and/or internal departments) can develop complementary products, technologies or services (Gawer, 2009) and is distinguished from DDOP.

2.2 Platform alliance

In the past studies, two types of platform alliance have been stated. One is "horizontal alliance," alliance of platforms which has similar function. These platforms can share their users or complementors and frequently is a strategy for weak platformers to beat the competitive platform. For example, in order to compete with NEC 98 series which was dominant in the Japanese PC market in early 1990s, Japan IBM promoted IBM DOS/V architecture in Japanese market successfully by sponsoring PC Open Architecture Developers' Group (OADG), a consortium of the major Japanese PC manufacturers to gain its market power. The other type is "cross industry alliance", an alliance of platforms with different products utilizing their users and complementors basis. For example, Google and Salesforce, providing web-based productivity application and CRM application respectively, collaborated in order to promote cloud-based enterprise service instead of on-premises software service provided by the incumbents such as Microsoft or IBM. (Negoro and Itoh, 2010)

Recent study by Negoro and Takeda (2018) analyzed alliance between an incumbent platformer and a data driven online platformer. Here, an incumbent platformer, a credit card acquirer, permitted an EC payment agency, a startup company which became to be a DDOP later, to access their complementary market. After a time, the EC payment agency diverse their business and became a rival of the incumbent by providing real shop clearance service which is a major market for credit card acquirer. (Negoro and Takeda, 2018)

2.3 Research gap

In the past studies of platform alliance, the cooperating platforms had been established based on similar technologies such as DOS/V architecture for PC or cloud-based application service. Studies covering alliance with different property such as product-based platform and DDOP is few, however this type of alliance were observed recently. Negoro and Takeda (2018) describes the relationship between incumbent platformer and data driven online platformer, however, this study could be interpreted as lose-win alliance and the way how to create win-win relationship is not clear.

3 Data and Methodology

This research aims to introduce hypothesis by analyzing qualitative case study as described below.

3.1 Framework of case analysis

First, the platform architecture of the case study was analyzed by using layer maps (Baldwin and Woodard, 2009) in order to identify the components which are operated across and/or separated between the two platforms. Then, the

network effect across the platforms (i.e. player introduction) are analyzed in order to identify the synergy of platform alliance (Negoro and Itoh, 2010). Finally, common characteristics of the case studies are introduced.

3.2 Data

The cases of platform alliance between an incumbent platformer (including closed platform) and a data driven online platformer, whose technology base are different, were studied. Two case studies in different kinds of industry segments were chosen. One is the case of game industry, the alliance of Nintendo and Niantic, a spin off company of Google which is famous for developing the smartphone application “Pokémon GO.” The other is the case of mine construction service industry, the alliance of Komatsu and GE.

The data of the case studies are based on literature review and interview survey.

4 Cases

4.1 Case of Nintendo: Alliance with Niantic “Pokémon GO”

Nintendo is an incumbent platformer in the video console market currently providing “Nintendo Switch.” The market is facing challenge of social game provided as freemium application of smartphones. Niantic is an DDOP established in 2015 invested by Google, Nintendo and The Pokémon Company. Niantic develops a social game based on “Real World Application Platform (RWA Platform)” which is a location-based service linked with planet-scale augmented reality and created their original game contents named “Ingress.”

Pokémon GO is a smartphone game which Niantic released at July 2016 in cooperation with Nintendo and The Pokémon Company, an affiliate company of Nintendo. This game can be played by walking in the real world capturing Pokémon which randomly appear in the display of player’s smartphone. Using GPS of smartphone system, the place where the player is located and the map displayed in the smartphone is synchronized. At the places called “PokéStop” or “Gym” located across the town, which is a part of RWA Platform, players can get a few items such as “monster ball” that is needed to capture Pokémon. These items can also be purchased. This business model had been established in the former Niantic game “Ingress” and the common function was shared with “Pokémon GO” as RWA Platform. The Pokémon Company assisted to design vision, graphical interface and music in developing this game. Nintendo developed a hardware “Pokémon GO Plus” which run in conjunction with smartphone and support players to capture Pokémon.

Pokémon GO attracted players across the world and marked over 130 million downloads in the first month after release. Nintendo commented that the influence of Pokémon GO to the corporate operating performance was limited. Although, “Pokémon GO Plus” was sold out in many stores and net earnings of the Pokémon Company increased more than 25 times compared with prior year in FY 2016 (the fiscal year Pokémon GO was released). As well as game players, Pokémon GO attracted complementors. Niantic had adopted a partnership model in their game including Ingress. As for Pokémon GO, they made the partner’s shop to become “PokéStop” or “Gym”, a hotspot place where every player need to visit to play the game. Several Pokémon events were held in these hotspots. The marketing manager of a partner corporation mentioned, “The game can obviously guide people to our shop.” As a new business, Niantic is now collaborating with Warner Brothers Interactive Entertainment and developing “Harry Potter: Wizards Unite” expected to be released in early 2019.

Nintendo will release their first Pokémon game “Let’s go Pokémon” for its Switch platform this November. This game has linkage with Pokémon GO. Player can transfer the game characters they captured at Pokémon GO to “Switch” platform game “Let’s go Pokémon” and vice versa. Moreover, the forthcoming complement console of “Let’s go Pokémon” named “Monster Ball Plus” can run in conjunction with Nintendo Switch console and also with smartphone just as same as “Pokémon GO Plus.”

4.2 Case of Komatsu: Alliance with GE in mine construction business

Komatsu is an incumbent platformer in the construction machine industry. Komatsu have been implemented the IoT monitoring system named “KOMTRAX (Komatsu Tracking System)”, which monitor the daily location and operating condition of the machines they provide, since 2001. This enabled Komatsu to leverage maintenance service of each

machine used by customers. (Osanai & Sakakibara, 2012) GE is not only a manufacturer but also is becoming a DDOP by launching “Industrial Internet initiative.” This is a concept connecting machines and devices, collecting data of operations, and providing services to clients based on analytics of these data and information across the industry. GE has released a cloud-based software platform “PREDIX” as a service to realize this concept. (Karim R. Lakhani et.al., 2014)

In 2015, Komatsu leveraged the KOMTRAX system starting to assemble and analyze data in almost real time in the mining equipment segment. This activity aims to utilize the KOMTRAX data not only for maintenance service but also for proposing more efficient use of machines to customers. Under this movement, Komatsu enhanced the relationship with GE, who was a supplier of Komatsu providing power-generating equipment in the mine construction segment for long time, started to cooperate by sharing bigdata in order to seek further efficiency. Komatsu could single-handedly improve user’s fuel efficiency by 5% but after sharing data with GE and using their analytics, the efficiency increased up to 13%. Besides data analysis, Komatsu have commercialized Autonomous Haulage System (AHS) with unmanned mining trucks since 2008. By developing further equipment and services, Komatsu intends to optimize the total operation process of mining industry ranged from mining pit to shipment port targeting to cut total production cost by 10%. (Nikkei, 2015) Komatsu and GE provide equipment to mine construction industry which is mutually complement, therefore the partnership of both company is advantageous to collect comprehensive operation data in the industry.

5. Results

5.1 Layer map analysis

Figure 1 is a layer map describing the alliance of Nintendo and Niantic. “Pokémon GO” was developed as a complementary service of Niantic’s “real world application platform” under close cooperation with Nintendo (including The Pokémon Company). Nintendo created a business in the "new adjacent market" which is sandwiched between its “Switch” platform and Niantic platform. This "new adjacent market" bridges two technologically different platforms by interfacing them in two ways. One is by sharing "characters" which can be transferred across both platforms described in the software layer of Figure 1. The other is by providing complementary hardware “Pokémon GO Plus” which works in conjunction with smartphone. Nintendo will expand this function in forthcoming hardware “Monster Ball Plus” which works in conjunction with smartphone and “Switch” console respectively, as described in the hardware layer of Figure 1. This attempt seems to be promising way for Nintendo to capture value form Niantic platform since game players can use both platforms in different scene since their function are complement. Niantic platform provides the real-world game which is targeted to play walking outside and Nintendo Switch platform provides sophisticated interface mainly targeted to the play in the fixed place. Moreover, Nintendo experienced a success in selling “Pokémon GO Plus.”

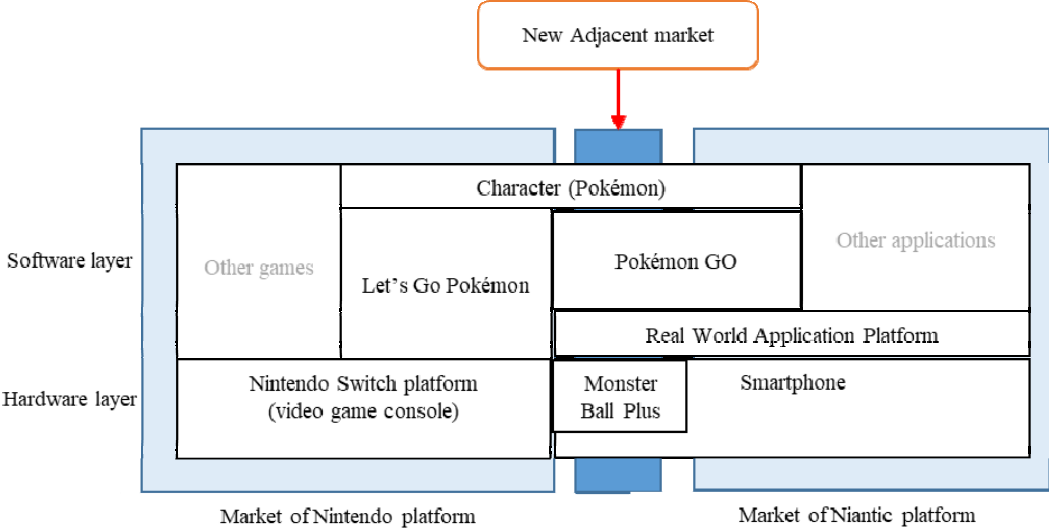


Figure 1 Layer map of Nintendo-Niantic alliance

Figure 2 is a layer map describing the alliance of Komatsu and GE. For GE, this alliance would be positioned as a complementary service of its Predix platform analyzing the data provided by Komatsu. Komatsu is on the way extending its market in mine construction domain leveraged by data driven service and made success to create external link through this alliance. This service could be positioned as complementary market of KOMTRAX (which is a closed platform). The alliance of Komatsu and GE is established in the overlapping market of both platforms which could be viewed as new adjacent market for both companies.

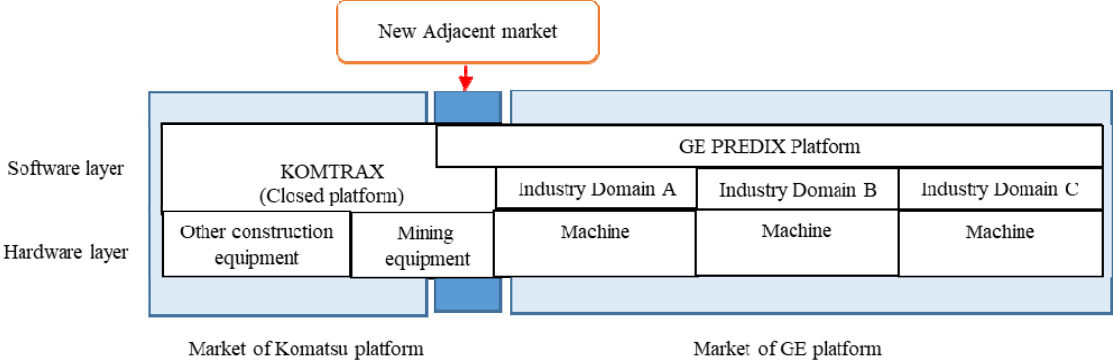


Figure 2 Layer map of Komatsu-GE alliance

5.2 Network effect analysis

Network effects concerning the alliance of Nintendo and Niantic is described in Figure 3. Three kinds of indirect network effects had been observed. First, large user base of the Niantic game attracted complementary services and created “two-sided market” which led Niantic to provide DDOP. Contrasted to the function of Nintendo Switch platform, which provides game in the “virtual world,” the essential function of Niantic platform was to link different societal domains, the “virtual world” and the “real world” by utilizing augmented reality. The value created by this function motivated players to walk and move in the real world. The appearance of Pokémon which motivates most player to move, could be loosely controlled by the game setting of Niantic. This attracted several business partners (i.e. a franchiser which wants to navigate customers to their shops) to sponsor the game. Second, marquee contents “Pokémon” played a role not only to attract more users to play the game but also to “broaden” the range of DDOP since the success of “Pokémon GO” attracted other contents holder who wants to utilize their asset. Last, the alliance of two platforms via “new adjacent market” enabled contents provider of Nintendo to access to the real-world hotspots such as “PokéStop” or “Gym” which is a creation of “new interconnection” that made the platform more multifaceted. By this way, not only Nintendo but also their contents provider can benefit from the network effect of Niantic platform.

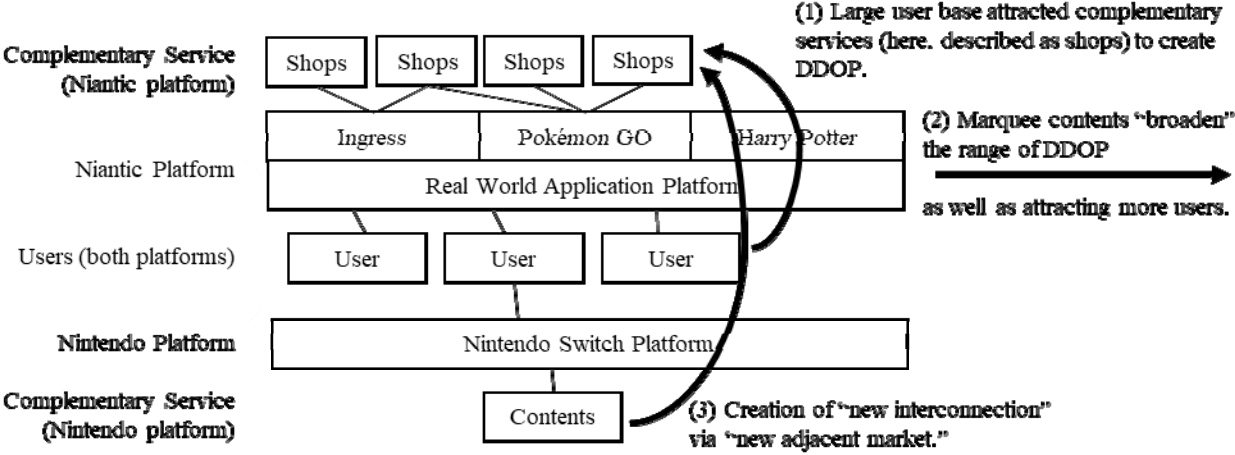


Figure 3 Network effect of Nintendo-Niantic alliance

Network effects concerning the alliance of Komatsu and GE is described in Figure 4. Again, three kinds of indirect network effects had been observed. First, large IoT machine base which GE originally had enabled them to create Predix platform, a DDOP. Next, GE obtained new external data in the mine industry segment by alliance with Komatsu which “broadened” the perspective of its platform. This also benefited Komatsu since the diversification of GE platform increases the efficiency of analyzed data fed back to Komatsu platform. Last, the alliance of two platforms via “new adjacent market” created potential for both company to access to the total operation process of mining industry, ranged from mining pit to shipment port, which is a creation of “new interconnection” that makes the platform more multifaceted. Linked by their IoT based equipment which is mutually complement, both company started to create new value in the mine industry segment.

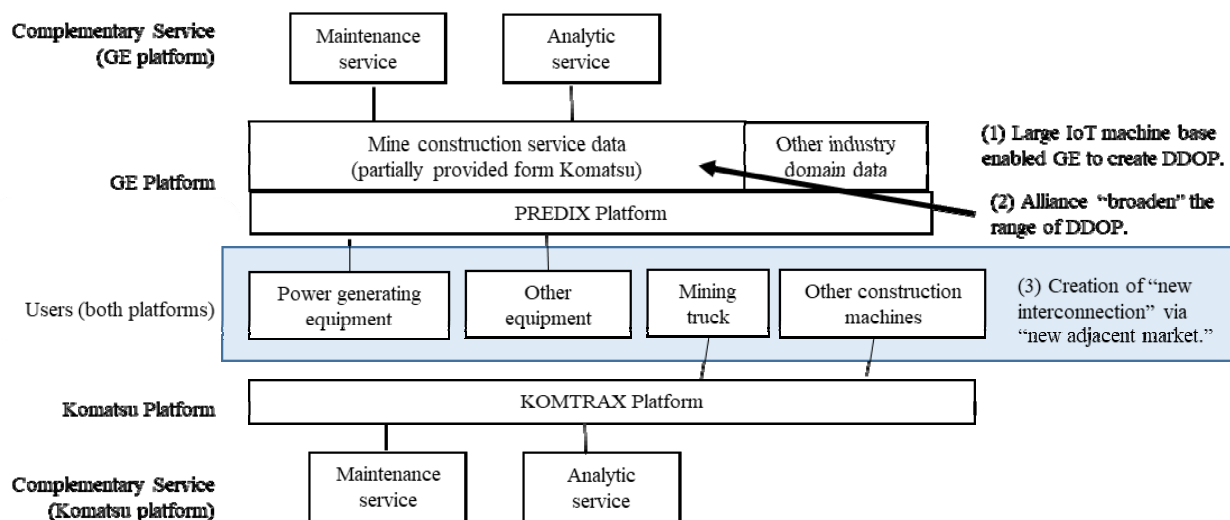


Figure4 Network effect of Komatsu-GE alliance

6. Discussion and Conclusion

As a result of layer map analysis, several common characteristics between two case studies had been observed. First, the major inherent functions (including the user needs which either platform meet) of the platforms were complement. Second, these two platforms which have different technological base were bridged by "new adjacent market." Last, the alliance was based on data centric relationship whose interface could be defined flexibly by software.

As a result of network effect analysis, incumbent platform and DDOP both benefitted from the network effect induced from each other’s platform in several ways. First, DDOP was created by linking different domains which never linked each other before. Second the alliance between two platforms contributed to “broaden” the range of DDOP by business diversification. This diversification created positive feedback to the incumbent platforms. Last, the alliance of two platforms created “new interconnection” which made these platforms more multifaceted and enabled complementary products or services of the incumbents to access to new market via “new adjacent market.”

As a conclusion of this study, new hypothesis was derived. Leveraged by its data centric structure, the essential function of DDOP was identified as an ability to create new value by interconnecting users in different platforms which made the network effect more multifaceted. Incumbent platformers can benefit from this multifaceted network effect by promoting platform alliance with DDOP. Creating “new adjacent market” which is sandwiched by both platforms seems to be key success factor for incumbent platformers in this alliance.

This paper proposed a new type of platform alliance, however more study including definition of the “new adjacent market” in detail is needed as a future study.

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Room A

Session – 5

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A Formal, Descriptive Model for the Business Case of Managerial Decision-Making

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Abstract This paper proposes a formal descriptive model of organizational decision-making called as Managerial Decision-Making Description Model (MDDM). This model introduces visual representations to describe managerial decisions redefining relationships between their objectives and resources. The MDDM not only describes various business cases but enables us to compare these decision-making processes formally. This paper presents the MDDM's methodologies and describes and compares the decision diagrams extracted from actual business cases.

Keywords formal description, decision diagram, business case, business structure

1 Introduction

This paper proposes a formal, descriptive model to describe managerial decision-making processes that transform business organizations. This heuristic tool, named the Managerial Decision-Making Description Model (MDDM) [1] provides a common method to compare decision-making processes for business cases as well as a means to visualize these processes. Here we introduce MDDM and demonstrate how MDDM works on actual business cases.

In contrast to the Object Modeling Group's models (CMMN (Case Management Model and Notation) [2], the BPMN (Business Process Model and Notation) [3], and DMN (the Decision Model and Notation) [4]), MDDM focuses on describing organizational decision-making that changes a business's structure. The CMMN, BPMN, and DMN provide useful representations of business's states and behavior as long as the entire business structure is presumed to be static or at least stable. In contrast, the MDDM focuses on a one-time transition process that changes entire business structure.

A High-Level Business Case (HLBC) [5], is presented to describe such a one-time transition of business structure. While HLBC represents an evolution of the functions and services of a business structure, the MDDM focuses on the decision-making process driving business structure transitions.

Accordingly, we began by defining key terminologies for the MDDM. First, the business structure of an organization is defined as a multi-layered structure of business objectives and their related resources or means. Next, managerial decision-making is understood as the way an agent (i.e., a member of an organization) defines or redefines business objectives

and their related resources in a business structure.

To formally describe managerial decision-making that changes the business structure of an organization, the MDDM must be able to represent following items.

- (a) the multi-layered structure of a business, and its transition,
- (b) the focus (or bounded scope) of agents' observations and actions,
- (c) the agent's position corresponding to each layer in the business structure,
- (d) the chronological order and the causality of agents' decisions.

By satisfying these requirements, the MDDM enables us to describe “who” decides “what”, “when,” and “where the decision affects on the business structure,” along with how the decisions change.

2 Methodologies

To represent a transition of business structures as a “Decision Diagram,” the MDDM uses three kinds of components. In placing and connecting those components, the decision diagram describes organizational decision-making as an equivalent circuit. The decision diagram satisfies the condition presented in the previous section.

2.1 Three major components

The MDDM uses three kinds of major components: (i) business structure, (ii) the environment, and (iii) agents' decision element.

2.1.1 Business structure component

The Business Structure Component represents a multi-layered structure of objectives-resources couplings, tied to the organizational business process. (Figure1)

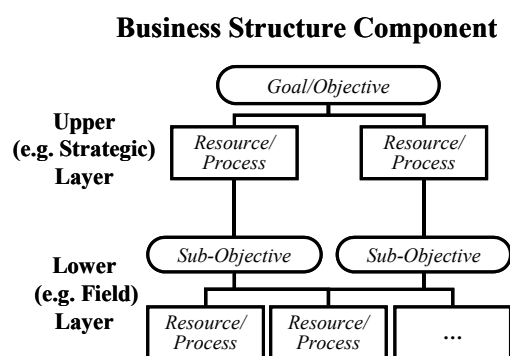


Figure 1 The Business Structure Component represents a multi-layered coupling of objectives and resources in business organizations.

This component is comprised of the objective symbols, resource symbols and the connections between them. Each objective symbol represents a goal, an objective, or a target a business layer. A resource symbol represents a resource, an operation, a product, or a means required

to achieve the objective symbol that couples with the connection. By heaping up the objectives-resources couplings, the Business Structure Component represents a multi-layered structure of business organizations.

2.1.2 Environmental component

The Environmental Component describes status transitions, and events outside of the organization (Figure 2). This component consists of status and event symbols. Each status symbol represents a technological situation or condition in the market or in another organization. The event symbol indicates that something occurred to with the status that triggers an agent’s decision, or a result caused by an agent’s decision. The status order Figure 2, and the events from left to right, indicate their chronological order.

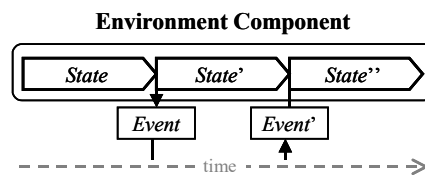


Figure 2 The Environmental Component represents states inside or outside the business, events caused by these state or agents’ decisions.

2.1.3 Agents’ decision element

Agent’s Decision Elements describe how agents redefine the objectives and resources in an organization’s business structure. Each agent’s decision is represented as a “Decision Element” with 2x2 terminals (Figure 3).

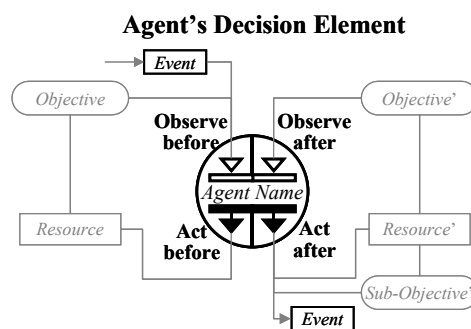


Figure 3 The Agent’s Decision Element redefines objectives-resources coupling in business structures.

Each terminal has a specific function. The left hand’s dual terminals in the decision element represent an agent’s observation-action pair before the decision. The upper left terminal indicates an agent’s former objective or the target. The lower left terminal

indicates an agent's former action, resources, or means for the former objective. In contrast, the right-hand two terminals represent an agent's observation-action pair as a consequence of an agent's decision. The upper right terminal indicates an agent's new objective or target, and the lower right terminal an agent's new resources or means to facilitate the new objective.

2.2 Composing the decision diagram

By allocating and connecting those components, the decision diagram describes the organizational decision-making involved in a business structure's transition (Figure 4).

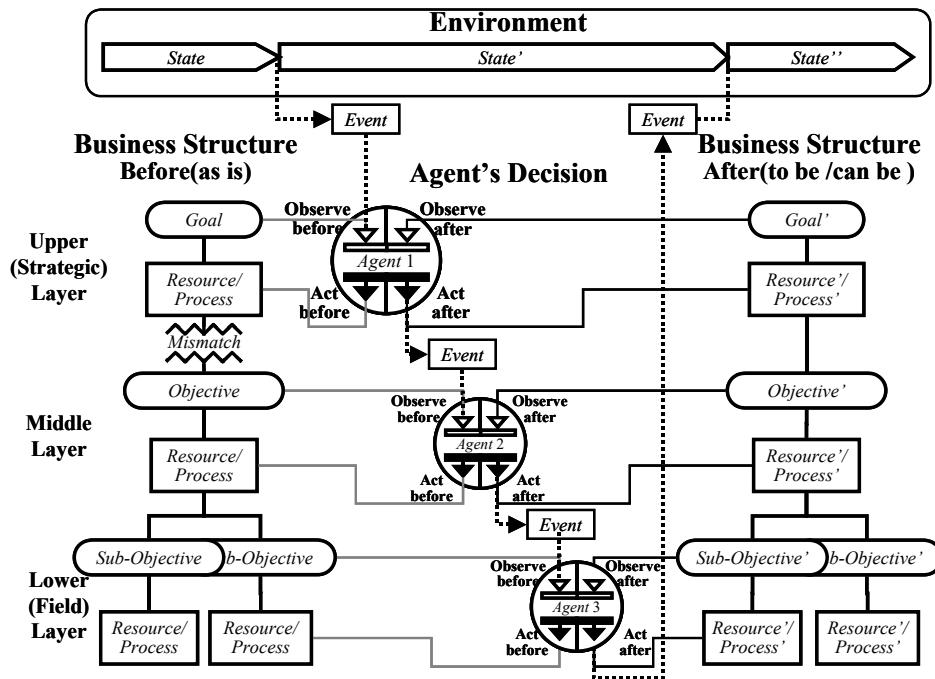


Figure 4 The Decision Diagram describes how agents' managerial decision-making transforms the business structure by connecting the three types of components.

To begin with, the environmental component is placed at the top or the bottom of the decision diagram. It introduces time (from old to new) in a horizontal direction (from left to right) in the decision diagram.

Next, to describe transitions in the business structure, the two business structure components are placed on the left and right-hand sides of the decision diagram, respectively. The left-side component represents the business structure that existed before agents' decisions and the right-side component represents the business structure that result from agents' decisions. We call the left-side structure "Before" or "As Is", and the right-side one

“After,” “To Be,” or “Outcome.” These business structures introduce vertical layers into the decision diagram from strategic management (upper) to field operations (lower).

Third, an agent’s decision elements are allocated between business structures. This allocation reflects the organizational position and chronological order of an agents’ decisions. The decision’s vertical position indicates the structural layer to which an agent belongs. The horizontal order of the decisions, from left to right, indicates their chronological order.

Fourth, agent decisions connect to the other components and decision elements. The upper left terminal of each decision element connects to the symbols that an agent observes as the objective or the target in the left-hand (“before”) business structure. The lower left terminal connects to symbols that an agent acted upon regarding the resource or the means in the left-hand (“before”) business structure. In the upper right terminal of each decision element connects to symbols that an agent observes as the new objective or target in the right-hand (“after”) business structure. The lower right terminal connects to symbols that an agent uses to take action regarding the resources or the means in the right-hand (“after”) business structure.

Finally, either an environment-agent interaction or an agent-agent interaction is represented by connecting an agent’s terminal and related event symbol. For example, when an event related to the environment triggers an agent’s decision, the event symbol is connected to the agent’s upper left terminal. Similarly, if an agent’s decision triggers another agent’s decision, the agent’s lower right terminal and the other agent’s upper right terminal are connected through the trigger event’s symbol.

Meanwhile, if the relationship between two symbols that should be related is either missing or negative, the disconnection symbol should be used (Figure 5). The disconnection symbol represents a mismatch in objectives-resources coupling, an incoherence between upper- and lower-layer business structures, an objection to an event or a decision, or a communications gap between agents.

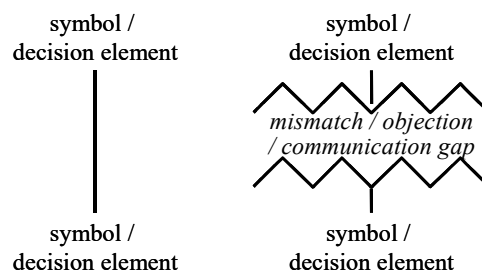


Figure 5 In contrast to the connection (left), the disconnection (right) describes a mismatch or an incoherence in business structure, objection, or communications gap between agents.

2.3 Properties of the decision diagram

A decision diagram of the organizational decision-making enables us to describe the following properties, required in the first section.

- (a) A decision diagram represents a multi-layered structure, introduced by business structure components, before and after a structure's transition.
- (b) Each agent in decision diagram decides upon specific observation-action (objectives-resources) pairs, limited by their scope and position.
- (c) In a decision diagram, each agent's vertical position corresponds to business structure layer in which the agent belongs.
- (d) In a decision diagram, each agent's horizontal position reflects the chronological order of his decision, and event symbols' connections represent causalities between decisions and events.

These properties provide points of view to compare decision diagrams as configurations of the diagrams themselves or of the symbols' meanings. Configurations are observed as the distinction between decision diagrams' layouts and connections of the symbols or decision elements. Meanings are read as the distinction between the content of either the symbols or the decision elements.

2.4 Extension of the decision diagram to describe interaction between cases

The decision diagram can be extendable to describe interactions between two or more decision-making cases. The extension is realized by introducing the common environment component, which connects business decision-making cases that affect each other.

An Extended Decision Diagram consists of related decision-making cases and the common environment component that connects these cases (Figure 6). The common environment component describes the common statuses observed or affected by the decision diagrams. An event symbol between a common environment and a decision diagram indicates such observation or effect.

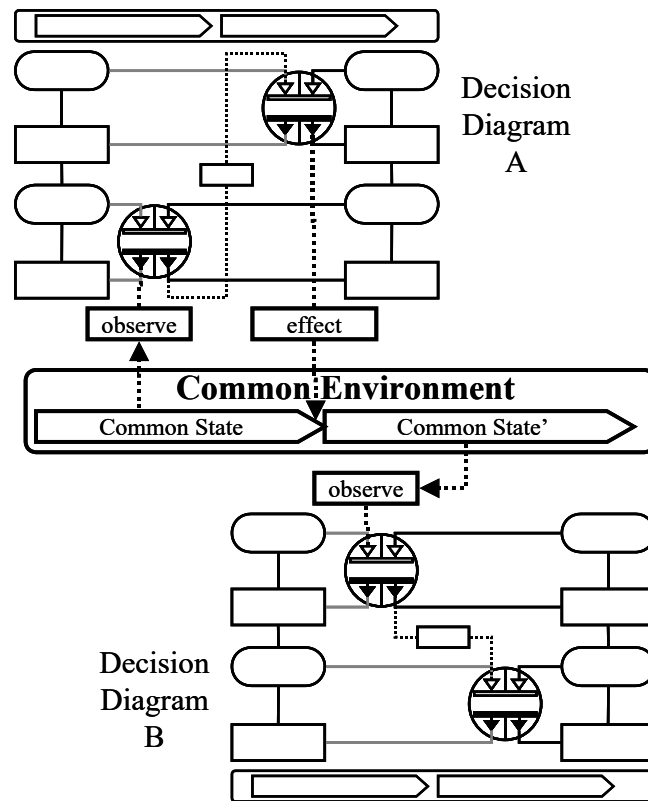


Figure 6 An example of the extended decision diagram illustrates the decision diagram A and B interact via the common environment and events.

3 Application to Actual Business Cases

Here we illustrate how the MDDM describes actual managerial decision-making, using well-known business innovation cases. The decision diagram from the Honda case shows typical bottom-up managerial decision-making. While the next decision diagram (from the Sony case) is similar, a connecting event distinguishes the two cases. The extended diagram from the Harley-Davidson case shows unsuccessful top-down managerial decision-making, in an attempt to compete with Honda.

3.1 The Honda Supercab case

Here, the MDDM clarifies the managerial decision-making process in an actual business case. The decision diagram of the case visualizes the decision-making process as a simple layout of decision elements.

The Honda Supercub case, introduced in the Christensen's classic text [6], is a typical example of destructive innovation. In 1959, Honda sent a team to enter to the U.S. motorcycle market. After hopeless efforts to sell a big, highway bike, Kawashima, the leader

of the team started to pursue new market opportunities of the light-bike (Supercub) market, which he found accidentally. Then Kawashima argued to the Tokyo headquarters to change the company’s unsuccessful big-bike strategy.

The case’s decision diagram visualizes the transition of Honda’s U.S. business model from the large highway-bike motorcycle smaller recreational-bike market. The decision diagram also illustrates that the transition was led by a bottom-up layout of the decision elements, and the direct connection from the manager Kawashima to the Tokyo headquarters. (Fig. 7)

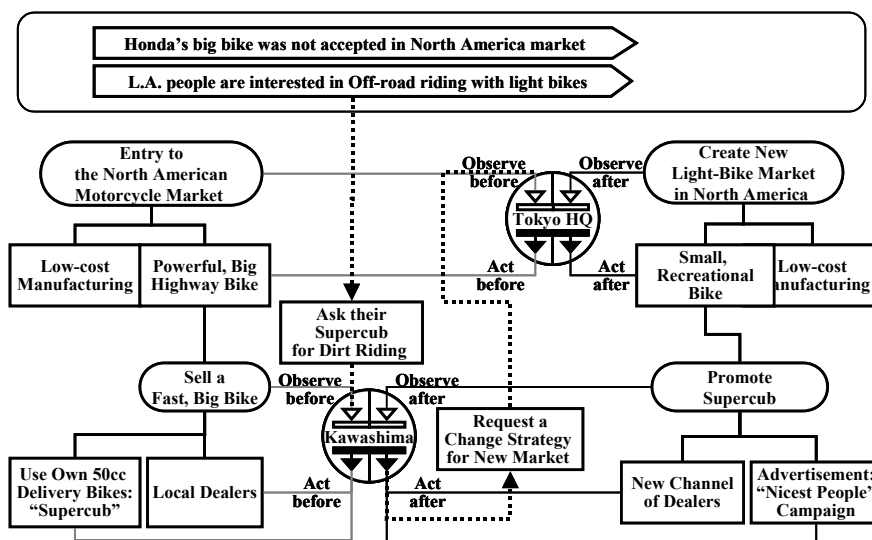


Figure 7 The decision diagram for Honda Supercub case: the bottom-up managerial decision-making for transitioning from a large-bike strategy (left) to a light-bike strategy (right).

3.2 The Sony Walkman case

The next decision diagram is extracted from the Sony Walkman case, which was introduced in the official history of Sony [7][8]. It also is a typical example of destructive innovation. According to the case, in 1978, Ibuka (the Honorary Chairman of Sony) privately asked Ohson (the manager of the tape recorder division) to convert a handy tape-recorder into a stereo playback machine. The good sound from the modified machine pleased Ibuka, who then he personally took the machine to Chairman Morita to let him try it. Morita decided instantly to launch the machine into the market as a product presenting a totally new way to enjoy music. The new product was named the Walkman in 1979.

The decision diagram for this case shows a transition of Sony’s business structure shifting from a high-low mix strategy (for the cassette tape recorder market) to the creation of a playback-only headphone-player market. While the decision diagram for

this transition is similar to the bottom-up decision-making process, the decision elements were connected by Ibuka's personal behavior events. This is a typical example of managerial decision-making promoted by an informal communication via an unofficial actor in the organization (Figure 8).

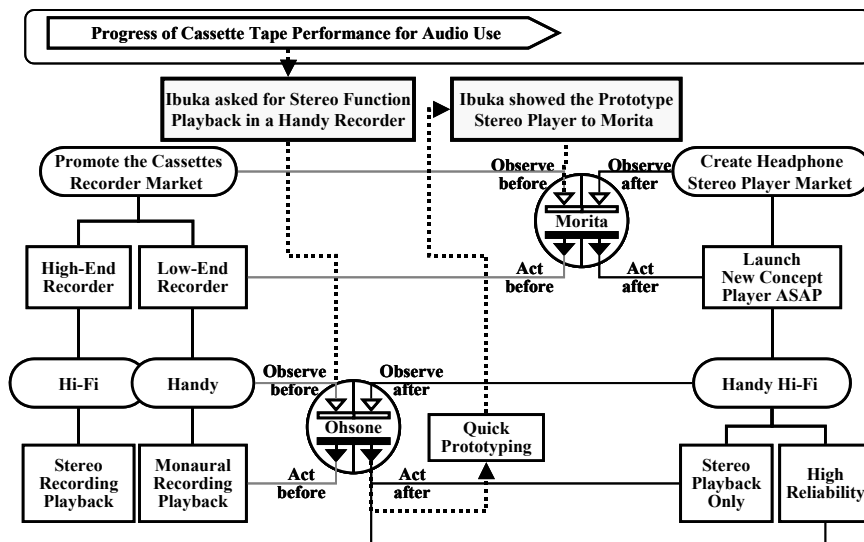


Figure 8 The decision diagram for the Sony Walkman case: informal communication via Ibuka led the transition from the high-low mix structure (left) to the new market creation strategy (right).

3.3 The case of Harley-Davidson chasing Honda

The third actual example is an extended decision diagram describing the relationship between two business cases.

Returning to the Christensen's book, Harley-Davidson tried to compete in the North American light-bike market, which had been created and dominated by Honda. Although Harley acquired an Italian light-bike model and tried to launch it in the market, Harley's dealers objected to selling such a low-profit model. They also felt that a small bike compromised the brand image for their core customers [6].

The extended decision diagram of this case illustrates the unsuccessful transition of Harley's business structure to the light-bike market created by Honda. The extended decision diagram also shows that Harley's effort was triggered by the Honda case. The top-down layout of the decision elements ends with the dealers' objection, and a mismatch in the business structure (Figure 9).

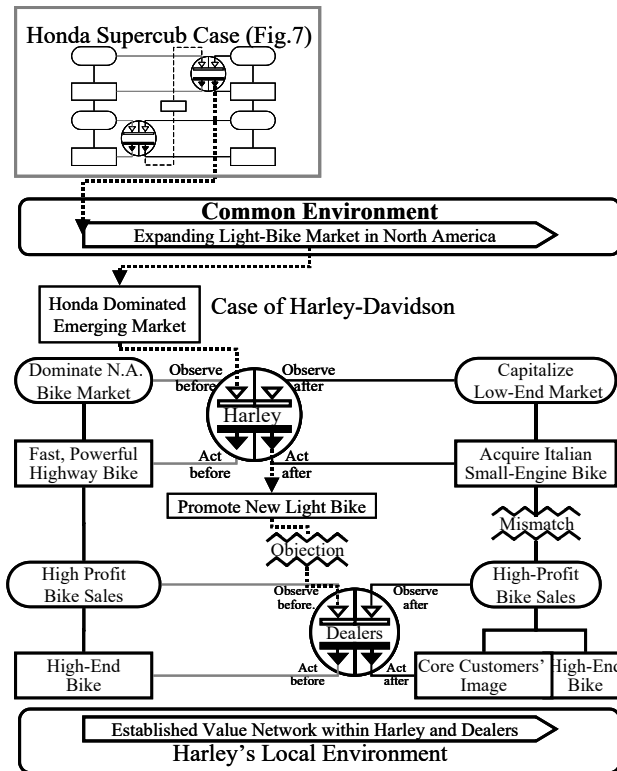


Figure 9 The extended decision diagram of the Harley case: triggered by the of Honda case, the top-down decision led to objections and a mismatch in the business structure.

4 Summary and Remarks

To formally describe business cases, MDDM provides a decision diagram that illustrates the transition of business structures caused by related agents' decisions. The decision diagram also represents a chronological order and causalities between the decisions and the decisions and the environment. The MDDM discriminates between the decision style in a business case, e.g., top-down, bottom-up, or informal communication. An extended decision diagram describes interacting decision diagrams. Illustrated the decision diagrams of the actual business cases of the Honda Super Cub, and the Sony Walkman, and the extended decision diagrams of Harley-Davidson's unsuccessful light bike competition with Honda.

The MDDM naturally provides decision diagrams from organizational agent-based simulation (ABS) logs, business game logs as well as of the actual business cases. The simulation study on the Kaizen and deviation [9] indicates that no essential difference exists between cases from organizational ABS logs and actual business cases. We will exemplify a business simulation analysis using MDDM in another paper.

A paper on business gaming [10] already presented the simulated business gaming environment, integrated with case learning, and based on actual business cases. The

MDDM will provide an effective way to describe gaming players' decisions and compare them formally to original business cases.

Acknowledgments

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Classification of Decision-Making Process in Organizational Simulation and Correspondence with Business Case

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Abstract To understand social and organizational phenomena and connect them to the design of a system, an approach to implement an agent-based model and a case study have been proposed. This approach includes complex reality by using the agent-based model, evaluates and compares the obtained virtual cases from simulation logs and real business cases. In this study, we propose a methodology that extends the approach to the following two points i.e., 1) systematically analyzing the simulation logs generated from the agent-based model and 2) efficiently comparing virtual and actual cases. To confirm the feasibility of our proposed methodology, an agent-based model that expresses the decision-making process concerning external environment recognition of an organization was established. Furthermore, a comparison of the business case with a similar theme was performed. Hence, this new methodology enables 1) to comprehensively understand the results and processes of the simulation and to discuss the occurrence frequency and 2) to compare virtual and real cases directly regardless of natural language.

Keywords agent-based model, organizational simulation, log analysis, business case, decision making

1 Introduction

To understand social and organizational phenomena and connect these to the design of a system, an approach to implement the agent-based model (hereinafter “ABM”) and a case study have been proposed (Terano T. & Koyama Y. 2015). This approach includes complex reality by using the ABM, evaluates and compares the obtained virtual cases from simulation logs and real business cases. As a specific precedent case of the approach, Kobayashi et al. (Kobayashi T. et al. 2012) presented an ABM expressing Kaizen and deviation behavior in an organization. They indicated that there is no essential difference between cases based on organizational ABM logs and real business cases. However, there are areas for continued improvements considering that 1) the virtual and actual cases remain in ad hoc comparisons and 2) the two cases are compared on the basis of a natural language and cannot be overviewed.

In this study, a methodology that extends the approach to the 1) systematically analyzing the simulation logs generated from the ABM to obtain comprehensively results and processes of the simulation and 2) efficiently comparing virtual and actual cases directly is proposed. Then, the idea of log analysis (Tanaka Y. et al. 2017) is applied for the systematic analyses of the simulation logs. Furthermore, the managerial decision-making description model (hereinafter “MDDM”) (Kunigami M. et al. 2018) as a common way to visualize a decision-making process within the business case was adopted.

The paper is organized, as follows. Section 2 introduces relevant research. Section 3 explains the proposed methodology. Section 4 confirms the feasibility of the proposed method. First, the ABM simulation logs was categorized, then a virtual case by MDDM was generated, and finally the virtual and real case was compared. Finally, Section 5 presents the conclusions of the study.

2 Related Work

2.1 Comparison between the Business Case and ABM

Kobayashi et al. (Kobayashi T. et al. 2012) presented an ABM expressing the Kaizen and deviation behavior in an organization. They compared the virtual cases generated from the simulation log with the real ones. Specifically, they used a “template” representing the skeleton of the cases created based on the actual case, described the simulation log as a virtual case in a natural language, and compared it with real cases (Figure 1). Consequently, they revealed that virtual and real cases can be compared. However, there areas for continued development considering that 1) the virtual and actual cases remain in ad hoc comparisons and 2) the two cases are compared on the basis of a natural language and cannot be overviewed.

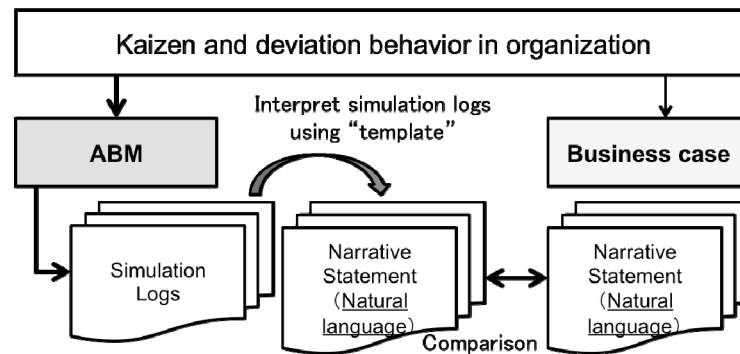


Figure 1 Method to implement business case and ABM proposed by Kobayashi et al. (Kobayashi T. et al. 2012).

Kikuchi et al. (Kikuchi T. 2018) also explained the virtual case generated from the ABM by using MDDM. They confirmed that virtual and real cases are able to be compared in a unified form without using a natural language. In this study, we extend the research and propose a methodology to overcome the above improvement points.

2.2 Log analysis for the ABM

Tanaka et al. (Tanaka Y. et al. 2017) conducted a systematic analysis on a set of entire simulation log in a simulation model of an organization. Specifically, the entire log was separated into clusters according to the model structure, and the properties of the cluster were explained. Furthermore, through mutual comparison among clusters, they analyzed the factor that caused the cluster to be divided. This unique method is an intermediate method between 1) the macro statistical analysis method for the entire log and 2) the description analysis method for each micro log level for each log. In this study, we categorize the entire log according to the simulation process based on the research idea.

2.3 Managerial Decision-making Description Model (MDDM)

Kunigami et al. (Kunigami M. et al. 2018) proposed a formal description model to describe managerial decision-making processes used to transform a business organization. This heuristic tool called MDDM provides a common way to visualize a decision-making process within the business case. To represent the transition of the business structure, the MDDM uses three types of components, namely, (i) business structure, (ii) environment, and (iii) agents' decision element. By allocating and connecting these components, it describes the managerial decision making as a decision diagram.

Then, the business structure component represents a multi-layered structure (i.e., strategic, middle, and field layers) of objective–resource couplings in the organizational business process. The environment component describes the states, transitions of status, and events outside of an organization. It consists of status and event symbols. Each status represents a situation or condition of technology, market, or another organization. Meanwhile, agent's decision element describes how an agent redefines the objectives and means in a business structure of an organization. Each decision of the agent is

represented by a “decision element” with 2×2 terminals. Each terminal has a specific function. The left-hand dual terminals of a decision element represent the agent’s observation–action pair prior to the decision. Meanwhile, the right-hand two terminals represent the agent’s observation–action pair as a consequence of his/her decision. The upper dual terminals indicate the agent’s objectives or targets, whereas the lower ones denote the corresponding resources or means to facilitate these objectives.

Figure 2 shows an example describing the case of Honda’s entry into the North American motorcycle market (Christensen C.M. 1997). Decision making has been made from a field layer member via a strategic layer member. The figure also expresses the bottom-up-type decision-making case.

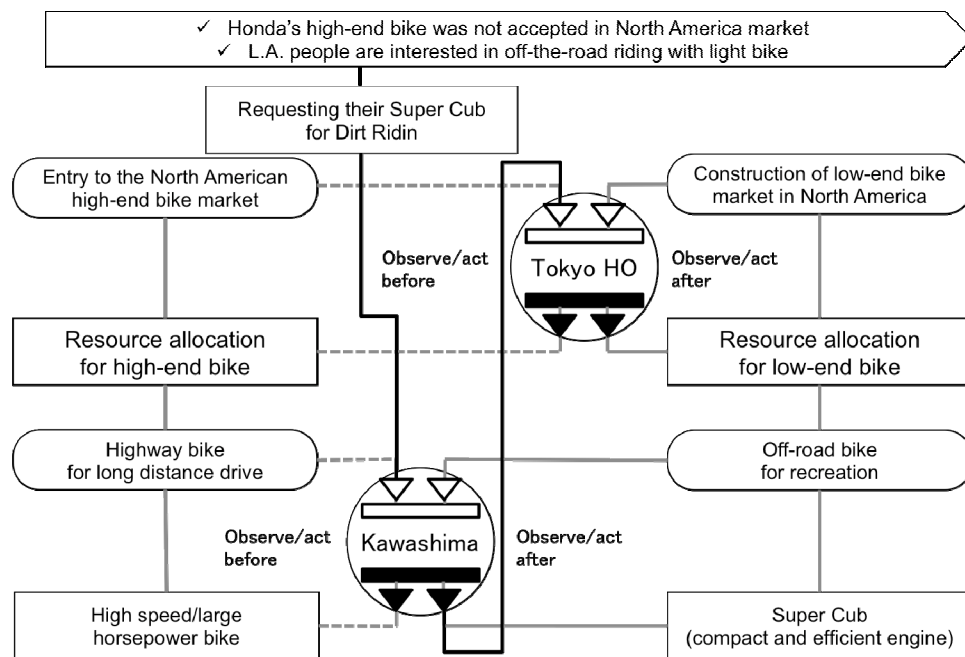


Figure 2 Example of a decision diagram describing the case of Honda’s entry into the North American motorcycle market by using MDDM (Christensen C.M. 1997). Decision making has been made from the field layer member via the strategic layer member, indicating the bottom-up-type decision making.

3 Methodology

As an improvement for the comparison of the ABM and business cases, a methodology to achieve an effective implementation is proposed herein (Figure 3). As the figure shows, the procedure of the proposed method is described in detail from Step 1 to 5.

Step 1 - ABM construction

Construct the ABM to describe social and organizational phenomena and problems.

Step 2 - Generation of simulation logs via multiple trials

Execute simulation by combining manipulated variables in a model and generate many logs during the simulation process.

Step 3 - Classification of simulation logs

Categorize the logs generated in Step 2 and obtain the overall picture of the “possible” process. This process is based on the policy of Tanaka et al. (Tanaka Y. et al. 2017) mentioned in Section 2.2. In this study, the organizational phenomena are considered. Hence, we focus on “who” decides “what,” “when,” and “where it falls within the business structure.” Based on Steps 2 and 3, we aim to systematically analyze the simulation log of the ABM.

Step 4 - Description in an abstract language

Directly generate virtual cases based on the logs in Step 3 by using an abstract language. In this study, we apply the

MDDM of Kunigami et al. (Kunigami M. et al. 2018) as an abstract language.

Step 5 - Comparison of virtual and actual cases

Write down both virtual and real cases in abstract languages that are not natural languages and compare them efficiently. Demonstration on Steps 1 – 5 is provided in Section 4.

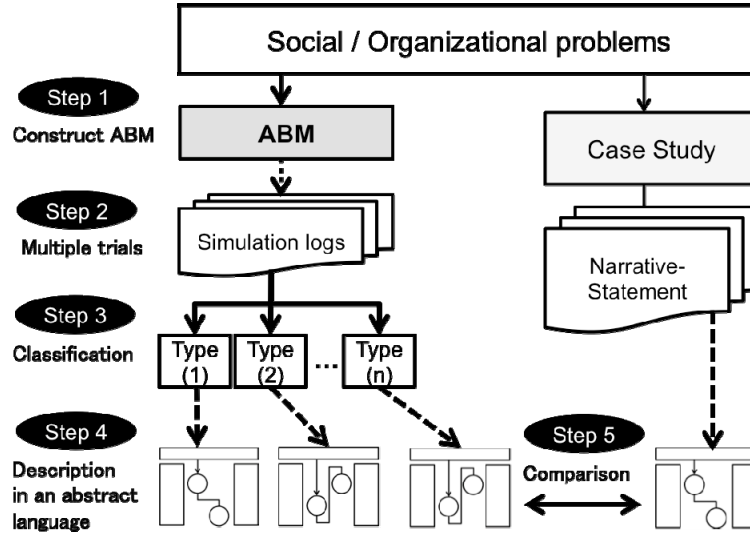


Figure 3 Outline of the proposed method. A methodology to establish an effective implementation of the ABM and business case. Features of the proposed method are, as follows. 1) generation of the simulation log via multiple trials (Step 2) and typing process (Step 3) and 2) description by using an abstract language (Step 4).

4 Demonstration

4.1 ABM construction

In this study, we construct the ABM by referring to the “organization’s environment recognition model” (Toriyama M. et al. 2010). The model expresses the propagation of the external environment of organizational members based on Axelrod’s tag (culture dissemination) model (Axelrod R. 1997). The directionality of the expansion is represented by two aspects of the agent nature and spatial structure. That is, 1) the inherent properties of each agent, which is not considered in a typical tag model, and agent’s cognitive bias, as well as the characteristics based on the environment recognition are represented, and 2) each agent is connected not by cellular spatial structure, but by communication network.

4.1.1 Agents

(1) Members and their attributes

The organization handling this study consists of N members.

$$Or = \{a ; i = 1, \dots, N\} \quad (1)$$

Furthermore, the objectives–resources possessed by each member are represented by the tag model (Figure 4).

The set of the objectives of the member a_i is

$$Obj_i = (obj_{i1}, obj_{i2}, \dots, obj_{im}), obj_{ik} \in \{1, 2, \dots, l\} \quad (2)$$

The set of resources of the member a_i is

$$Res_i = (res_{i1}, res_{i2}, \dots, res_{im}), res_{ik} \in \{1, 2, \dots, l\} \quad (3)$$

Then,

m is the number of elements, l is the alternative characteristics,

$$\dim Obj_i = \dim Res_i = m \quad (4)$$

The proposed model is an abstract representation of objective and resource symbols in MDDM as numerical strings.

Then, we express the business structure, Str_i , as follows:

$$Str_i = (Obj_i, Res_i) \quad (5)$$

Moreover, the element str_{ik} has time to preserve its structure, as follows.

$$t_{ik} \in T_i, T_i = \{t_g ; g = 1, \dots, 2m\} \quad (6)$$

Here, the increment of the holding period per simulation is set to $\Delta t_{ik} = 1/100$.

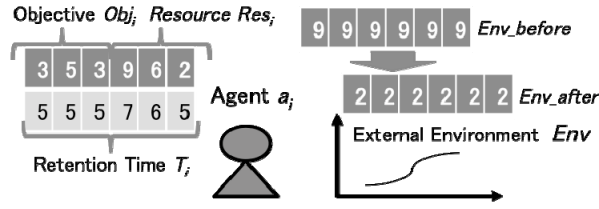


Figure 4 Modeling of the objectives–resources of members and external environment.

(2) Environment recognition entity

Among the members, those that recognize the environmental change are referred to as “environment recognition entity.

4.1.2 External environment

In this study, the external environment is expressed by using a tag model (Figure 4).

Then,

$$Env = (e_1, e_2, \dots, e_{2m}), e_k \in \{1, 2, \dots, l\} \quad \dim Env = 2m \quad (7)$$

Note that Env has Env_before , which represents the initial external environment and Env_after , which is the environment after the change.

4.1.3 Networks

(1) Networks among members

In the tag model, the agents are arranged in a cellular spatial structure, and interactions occur only between adjacent sites. Meanwhile, in the proposed model, the interactions occur between a member a_i and a member a_j (Section 4.1.4 (1)). Then,

$$a_j \in C_i^{formal} \cup C_i^{informal} \quad (8)$$

where,

C_i^{formal} is a set of members connected through formal communication network of a_i

$C_i^{informal}$ is a set of members connected through informal communication network of a_i

(2) Networks between the external environment and environment recognition entities

Interactions occur between the external environment and environment recognition entities (Section 4.1.4 (2)).

4.1.4 Interaction

(1) Interactions among members

The Hamming distance of the numeric string represents the proximity of the business structure of members a_i and a_j . Interactions occur depending on the coincident ratio r_{ij} in the numeric string, as follows.

$$r_{ij} = \frac{\sum_{k=1}^{2m} \alpha_{ijk}}{2m}, \quad \alpha_{ijk} = \begin{cases} 1(str_{ik} = str_{jk}) \\ 0(otherwise) \end{cases} \quad (9)$$

Accordingly, the closer the two business structures are to each other, the easier the interactions will occur. Hence, two business structures are closer if the interactions are numerous. Here, the interaction suggests replacing (i) str_{ik} with str_{jk} or (ii) str_{jk} with str_{ik} when $str_{ik} \neq str_{jk}$ between a_i and a_j . The selection of (i) and (ii) is determined by the superior–subordinate relationship of a_i and a_j and by considering the “cognitive bias” and “top-down ratio” described in the following section.

(a) Cognitive bias

In the tag model, the elements of the tag are rewritten with the probability according to the coincident ratio described above, thereby expressing the propagation of culture. In the proposed model, the business structure that a member possessed for a long time is difficult to change. Hence, based on the premise that the organization also has a difficulty in changing the environmental perception (Kagono T. 1988; Numagami T. et al. 2007), the propagation probability of the business structure among the members is expressed in the following equation.

$$P_{ijk} = r_{ij} \frac{K}{1 + (K/p_0 - 1)e^{-v_{in}t_{jk}}} \quad (10)$$

where p_{ijk} is the probability of propagating business structure str_{ik} held by member a_i to business structure str_{jk} owned by member a_j , $t_{jk} \in T_j$ is the time period holding str_{jk} , v_{in} is the parameter “Inertia” ($v_{in} \in I, I = \{i; 0 < i < 1\}$), and $p_0 = K = const$.

(b) Top-down ratio

After the members a_i and a_j interacting with each other are selected, the superior and subordinate relationships of a_i and a_j (members numbered in Section 4.2) are achieved. Then, the direction propagation of the recognition is determined 1) from superior to subordinate (probability r_{id}) and 2) from subordinate to superior (probability $1-r_{id}$). Here, the probability r_{id} is set to “top-down ratio.”

(2) Interactions between the external environment and environment recognition entities

In the proposed model, the external environment from the side of the organization is not taken into account. Hence, the external environment propagates the recognition by interacting with the environment recognition entities, but the opposite is not handled.

Then, the probability to propagate the k th element of the external environment E to the member a_i is defined.

$$p_{iEk} = r_{iE} = \frac{\sum_{k=1}^{2m} \beta_{iEk}}{2m}, \quad \beta_{iEk} = \begin{cases} 1(\text{str}_{ik} = e_k) \\ 0(\text{otherwise}) \end{cases} \quad (11)$$

4.1.5 Performance

The organization’s performance is expressed, as follows.

$$performance = \frac{1}{N} \frac{1}{2m} \sum_{i=1}^N \sum_{k=1}^{2m} \gamma_{ik}, \quad \gamma_{ik} = \begin{cases} 1(\text{str}_{ik} = e_k) \\ 0(\text{otherwise}) \end{cases} \quad (12)$$

As the consistency among the business structures of the members is higher, the consistency between the external environment and organization’s business structure will be also higher, and thus the performance is enhanced. In the simulation described in the following section, the performance is calculated for each combination of parameters.

4.2 Generation of simulation logs via multiple trials

Table 1 shows the parameters used in our experiment.

Table 1 Parameter set used in this simulation.

Parameters	Value	Classification
Number of agents N	7	Const. *
Organization hierarchy	3	Const. *
Number of elements m	3	Const. **
Alternative characteristics l	2	Const. **
Inertia v_{in}	0.001	Const. **
Constant value p_0	1.0	Const. **
Constant value K	0.05	Const. **
Top-down ratio r_{id}	50% – 90% (every 10%)	Operational variables (5 patterns)
Environment recognition entity	agent#4–#7(1 agent)	Operational variables (4 patterns)
Informal communication network	Nothing, #1–#4, #1–#5, #1–#6, #1–#7, #2–#6, #2–#7, #3–#4, #3–#5, #2–#7, #3–#6, #3–#7.	Operational variables (9 patterns)

* : the smallest organization unit consisting of the top, middle and bottom layers

** : referring to the previous study of Toriyama et al. (Toriyama M. et al. 2010)

Then, the number of agents N (seven) and organizational hierarchy (three) (i.e., top tier (upper), first hierarchy, middle tier, second hierarchy, and bottom layer, third hierarchy) as the smallest organizational unit consisting of the top, middle, and bottom layers. In addition, we set the number of elements m (three), alternative characteristics l (two), inertia v_{in} (0.001), p_0 (1.0), and K (0.05) referring to the previous study of Toriyama et al. (Toriyama M. et al. 2010).

Then, the following parameters were adopted as operation variables.

- (1) Top-down ratio r_{id} - 50%–90% (every 10%) (five patterns),
- (2) Environment recognition entity - agents #4–#7 (members of the bottom layer, one agent each, four patterns),
- (3) Informal communication network - nothing, agents #1–#4, #1–#5, #1–#6, #1–#7, #2–#6, #2–#7, #3–#4, #3–#5 (networks connecting different hierarchies, Figure 5) (nine patterns).

Generally, exhaustive simulations were performed for 1,000 times (180,000 in total) with random seeds changed for 180 parameter sets in total.

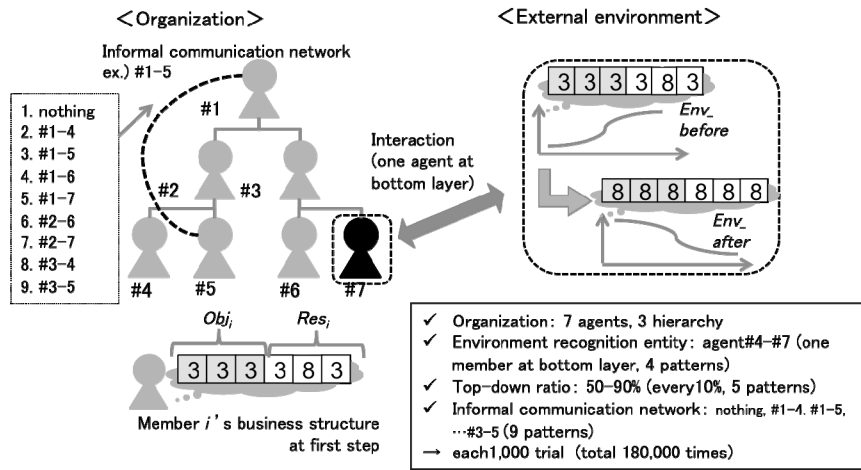


Figure 5 Schematic representation of the organizational hierarchy and simulation setting.

As the initial state of the simulation, a situation in which the business structure of all members completely matches with the initial external environment was assumed. As the simulation starts, the external environment changes, and the members change the business structure for the external environment. Here, the initial business structure, Str_i , and external environment, Env_before , of all members are indicated by tags “333, 383”, whereas the external environment, Env_after , after change is indicated by tags “888, 888.” Finally, at Step 100, whether the business structure of the member matches with the new external environment ($performance = 100\%$) was determined. Among the 1,000 trials mentioned above, the parameter set whose number of matches exceeds 80% was considered to be valid, and it was the target of the following process.

4.3 Classification of simulation logs

The simulation log generated in Section 4.2 was categorized according to the decision-making process. As mentioned in Section 3, the process consists of establishing “who” decides “what” and “when”, as well as “where it falls within the business structure.” To satisfy this requirement, ABM’s simulation log was coded and categorized in the following procedure (Figure 6).

- (1) Label the hierarchy class to which each member belongs, that is, top tier with “T,” middle tier with “M,” and bottom tier with “B.”
- (2) Identify the number of steps for each member to make a decision.
- (3) Depending on the number of steps in Step (2), rearrange the membership hierarchy of each member and encode by character string.

In this classification, given the overlapping combinations of two middle layers and four bottom members among all seven members, 105 theoretical character strings can be generated.

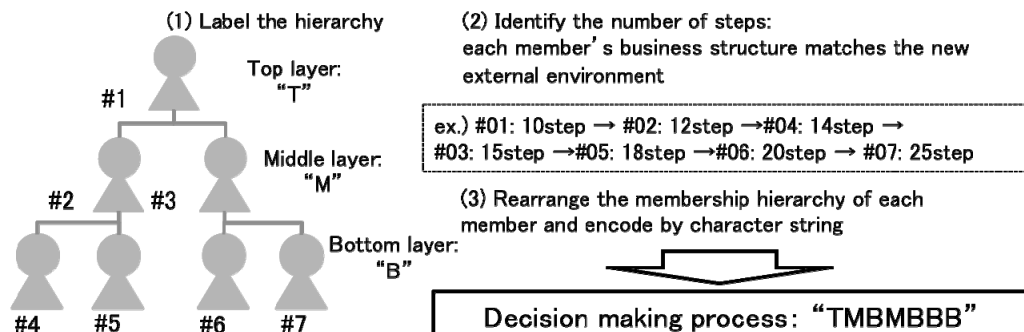


Figure 6 Example of classification of simulation logs. The hierarchy of each member is labeled, and the membership hierarchy is rearranged in the order of steps in making a decision. Such encoding enables us to understand the simulation process, such as “who/where in the organization (top/middle/bottom) decides what (the coincidence of the business structure with the external environment) and when (in what order).”

By using the above method, the simulation logs of multiple trials conducted in Section 4.2 are categorized. On the basis of the simulation results, all 68 processes (character strings) are observed. Among these, the top 10 patterns are listed in Table 2. By referring to the frequency of occurrence, discussing the probability of processes is useful. In addition, nearly 80% or more of the total occurrence frequency has a cumulative total of 10 patterns.

Table 2 The classification results of the simulation logs generated from multiple trials. These are sorted according to occurrence frequency and extracted processes of the top 10 patterns. Grasping possible decision-making processes and referring to occurrence frequencies enable us to discuss the probability of each process.

#	Process	Degree	Frequency(%)	#	Process	Degree	Frequency(%)
1	BMBTMBB	2951	16.6%	6	BMMTBBB	724	4.1%
2	BTMMBBB	2733	15.4%	7	BMBMTBB	643	3.6%
3	BTMBMBB	2651	14.9%	8	BMMBTBB	476	2.7%
4	BMTBMBB	2146	12.1%	9	BMMBBTB	358	2.0%
5	BMTMBBB	1960	11.0%	10	BTMBBMB	350	2.0%
Total of #1-10:							84.4%

By observing each case, it can be noticed that several cases in which the middle layer made decisions at the beginning and then the bottom, middle, and top layers made decisions (processes #1, #4, #5, #6, #7, and #8, hereinafter “Case A”) occur. Several cases in which the top layer made decisions at the beginning and thereafter other bottom/middle decisions made (processes #2, #3 and #10; hereinafter “Case B”) also occur.

As mentioned above, based on the analysis of the simulation logs in this section, grasping possible decision-making processes and referring to the occurrence frequencies enable us to discuss the probability of each process.

4.4 Description in an abstract language

On the basis of the results classified in Section 4.3, we write the generated virtual case by using the MDDM of Kunigami et al. (Kunigami M. et al. 2018). The Case B is taken as example.

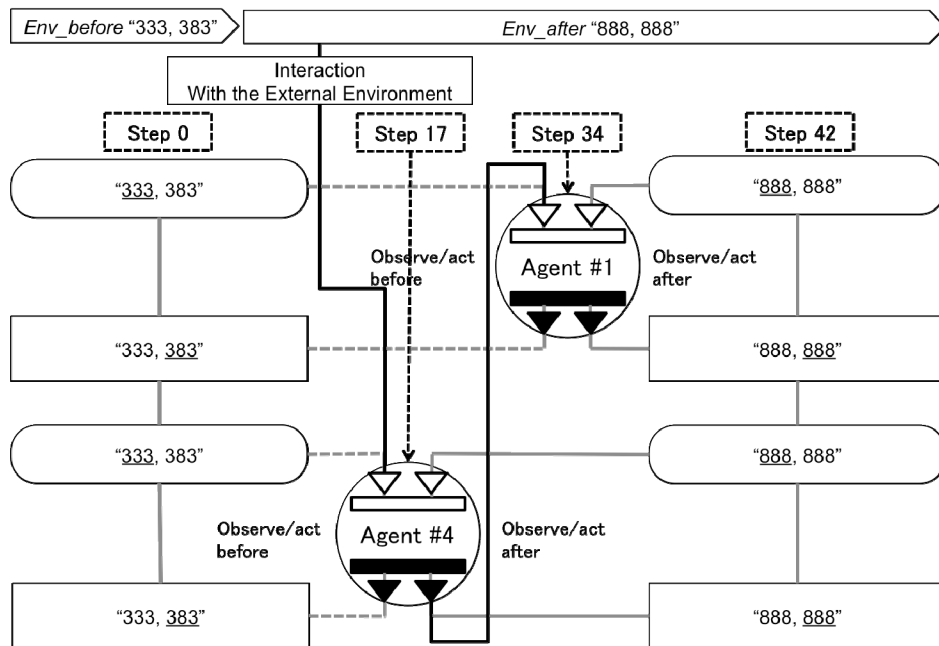


Figure 7 Example of constructing a virtual case by the using MDDM. A case where a bottom-up-type decision-making is conducted.

Figure 7 illustrates an example in which one trial of Case B is constructed as a decision diagram. Here, attention is paid to agent #4 (i.e., the environment recognition entity) and agent #1 (i.e., constituting the top layer). This virtual case indicates that 1) the bottom member recognizes the new external environment and 2) bottom-up-type decision-making stabilizes the business structure of the entire company through the top member.

4.5 Comparison of virtual and actual cases

The virtual case discussed in Section 4.4 (Figure 7) is the case where the bottom-up-type decision is conducted. A similar case is that of Honda's entry into the North American motorcycle market (Christensen C.M. 1997), as mentioned in Section 2.3 (Figure 2). By comparing Figures 7 and 2, it is possible to compare and create an overview and a descriptive uniformity by constructing virtual and real cases using MDDM.

5 Concluding Remarks

In this study, a methodology to implement the ABM and case study was proposed. The previous approach was extended to the following two points i.e., 1) systematically analyzing the simulation logs generated from the ABM and 2) efficiently comparing virtual and real cases. Consequently, this methodology enables 1) to comprehensively understand the results and processes of the simulation and discusses the occurrence frequency (Table 2) and 2) to compare the virtual with real case directly regardless of natural language. Hence, it is possible to compare and establish an overview and a descriptive uniformity (Figures 2 and 7).

For the future works, the following aspects are proposed to be investigated i.e., 1) to expand the scope of analysis and application target and 2) to apply the clustering method as a method for the classification of simulation logs.

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Proposed Roadmap of UTM 21st Century Education System Using TRIZ System Evolution Forecasting Methodology

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Abstract: In regards to Education 4.0, UTM has introduced a New Academia Learning Innovation (NALI) model. NALI is designed to be in line with the National Higher Education Strategic Plan that covers the 10 Shifts components. Under Education 4.0 will require human resources with adequate data and digital literacy. Students across disciplines will, therefore, need to gain digital literacy during their studies. For this, the concept of blended learning is emphasized in NALI model. Blended learning is a combination of active and systematic strategy with the use of digital teaching materials in class. This encourages better and more meaningful learning experience for students. In this digital era, globalised online learning, one of the critical components, is essential for supporting student-centred learning. Even though students are able to explore and gain quick information from the web search, however, to craft the digital learning framework for higher education is challenging. In this paper shows the evolution trends of education system road map by using new concept of TRIZ to forecast the direction of future education system.

Keywords: 21st century education, roadmap, TRIZ.

1. Introduction

For the past few decades, Malaysian higher education system has not only made significant gain in student enrolments, but the achievement has grown wider in global recognition such as research publications, patents, and institutional quality, as well as become a top destination for international students [1]. For continuously stay abreast with the global trends, Malaysian education system needs to keep evolving over time for providing talent and high-quality graduates. Preparing Malaysian, especially youth generation, that capable to strive in complex and ever-changing future will require strong fundamental transformation of how the higher education currently operate [2].

Currently, the impact of industrial revolution 4.0 (IR 4.0) has given a new impetus to educational transformation [3]. Thus, new educational programmes will have to be developed to meet changing demands especially across disciplines. The IR 4.0 demands has led to a new paradigm of higher education, known as Education 4.0 that train students to produce innovations. Malaysian thinkers agree the Education 4.0 will be shaped with education that able to produce highly creative graduates with the ability to think critically regardless of their disciplines [4]. In the era of IR 4.0 jobs that require creativity are likely to stay. For this, Malaysia Education Blueprint (2015-2025) has identified 10 Shifts that would be needed to

take the Malaysian higher education system towards becoming global educational expert and the development of 21st century citizenship [5].

2. Transformation of 21st Century Education System

Growing up with this level of technology means growing up with a completely unprecedented amount of information at your fingertips. There are kids who have never been more than a few seconds away from the answers to their questions, with everything just a quick search away. They are able to teach themselves about any topic they are interested in without even leaving their bedroom. The current cohort of students come from Digital native generation. These two generations have grown up with advanced technology as a given in their homes and classrooms. They are digital natives, as comfortable using apps and code as their grandparents were flipping pages [6].

Digital native generation are also the most internationally connected in history. They encounter people online from all over the world and can easily make friends on the other side of the planet before they have even left their home state. Schools and parents are also increasingly offering children and young people the opportunity to travel, creating a truly borderless experience of learning. The students in our schools today are intelligent, independent and extremely capable. They are skilled with technology and comfortable with global and intercultural communication. We can expect that future generations are going to have even more experience in these areas[7].

A 21st century education is about giving students the skills they need to succeed in this new world and helping them grow the confidence to practice those skills. With so much information readily available to them, 21st century skills focus more on making sense of that information, sharing and using it in smart ways. While digital integration is also fundamental to a thorough 21st century education, it is not enough to simply add technology to existing teaching methods [8]. Technology must be used strategically to benefit students. Students are increasingly advanced users of technology even as they enter school for the first time, so this can often mean being open to the possibilities presented rather than attempting to teach and prescribe the use of certain programs. Many a classroom ‘technology class’ has baffled children by attempting to teach them about programs, websites and hardware that are no longer relevant or that they understand far better than the teacher does [9].

3. The challenges in 21st Century Education Transformation Roadmap

The 21st century education contained various challenges and also opportunity for education provider such as UTM in excel together with the trends. The form and shape of UTM’s 21st century education will eventually change through innovation, but the functionality is always intact as UTM’s education system. However, there are lacks implementation and execution of strategy regarding with the transformational of form and function for UTM 21st century education system [10]. By having those strategy, it will able to have a strong roadmap on the direction of transformation and effectively execute the process of transformation at a higher degree. In the context of UTM’s initiatives and

transformation strategy towards 21st century education system, this paper will focus on; exploring the predictive trends of transformational shape and form towards 21st century education system and develop a transformational roadmap on the trends of UTM's evolution towards 21st century education system using TRIZ forecasting methodology.

4. The TRIZ concept of evolution trends of education system towards 21st century education

TRIZ is the Russian acronym for "Teoriya Resheniya Izobretatelskikh Zadach" (теория решения изобретательских задач) meaning the 'Theory of Inventive Problem Solving' Developed in 1946 by soviet inventor Genrich Altshuller and his colleagues. The key objective of TRIZ methodology is to have problem solving processes that rooted from the development of patented invention that is faster and better in term of solving technical or engineering problems. From previous research, the development of invention involved fundamental concept of technological system evolution that consist of repeated trends [11,12]. By understanding how technology system evolves, we can foresee the directions of system change and take the opportunities in business competition. There are 9 trends of engineering system evolution in TRIZ methodology [13]. However, this paper only uses two significant trends that able to support the transformational of education system forwards. The first selected trends are trends of increasing towards supersystem that pushing system towards utilizing the function of external system to carry out the core function of education system, as shows in Fig1.

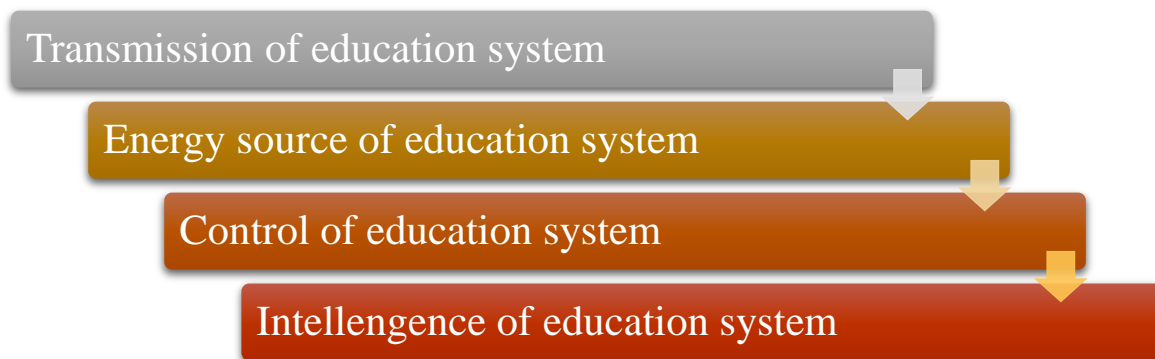


Fig. 1 Trend of increasing of functionality towards supersystem of education system

The second trends are the trends of decreasing human involvement that focus to changing the education system towards less dependency of human in carry out the operation of education system, as shows in Fig2. The trends started with people interaction of education system and adding supporting system in teaching and learning process. Then, digital elements become important elements in the education system and move towards improving level of connectivity and intelligence in education operation. The final concept of this trends will be the autonomous elements that have been integrated or embedded within the education operational system.

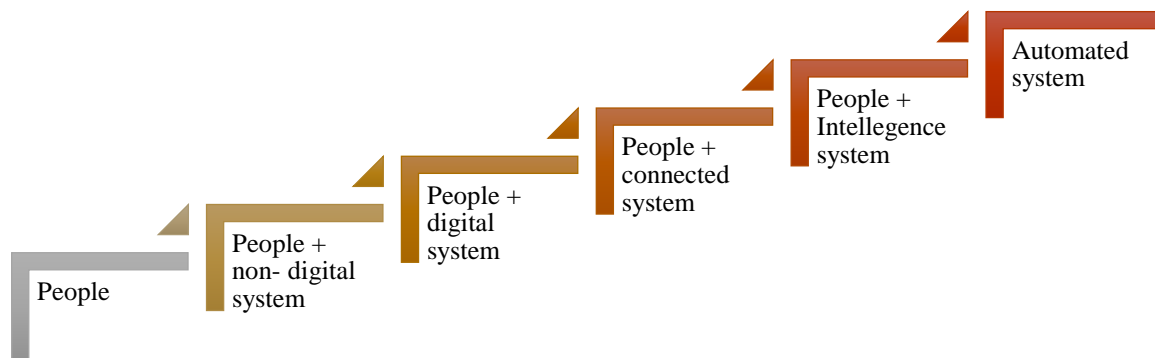


Fig 2. Trends of digitalization in reducing human involvement of education system

5. The transformational matrix of UTM's 21st century education system evolution

Fig. 3 shows the transformational matrix of UTM's evolution towards 21st century education system by combining two selected TRIZ trends that have been mentioned in the previous section. It consists of S-curve maturity model and combined it with two TRIZ the trends of system evolution. The proposed matrix is integrated with another TRIZ tool called S-curve trend.

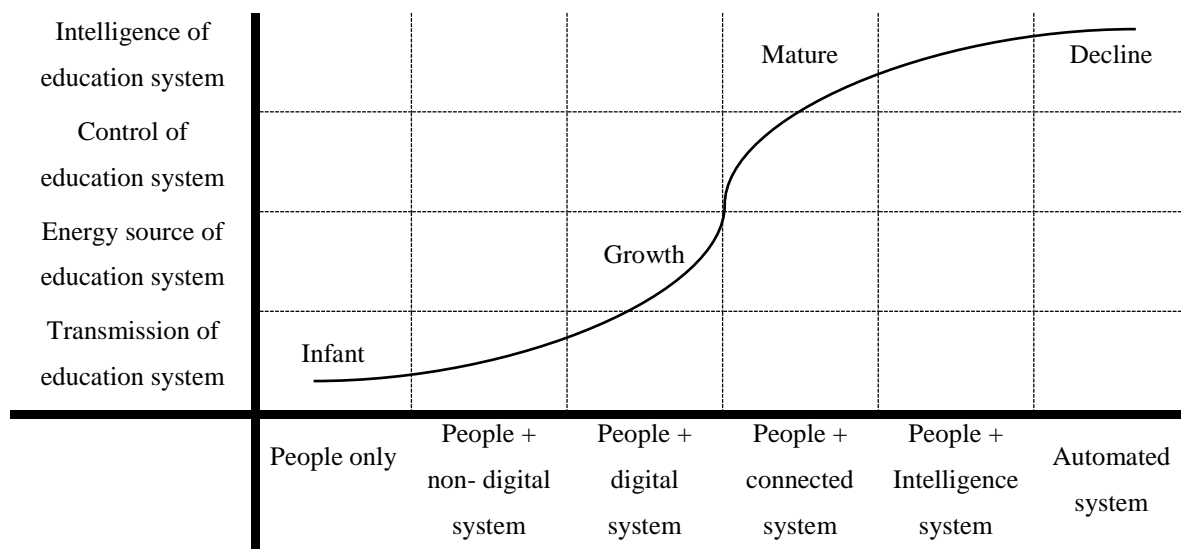


Fig 3 The transformational matrix of UTM's 21st century education system evolution

The S-curve consist of system maturity as the education evolves towards 21st century system. There are 4 phases in the S-curve;

1. Infant phase that represent the new adopter of early transformational changes in conventional education system,
2. Growth phase that represents the increase of degree of transformational in education system that involved digitalization and outsourcing the specific functions to external education system
3. Mature phase that represent radical transformation changes of education system towards connectivity and add more value on the level of control system.
4. Final phase is decline phase. It represents the optimize education system that highly automate and use high level of intelligent functionality in the operation of education system. From this phase, the optimization leads to saturation of system change and new innovation leaps are critically needed for the education system. Without innovation, the education will be not competitive and phase out eventually in future.

This matrix able to provide UTM a roadmap to prepare and implement phase by phase in transforming current education system to 21st century concept. The realization of these roadmap requires multiple levels of design and development effort and skill. Creating a success transformational education system is also a complex task and it need to be accepted by its users who are primarily the 21st century higher education students [14]. It must be effective in engaging and enriching students learning.

Conclusions

The transformational changes are critical to UTM in evolving the education system towards 21st century teaching and learning. The transition must be guided with clear direction and supported with implementation concept of education system transformational changes. The element of digitalization of systems within the education program are one of the critical factors to move forward. However, the form and shape are changes according to technology trends and progress. TRIZ methodology have been introduce in this paper based from the ability to forecast technology evolution with several tools and techniques such as trends of engineering system evolution and S-curve. Based from system functionality, the education system will transfer out to external system that is abundance such as online system that available in the internet. The changes towards automation of education system also pushed the education system evolved and transform to a higher level of functionality.

The TRIZ tools are integrated together and formed the proposed transformational matrix for UTM to evolve its education system towards 21st century goals. The proposed matrix provides UTM to identify their position in terms of education evolution phase and strategize their way forward to the next phase of evolution.

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Room A

Session – 8

ICIM 2018

Shareholder Perks and Earnings-Price Ratio

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Abstract Shareholder perk (SP) programs are widely observed among Japanese listed companies. SP can be regarded as a different form of distribution and distributed disproportionately with respect to number of shareholding, letting different payout to retail and institutional investors. We focus on this Japan-specific phenomenon and investigate whether SP affects Earnings to Price (E/P) ratio as well as Price to Earnings (P/E) ratio by several approaches. Our main test applying propensity score matching finds SP affects E/P negatively and P/E positively with significance. This result suggests E/P incorporated economic value of SP. The impact measured by E/P is more robust than measured by P/E. Forward E/P and P/E shows more consistent difference between SP and non SP firms, implying SP has some influence to risk and future growth. We also find the influence of SP on E/P varies contingent on E/P level from quantile regression in that SP has stronger negative relationship with high E/P. Furthermore, one-year transition of SP and non SP firms based on portfolio sorted by forward E/P is examined. The portfolio analysis indicates more stable transition of SP firms than non-SP firms especially when they have low E/P ratio.

Keywords Shareholder perks, Earning price ratio, Capital market anomaly

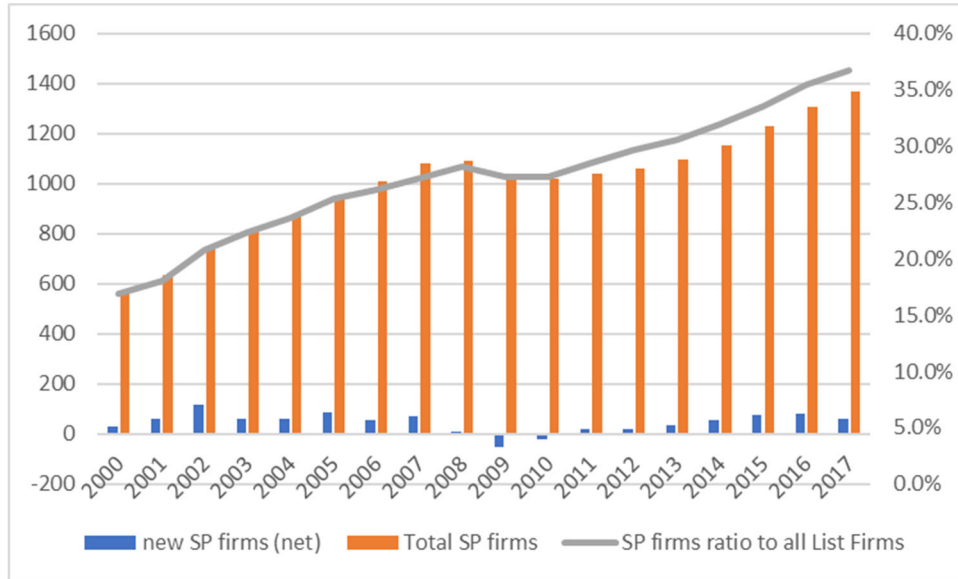
1 Introduction

Shareholder perks (hereafter SP) are recognized as plans of which companies offer good and/or services to shareholders having more than a give number of shares [1]. SP plan is not Japan-specific yet the number of SP offering companies in Japan overwhelms other countries. The number has been steadily increasing and reaches approximately 1400 listed companies, a record proportion of 36.8 percent of all the listed companies as of September 2017. The Company Act of Japan has yet no provisions regarding SP despite its popularity, provoking a long-lasting controversy about the nature of SP [2]. In the absence of legislation, SP offering companies typically introduce SP as a part of distribution policy along with dividend. Figure 1 presents the trend of SP companies since 2000. The figure shows the proportion of SP companies has almost doubled in this century

The differences between SP and dividend are mainly three aspects. First, companies can adopt SP plan without resolution of a shareholder meeting because it is not distribution of profit from the standpoint of the law. Thus, companies have much discretion at designing SP scheme so that they strategize SP for achieving desirable ownership structure, although no company makes SP distribution in cash form. Companies can even offer SP when they report loss or pay SP far more than dividend. Second, associated with the first feature, company usually provides benefits to retail investors disproportionately, diverging from the base of equity [3]. Third, SP companies expense SP related expenditure for reporting purpose. Research report No.3 released by Accounting System Committee of the Japanese Institute of Certified Public Accountants in 2013 offers an authoritative guideline as to the accounting for SP. The report concludes that the expensing practice is legitimate because i.) the article 454 of the Company Act stipulating dividend of surplus does not apply to SP and ii.) SP is different from dividend for its disproportionality.

The literature documents ex-SP day stock price drop which implies SP's distribution nature [4], [5]. SP can help companies enlarge retail shareholder base [6],[7],[8],[9], reduce liquidity risk [7],[10] and increase return [9]. Although the evidence is mixed, SP also help reducing cost of equity [8], [9]. These results are consistent with Amihud et al. [11], which found the causal relationship between an initiative facilitating small investors' trading and stock price in Japan.

Figure 1 SP offering company trend



Meanwhile, the impact of SP on accounting number and consequently accounting based multiples is still under-investigated. Given the perceived distribution nature, SP affects comparability of accounting numbers and accounting based multiples systematically between SP and non-SP companies as well as between retail and large shareholders of SP companies. This in turn casts doubt on the current accounting treatment for SP from economic substance perspective [12]. The interpretative difficulty arises especially in association with earnings and payout related numbers and multiples if SP is expensed yet perceived as distribution.

Barber and Odean found retail investors prefer attention grabbing stocks [13]. SP announcement is covered in the news so that investors tend to pay more attention. However, SP news needs substantial outlays thereafter. The number of firms suspending SP program remain around 10, approximately 0.5% in the last ten years except 2009 reflecting the aftermath of the financial crisis (approximately 40 companies stopped SP in 2009), at the figure1 shows. Retail investors expect to enjoy SP benefits for considerable length of time. Therefore, the financial numbers of SP firms based on the current accounting practice always underrepresent fundamental to them. Meanwhile, as the number of shareholders it can be argued that large shareholders accept to bear the SP cost for higher liquidity as the evidence suggests. SP expensing practice may be reasonable for them.

If the above argument holds, SP practice can be one of the important sources of earning-stock price anomaly in Japan. We may observe systematic difference in multiples between SP and non-SP firms, even if retail investors do not fully acknowledge SP implication to reported earnings. Among many multiples, this paper especially sheds light on its implication for earnings to price ratio (E/P), the reversal of P/E ratio for two reasons. First, P/E has retained its popularity among trailing multiples [14]. The literature also reports security analysts use PER for valuation in US [15], Europe [16] and Japan [17]. Second, as we described above, the direct trade-off between SP and earnings demands careful deliberation to firms in balancing SP and earnings given the importance of earnings. Obviously, firms can report higher earnings which investors usually take it favorable, if they don't offer SP¹. This paper investigates whether SP has significant impact enough to alter relationship between earnings and stock price given its sticky nature. Should this be the case, financial reporting regulation needs to consider accounting for SP so that investors use reported earnings to project future cash stream. We also examine whether SP adjusted portfolio sorted by E/P can earn higher return. Institutional investors can ensure the economy of SP if the portfolio gives excess return as far as it compensates the cost they bear.

¹ We assume SP expenditure is not expensed for tax purpose. While the tax treatment for SP is still opaque, the National Tax Tribunal decided SP should be treated as disallowable expense in a recent case.

Next section briefly reviews E/P research and illustrates how SP can affect E/P by a simple example. Section three clarifies research setting, followed by section four presenting the test result. Final section concludes and proposes future research agenda.

2 E/P and Accounting for SP

E/P valuation and investment strategy has long history in practice since Graham and Dodd proposed. It assumes firms of the same fundamental have the same ratio. Following the seminal work by Ohlson [18] and Ohlson and Juettner-Nauroth [19] extending dividend discount model, the literature often analyses E/P based on the residual income model and interprets as the product of risk and expected growth in abnormal earnings [20]. The evidence confirms SP lowers market related risk metric (e.g. liquidity and beta), suggesting E/P should be smaller. On the other hand, SP impact on growth expectation and earnings volatility is still uncertain mainly for two interrelated reasons. First, managers have discretion to change SP program anytime. If management may increase retail shareholder base to make themselves better off, they may augment SP even sacrificing promising investment opportunity, given retail investors' relatively little interest in fundamentals. Second, change of the number of retail investors, affecting SP expense and thus earnings, are not predictable. Therefore, investors may require SP discount.

In addition to the above discussion, SP raises more fundamental question in that it violates law of one price. Stock valuation model including P/E arguably assumes the same future cash flow to each share in the same class, allowing us to conceptualize homogeneous investors, while SP stock is not the case given its distribution nature. We briefly examine this issue with an example. For brevity, we don't consider tax effect given the different treatment of SP for reporting and tax purpose.

Kyokuyo, a seafood manufacturing and trading company listed with the first section of Tokyo Stock Exchange, offered assorted their own products valued at 5,000 JPY equally to all the shareholders holding no less than 100 shares in 2017 fiscal year. Given the number of shareholders (31,856 individuals and institutions as of March 31, 2017) and the SP value in the year, the total SP expenditure amounted to approximately 159 million JPY, excluding delivery and administrative costs. Meanwhile, as the reported earnings before income taxes and net income for the year was 3,902 and 2,384 million JPY respectively. The reported (undiluted) EPS was 208.94, while the reported P/E was 14.1. The dividend per share amounted to 60, yielding payout ratio of 28.7.

Given the reported number, SP expenditure drove EBIT, net income and EPS down by approximately 4%. Resultantly, P/E (E/P) drops (rises) from 14.1(0.71) to 13.6 (0.73). If the company uses exactly the same amount with SP expenditure for dividend per share increases 13 JPY and payout ratio becomes 35.1, after controlling for SP expenditure. Assuming the perfect substitution between dividend and SP, these two sets of accounting numbers represent the same fundamentals, except the recipient and distribution channel. While the rearrangement above seems to present moderate change, the disproportionality with respect to the number of shareholding makes the sharp contrast, especially dividend per share. The company paid dividend 60 JPY. A large shareholder, say having 10,000 shares, receives SP per share is 0.5 JPY (5,000/10,000). For retail investors having only 100 shares, the total income gain per share calculated by the sum of dividend per share and SP per share equals 110 (60 +5,000/100). Assuming the clean surplus relationship, our interest is whether observed E/P diverges from the one which reflects large investor's expected future cash flow based on their current payout ratio.

3 Research Design and Data

3.1 Research interests and methodology

The first objective of this paper is to examine if SP affects E/P ratio systematically over time. We apply propensity score matching (PSM) approach to mitigate non-randomness of SP firms (self-selection problem in this study) like Karhoff et al. [9]. Propensity score is the conditional probability of receiving treatment, SP program implementation in our study, given the observed covariates [21]. For conducting PSM, we assume companies decide whether or not to offer SP every year and

regard this decision as treatment. Although SP programs in general have continuity, it is not unrealistic to assume that management review the effect of SP and reconsider the package allowing for abandonment option.

PSM has a prominent feature enabling researchers to control for many variables at matching so that they expect to have unbiased treatment effect. This feature is particularly important for two reasons. First, E/P is a unified measure of fundamentals affected by many factors. Second, due to the lack of theory and evidence on the antecedents of SP offering, we don't know the number of dimensions needed to be matched for unbiased estimation a priori. Thus, we include many candidates of control variables collected from E/P studies in addition to common fundamental measures and then select significant variables after running stepwise logit regression on SP offering. This strategy minimizes the risk of omitted confounding variables yet the risk of unobserved variables which are only relevant to SP may exist. Besides, our sample may potentially suffer from individual invariant factors because of panel structure. However, we don't apply fixed effect logit regression for its drawbacks [22]. We compare SP and non-SP firm year by year to relief this problem. Given these limitations in mind, if we find significant average treatment effect on the SP firms conditioning on the control variables, SP affects E/P systematically.

While P/E is more popular than E/P in practice, we use E/P as the response. E/P can help avoid zero or negative denominator problem which requires dropping considerable number of observations and negatively affect the generality of the result. Both reported and forecasted earnings are used as numerator (i.e. trailing and forward E/P) for the test. The evidence consistently suggests forward E/P can better predict future growth and return [23], [24], implying forward E/P is more reliable valuation metric than trailing E/P. Nevertheless, SP impact on stock price may occur due to active stock purchase by retail investors, but not institutional investors. Our previous study finds retail investors pay attention to P/E to the same degree with SP at stock purchasing decision [25]. They may balance E/P and SP and make decision, *ceteris paribus*. They do not purchase SP stocks because of the seeming low E/P, neglecting SP, which lifts up E/P to the equivalent level with non SP firms. Nevertheless, retail investors refer to trailing E/P since they may not know the superiority of E/P or do not have easy access to it. For this reason, we examine both forward and trailing E/P. We additionally estimate SP effect on P/E, considering popularity in practice.

In addition to the continuous difference in E/P and P/E between SP and non-SP firms, this study has two more interests. First one is to see if the moderation effect of SP on E/P varies contingent on E/P level. We apply quantile regression for this purpose. Another one is to see whether SP firms show different behavior of E/P over time. We apply the traditional portfolio approach sorted by E/P following Beaver and Moore [26]. The evidence suggests, that, a common premise behind value investment strategy, high E/P firms earn higher return and vice versa [27]. This implies extreme E/P will revert to normal level in subsequent years. However, if SP affects fundamental in non-linear way and is incorporated in E/P, E/P change of SP firms may differ from the others. We compare one-year transition of SP and non-SP firms in 10 partitioned portfolio sorted by forward E/P each year and see the difference.

3.2 Data

The sample includes all the listed firms in Japan. Financial and market data are drawn from Nikken Financial Quest (FQ), while SP data are hand-collected from the autumn edition of Japan Company Handbook published by Toyo Keizai each year. The observation period extends from 2005 to 2015. The data filed in FQ are restricted to the active companies at downloading date and thus our sample does not consist of delisted firms. We also exclude the companies in financial industry classified by one digit Nikkei industry code.

In order to calculate E/P, we refer to closing stock price adjusted for stock split at the final trading day in March. We assume the E/P incorporates SP information mentioned above. Unlike the other research using forward E/P, we use management forecast as numerator for two reasons. First, analyst forecast for small to mid-cap companies are often unavailable while the proportion of those companies in the SP universe cannot be negligible. Analyst forecast exploitation will cause large loss of observations. Second, manager forecast more likely reflects planned SP expenditure than analyst forecast given the complexity of many SP programs.

It should be noted that industry treatment was the most challenging part in variable operationalization. Table 1 shows the number and proportion of the SP company-year in the sample by Nikkei two-digit industry classification, suggesting high concentration in several industry sectors. For instance, almost all the companies (96 %) in railroad and bus industry offer SP. It is well known that industry attribute significantly affects E/P [27], demanding appropriate control of industry effect to investigate unbiased SP effect. As PSM usually assumes the number of control sample exceeds that of treated sample, coherent matching SP and non-SP firms in 2-digits industry classification can hardly achieve in the industries where SP companies dominate, such as foods and retail. Thus, as a second best option, we decided to use 1-digit classification for consistent PSM. For brevity, table 2 presents the definition and descriptive statistics of the variables selected at stepwise logit regression and used in subsequent regression analysis. We trimmed the data by excluding top and bottom 1% of each continuous variable. Sample to be used in each test varies contingent on dependent variable (i.e, type of E/P). Due to huge variance of several variables which make matching process complicated, we tried several proxy options for each constructs from using raw value to binary transformation since the test in this study signifies reliable matching subject to selected variables. We conducted repetitive trial and error process of logit regression and following PSM until finding well balanced matches satisfying propensity score test. Therefore, variable type for each construct varies. The inconsistency between variables should be modified in future research.

4 Results and Discussion

Table 3 reports the result of stepwise logit regression for identifying significant variables which separates SP and non-SP firms. After controlling industry and year, we find six significant variables which subsequently help achieve reliable matching. Logit regression suggests firms are more likely to offer SP when they show (1) high capital intensive asset structure, (2) lower leverage, (3) larger size, (4) lower growth, (5) higher ROA and (6) distribution. The differences in earnings based ratio, ROA and orgrowth, should be carefully interpreted since we don't adjust potential negative impact of SP on earnings. Intuitively, mature and financially healthy firms has high probability to be SP firms. This result is not surprising, as far as institutional investors are aware they substantially bear SP expenditure program or give up their stake because of disproportionality, they may be more keen to the inequitable situation caused by SP when a company face higher risk (including growth opportunity). In turn, managers are more reluctant to offer SP. For instance, textbooks mention companies should retain excess cash flow if there are good investment opportunity. Thus, it is not logical to offer SP while offering SP. On the way around, SP program may be a signal of future stable fundamental from management which can be decreasing factor of earnings volatility.

We then apply PSM using these significant variables. Table 4 shows the matching result and table 5 presents SP effect on the different measures of earnings-price relationship (industry and year dummy are omitted in both tables). In order to have more robust results, we execute bootstrapping (1,000 trails each set) to see the difference between the two groups. Table 4 ensures PSM successfully control the differences in those variables between matched SP and non-SP firms as t values for all the mean differences turns to be insignificant, suggesting our sample does not face common support problems. By matching rule, our matched pair cannot be the same company in different year.

The average treatment effect on treated (ATT) by SP, although the significance in the early sample period is sensitive, is consistent with our expectation. That is, SP effects E/P negatively yet P/E positively, implying fundamental measured by earnings-price relationship reflects SP. In order to examine the bias inherent in matching process, we complementary run bootstrap regression including the same variables for logit regression plus lagged SP as independent variables for the entire sample without matching (not reported). The regression result shows the same result of which SP has significant negative value at 1% criteria. ATT on E/P shows more consistent result than P/E due to the sensitivity of P/E and omitted sample because of zero and/or negative denominator concern. Forward ratio has more stable result than trailing ratio. Given the evidence from E/P study, this suggests SP can be a factor affecting risk and/or future growth expectation.

Our result supports the literature finding that SP reduces liquidity risk and consequently reduces cost of equity

from a different angle, since PSM controls profitability measured by ROA so that to some extent we can assume the same earning generation between the matched firms. Therefore, risk reduction effect of SP sustains for long. ATT on EPest, the most stable ratio, over the sample period move around -0.01 suggesting the average effect holds the same magnitude. Therefore, for the investors who don't have knowledge about SP or see no value in it with having interest in other factors, stock price of SP company usually seems somewhat 'expensive', other things being equal. From this result, we can suggest neglecting SP at fundamental analysis of Japanese stocks may cause systematic bias.

Table 1 SP firm-year sample distribution by industry (2-digit Nikkei Industry Classification)

Industry	Number	Percentage
Ceramics	46	7.4%
Chemicals	447	20.5%
Communication Service	117	35.3%
Construction	236	12.7%
Drugs	90	13.9%
Electric Equipment	248	8.9%
Financial & Bank	441	26.0%
Fish & Marine Product	50	46.3%
Foods	999	75.7%
Iron & Steel	59	11.8%
Machines	184	7.4%
Manufacturing	385	32.5%
Measuring Devices	48	8.8%
Metal Products	216	16.2%
Mining	7	11.3%
Motor Vehicles & Auto P	195	23.6%
Oil	2	1.9%
Pulp and Paper	53	20.5%
Railroad & Bus	309	96.0%
Real Estate	275	25.1%
Retail Stores	1,665	65.6%
Services	2,359	29.5%
Shipbuilding & Repair	1	2.1%
Textile Goods	112	22.7%
Transportation	276	25.0%
Utilities	5	2.2%
Wholesale	1,188	31.1%

Table 2 Variable definition and descriptive statistics

Variable	Mean	S.D	Min	Max	N
EP	0.025	0.167	-0.965	0.327	33000
PER	28.107	44.426	2.779	335.84	27000
EP est	0.068	0.047	0.004	0.265	28000
PE est	28.617	39.876	3.777	282.478	28000
FAA	43.599	19.876	4.712	91.044	35000
ibD_A	19.648	18.242	0	70.76	35000
logS	10.287	1.778	6.031	14.916	35000
Orgrowth	3.001	1.413	1	5	30000
ROA	5.162	7.136	-25.803	28.761	35000
DVD	0.813	0.39	0	1	35000

E/P= EPS / Stock price (EPS calculated by net income divided by average number of share outstanding),

PER=reversal of E/P, EP est= Earnings forecast for the next fiscal year per share/ Stock price

PE est= Reversal of EP est, FAA= Fixed asset / Total Asset, ibD_A=Liability with interest/ Total asset

logS= logarithm of Sales, orgrowth: past one-year growth in ordinary profit (classified into 5 ranks from lowest to highest)

ROA= Ordinary profit/ Total asset, DVD; 1 if a firm pay dividend in the year otherwise=0

Table 3 Logit regression for identifying classification variables

Variables	FAA	ibD_A	logS	Orgrowth	ROA	DVD	Industry	Year
Coef.	3.07***	-0.58***	0.10***	-0.04***	1.69***	0.42***	Yes	Yes
Z	38.83	-6.46	10.9	-3.87	5.91	7.74	-	-

LR chi2(17) 3703.89

Pseudo R2 0.1054

*all variables are significant at 1%

Table 4 Propensity score matching result

Variable	Unmatched Matched	Treated (mean)	Control (mean)	%bias	%reduct bias	t	p>t V(C)
FAA	U	52.24	41.34	57.00	0.00	45.47	0.00
	M	52.24	52.33	-0.50	99.20	-0.28	0.78
ibD_A	U	20.17	18.07	11.90	0.00	9.39	0.00
	M	20.17	20.47	-1.70	85.80	-1.08	0.28
logS	U	10.76	10.48	17.50	0.00	13.31	0.00
	M	10.76	10.77	-0.30	98.20	-0.21	0.84
orgrowth	U	2.94	2.99	-4.00	0.00	-3.09	0.00
	M	2.94	2.92	1.20	70.50	0.81	0.42
ROA	U	6.03	5.76	4.90	0.00	3.74	0.00
	M	6.03	6.03	-0.10	98.70	-0.05	0.96
DVD	U	0.94	0.89	16.00	0.00	11.89	0.00
	M	0.94	0.94	-1.10	93.10	-0.84	0.40

Table 5 Average treatment effect of SP on various earnings-price ratios

	all	2005	2006	2007	2008	2009
EP	-0.009***	-0.006**	-0.002	-0.005*	-0.01***	-0.007
PER	3.062***	4.953	2.248	4.728	3.616	5.484
Epest	-0.008***	-0.004	-0.005**	-0.004*	-0.006*	-0.016***
PERest	3.669***	1.247	6.798**	4.432**	4.72***	5.312
	2010	2011	2012	2013	2014	2015
EP	-0.01**	-0.005	-0.009**	-0.012***	-0.012***	-0.015***
PER	2.099	2.336	0.923	6.564***	3.692*	5.72***
Epest	-0.013***	-0.008**	-0.007**	-0.01***	-0.011***	-0.013***
PERest	4.809	1.535	1.682	3.388*	3.537**	6.2***

*:10%, **:5%, ***:1% significance respectively

Table 6 reports the quantile regression result and accompanying Wald test for examining SP coefficient differences by quantile. If investors find a company of very strong future prospect, the expected cash flow from SP might consist of smaller portion of the value. Therefore, investors pay relatively less attention to SP and its impact on E/P should be smaller. However, when investors perceive weak future prospect in a company, SP cash flow plays significant role at valuation. The result is perfectly consistent with our expectation. While the coefficients stay negative at all quantiles, the magnitude increases monotonically as E/P increases at statistically significant level. This suggests nonlinear relationship between SP and E/P. Put it differently, high growth potential itself is enough to attract investors and SP offering has moderate impact. The stronger impact of SP on high E/P firms may demand somewhat different interpretation. Companies residing in higher quantiles are usually regarded as value stocks. As argued previously, institutional investors do not receive fringe SP benefit since they usually hold large number of stocks. Negative impact of SP on higher quantile may imply retail investors are more tempted to purchase value SP stocks, lowering E/P regardless of less attractive future prospect. PSM test suggests more prospective companies are likely to offer SP. The benefit of offering SP measured by its impact on E/P can appear when they fail to show strong fundamental especially.

Table 6 The result of quantile regression on forward E/P

VARIABLES	q10	q25	q50	q75	q90	Wald test
sp_lag	-0.002***	-0.004***	-0.006***	-0.009***	-0.011***	(1) [q10]sp_lag - [q25]sp_lag, Prob > F = 0.0208
	(-4.71)	(-6.26)	(-8.30)	(-11.68)	(-15.64)	(2) [q25]sp_lag - [q50]sp_lag = 0, Prob > F = 0.000
FAA	-0.000	-0.000***	-0.000***	-0.000***	-0.000***	(3) [q50]sp_lag - [q75]sp_lag = 0, Prob > F = 0.000
	(-1.38)	(-5.29)	(-10.46)	(-14.23)	(-12.95)	(4) [q75]sp_lag - [q90]sp_lag = 0, Prob > F = 0.000
ibD_A	0.000***	0.000***	0.000***	0.001***	0.001***	
	(3.24)	(10.37)	(20.23)	(27.25)	(21.22)	
logS	0.001***	0.001***	-0.000	-0.001***	-0.002***	
	(8.78)	(7.48)	(-1.53)	(-7.86)	(-8.29)	
orgrowth	0.001***	0.001***	0.001***	0.000*	0.000	
	(4.52)	(4.85)	(4.21)	(1.95)	(0.70)	
ROA	0.002***	0.002***	0.003***	0.003***	0.002***	
	(30.64)	(33.13)	(33.30)	(26.76)	(25.66)	
DVD	0.008***	0.013***	0.013***	0.005***	-0.008***	
	(13.50)	(14.04)	(11.39)	(3.01)	(-3.46)	
Pseudo-R2	0.0811	0.0824	0.0931	0.1352	0.1703	*industry and year dummy are not reported in the table

Table 7 Differences of one-year transition in E/P sorted portfolio between SP and non-SP firms

	1	2	3	4	5	6	7	8	9	10
1	1.43%	0.02%	-0.13%	-0.03%	0.00%	-0.04%	-0.22%	-0.11%	-0.15%	-0.21%
2	0.55%	0.82%	0.36%	0.09%	-0.14%	-0.07%	0.01%	-0.17%	-0.04%	-0.12%
3	0.04%	0.35%	0.26%	0.23%	0.05%	-0.07%	-0.18%	-0.06%	-0.12%	-0.07%
4	0.03%	0.31%	0.12%	0.65%	0.20%	0.17%	-0.09%	-0.08%	-0.15%	-0.21%
5	0.09%	-0.14%	0.19%	0.28%	-0.03%	0.56%	0.10%	-0.12%	-0.08%	-0.17%
6	-0.14%	-0.06%	0.54%	0.30%	0.07%	0.09%	0.15%	-0.36%	-0.24%	0.01%
7	0.00%	-0.20%	0.09%	0.19%	0.30%	0.15%	0.44%	-0.07%	0.02%	-0.32%
8	-0.28%	0.12%	-0.12%	-0.17%	-0.13%	-0.29%	0.51%	0.57%	0.01%	-0.45%
9	-0.01%	-0.08%	-0.09%	0.05%	-0.16%	-0.02%	-0.01%	0.11%	-0.40%	-0.32%
10	-0.14%	-0.03%	-0.05%	-0.19%	-0.08%	-0.07%	-0.14%	-0.34%	-0.54%	-2.15%
* Percentage difference calculated by the percentage of each elements in SP companies matrix minus that of non-SP companies										
* Vertical rank represents formulation year while horizontal rank for succeeding year										

We finally investigate the transition pattern of E/P of SP firms by the portfolio approach. Typical fundamental based investment strategy implicitly assumes convergence of E/P to average level. If SP firm receives ‘premium’ of E/P continuously from stock market, we observe similar transition pattern for SP and non-SP firms. Otherwise, traditional yet popular value investment strategy may sometimes work inefficiently due to SP. We partitioned the sample each year into 10 portfolio sorted by forward E/P in ascending order for this analysis. Lowest E/P companies are categorized in rank 1 portfolio while highest companies are grouped in rank 10. and separated SP and non-SP firms. We then develop one-year transition matrix of SP and non-SP firms. Table 7 reports only presents the difference between SP and non-SP firms in percentage of the population in each pair after summing up all the observation for brevity reason. Positive value indicates percentage of SP companies in the cell exceeds that of non-SP firms and vice versa.

Few insights from this matrix are worth to mention. First, SP firms are less likely to stay in higher E/P rank portfolio. The consistent negative value in the bottom (i.e. 9 and 10 in the row) reflects this tendency as the difference in percentage is calculated based on the percentage of firms classified in SP and non-SP group. The difference reflects the difference in original matrix developed separately and that in transition effect. As we argued previously, SP firms show better financial performance than non-SP firms. Given the panel nature of our dataset, it is not surprising SP firms tend to stay in higher rank. Second, the transition of SP companies are less volatile than non-SP firms. This pattern is apparent especially when they reside in higher rank portfolio as the top left part shows positive value expect few pairs. The quantile regression suggests SP works as repressing force to E/P. Therefore, this pattern is consistent with the regression result.

5 Conclusion

This paper focuses on SP as a unique institutional setting in Japanese stock market and investigates the relationship between SP and E/P for its popularity in investment world. This paper delivers four major findings. First, SP firms show more solid and stable financial performance than non-SP firms. Second, SP firms have lower E/P than non-SP firms consistently. Third, SP impact of EP monotonically increases as E/P decreases. Forth, SP firms more stable transition of E/P than non-SP firms in one-year horizon. We believe our results is insightful for investors by show the evidence that E/P in Japan reflects SP significantly. Investors should be cautioned about the influence of SP when they exploit E/P at investment analysis.

However, the analysis reported in this paper is yet preliminary and has limitations. First, we are fully aware that SP may has strong linkage with corporate governance structure which is not examined in this paper. This problem should be examined by investigating the antecedents of SP offering. Second, we implicitly assume the same magnitude of SP and

simply dichotomize listed companies to SP and non-SP firms. However, the structure and magnitude of SP vary magnificently across firms, making its effect more complicated. Third, we don't investigate the relationship between SP and other determinants of E/P. Therefore, we reserve our inference as to the mechanism how SP affect E/P and focus on fact-finding. Fourth, although we focus on E/P in this paper given its popularity in practice, it is indecisive whether other fundamental measures are also affected by SP. Future research will help address these limitations and offer more convincing theory for the role of SP in stock market.

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Analyzing the Relationship between News Articles and Asset Price Fluctuations in the Chinese Stock Market through Sparse Composite Document Vectors

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Abstract This paper proposes a method of building a polarity dictionary using news articles and stock prices in the Chinese market by textual analysis in finance. In order to measure the degree of polarity, we associated the news articles' sparse composite document vectors to a score. The score is calculated by the method of event study with the abnormal change rate of stock prices on the publication date. We conducted support vector regression (SVR) and built a polarity dictionary with polarity data from learners. Furthermore, we made a comparison on accuracy to traditional ways of calculating word polarity in which news articles are represented by a one-hot wordlist. This polarity dictionary contributes to uncovering the relationship between textual information and stock markets.

Key words Asset Pricing, Natural language processing, Sentiment dictionary, Sparse Composite Document Vectors

1 Background

In recent years, a lot of news related to stocks has been posted on the Internet, and many empirical studies explaining the relationship between financial market fluctuations and news have been conducted. For example, As in (Tetlock, 2007), systematical studies on the interactions between media content and stock market activity and a straightforward measure of media content that appears to correspond to either negative investor sentiment or risk aversion were conducted. As in (Loughran, 2011), they found that almost three-quarters of negative word counts in 10-K filings based on the Harvard dictionary are typically not negative in a financial context. Common words like depreciation, liability, foreign, and board are not tonal when occurring in a 10-K.

There are a great number of studies focusing on polar dictionaries conducted by using one-hot lists as document vectors. As in (Goshima, 2017), they specialized in the financial field and proposed a method of building a sentiment dictionary using only news and stock price data for text analysis in finance. This study obtained word polarity from stock price fluctuations and calculated stock price returns following announcements in news articles. Then support vector regression was conducted to build a sentiment dictionary by extracting word polarity from learners. As in (Seki, 2017), they took advantage of news headlines and a given financial variable, such as stock prices, so as to generate initial sentiment lexicons. Then the initial lexicons were filtered based on their co-occurrences with financial seed words and subsequently expanded by analogical reasoning, using distributed representation of words. Evaluative experiments on around 12 years' worth of news data show that the resulting lexicons are mostly reasonable. Since detailed research on word polarity using stock price information is limited, we conducted this study based on information from China.

In order to make the polarity dictionary, we must construct an algorithm that allows us to accurately represent the relationship between sentences and stock price fluctuations. As in (Dheeraj Mekala, 2017), Sparse composite document vector (SCDV) is a feature vector formation technique for documents, which overcomes several shortcomings of the current distributional paragraph vector representations that are widely used for text representation. In this research, we attempt to construct a polarity dictionary with SCDV. We used daily data of the China stock market and news data to evaluate stock price fluctuations. To be more specific, we focused on the Shanghai market A shares and Shenzhen market A shares of mainland China. We attempted to calculate the degree of positivity or negativity of the word which emerged from the news articles by the daily return of the stocks that were mentioned in the news articles. By using the polarity

dictionary, we can make estimations of the stock price fluctuations, which can be helpful in decision-making for investors. In the following section, we describe data and methodology. Section 3 explains results. Then we conclude our discussion in Section 4.

2 Data and Methodology

2.1 Data

In order to create a word list in this research, news articles in 2014 (19,533 in total) which were posted on the Chinese financial information website, Hexun, was used. As Figure 1 shows, the stock mentioned in the news article has its code noted at the end. In other words, information on the stock is included in the news related to that stock.

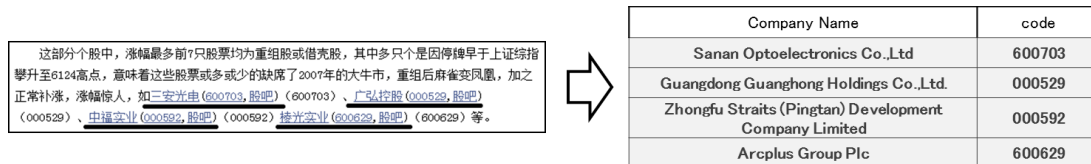


Figure 1 An example of news on hexun page

In addition, date and time of publication and the headlines of the news articles were extracted from the Hexun page. The data of the stock return and risk-factor return of each stock was used to evaluate the score of each news article. We used the daily data on the return of the stock prices provided by the Tonghuashun financial data online service system. Also, the data provided by China Central University of Finance and Economics¹ was used as the risk factor return data.

2.2 Method

In this study, the preparation of the training data set was mainly divided into two parts.

2.2.1 Scoring

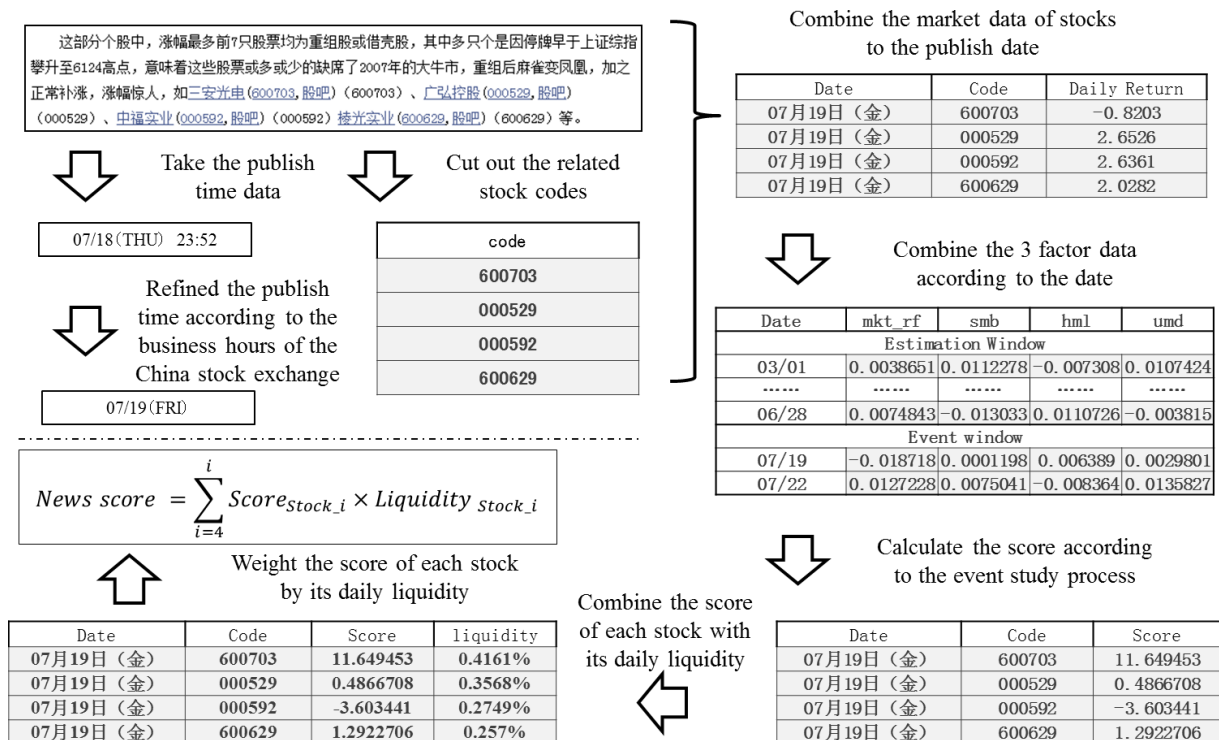


Figure 2 Scoring process

¹ China Central University of Finance and Economics; <http://sf.cufe.edu.cn/kxyj/kyjg/zgzcglyjzx/zlxzzq/98178.htm>

As Fig.2 shows, we adjusted the publish date and time of the news. First, the news which had been delivered after 15:00 was adjusted to the next day. News that were published during the weekends was adjusted to the following Monday. Next, the stock codes cut out from the articles are combined with the daily stock returns, and a score was attached to the news by event study analysis.

Event study is a method of analyzing how the disclosure of certain information (which means event) about a company affects its market value. As in (Mackinlay, 1997), using financial market data, an event study measures the impact of a specific event on the value of a firm. In this study, we set the estimation window and event window as follows:

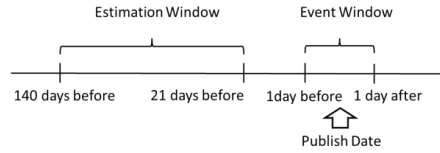


Figure 3 Estimation window and event window

As shown in Figure 3, the estimation window starts from 140 days before the publish date and ends 21 days before the publishing date, and lasts for 120 days. The event window starts from one day before the publication date and ends the day after the publication date. In the estimation window, we presume parameters of the Fama-French 3-factor model of each issue. As in (Fama, 1992), there are three stock-market factors: an overall market factor and factors related to firm size and book-to-market equity, which seems to explain average returns on stocks and bonds. Fama-French's three-factor model is as follows:

$$R(t) - RF(t) = a + b[RM(t) - RF(t)] + sSMB(t) + hHML(t) + e(t) \quad (1)$$

RF: Risk-free return rate

RM: Return of the market portfolio

SMB: Small market capitalization Minus Big market capitalization beta

HML: High book-to-market ratio Minus Low book-to-market ratio beta

Estimation was performed by linear analysis using Fama-French 3-factor model. By using the parameters presumed in the estimation window, we calculated the daily abnormal return AR (t) during the event window according to the following formula.

$$AR(t) = R(t) - RF(t) - [a + b[RM(t) - RF(t)] + sSMB(t) + hHML(t) + e(t)] \quad (2)$$

In order to obtain the cumulative abnormal return (CAR), we summed up every day abnormal return during the event window.

$$CAR[t1, t2] = \sum_{t=t1}^{t2} AR(t) \quad (3)$$

t1: The date of publication

t2: The day after publication

We then divided the cumulative abnormal returns by the standard deviation of the 3-factor model in the estimation window for standardization.

$$SCAR[t1, t2] = \frac{CAR[t1, t2]}{\sigma[t3, t4]} \quad (4)$$

t3: 140 days before the date of publication

t4: 21 days before the date of publication

In this study, we take the standardized cumulative abnormal return (SCAR) as the score of the news. For the news articles relating to several stocks, we weighted each stock's standardized cumulative abnormal return according to their liquidities.

$$liquidity = \frac{Trading\ volume}{number\ of\ listed\ shares} \times 100 \quad (5)$$

$$News\ score = \sum_{i=1}^n (Score_{stock_i} \times Liquidity_{stock_i}) \quad (6)$$

2.2.2 Wordlist

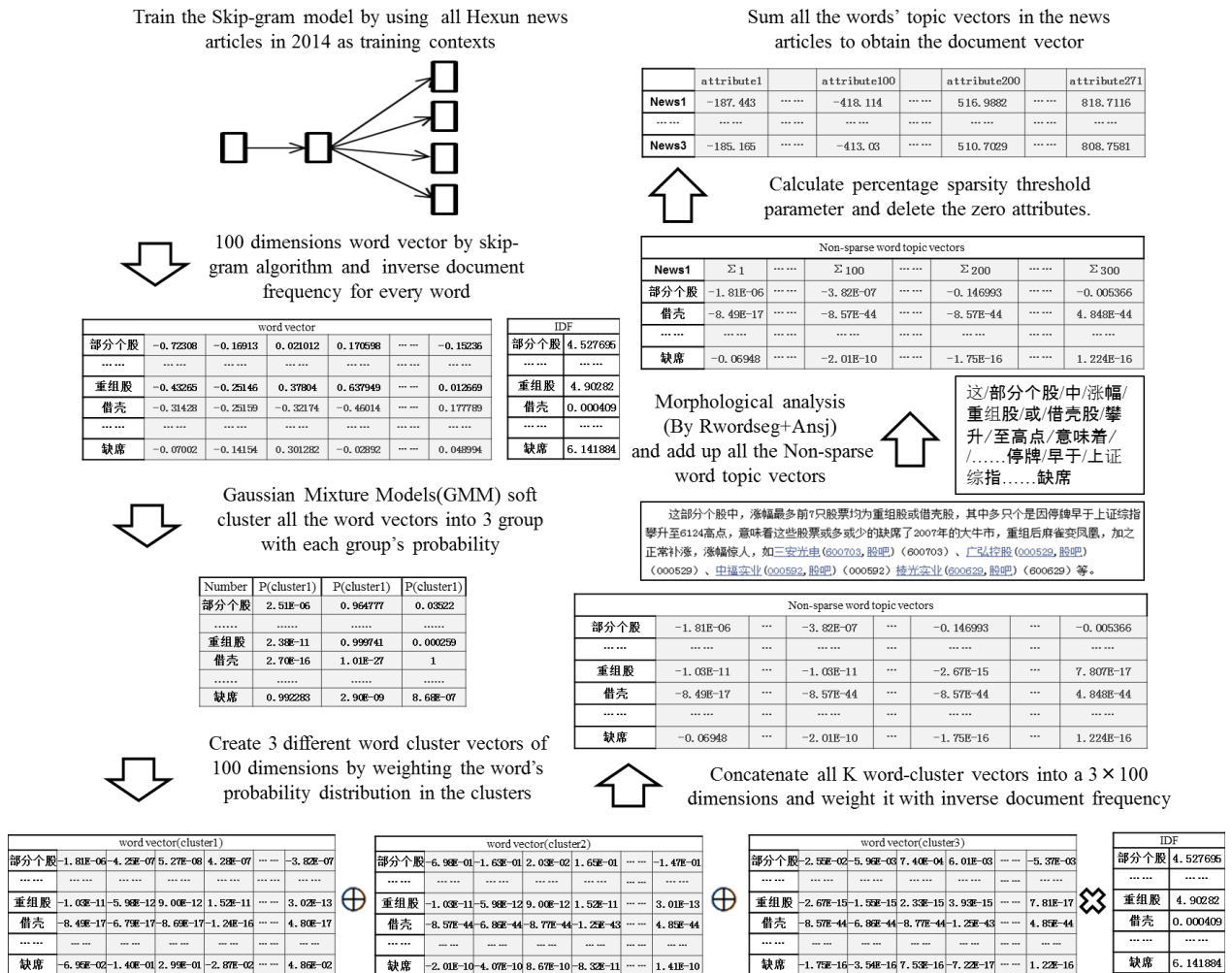


Figure 4 Process of making sparse document vector

Figure 4 indicates the process of creating a sparse document vector of Hexun news in 2014. Firstly, we trained the Skip-gram model by using all Hexun news articles in 2014 as training contexts and gathered the 100 dimensions word vectors from the skip-gram model. Gaussian mixture models (GMM) was used to soft cluster all the word vectors into 3 groups with each group's probability. After that, we created 3 different word cluster vectors of 100 (which means 300 attributes for each word) dimensions by weighting the word's probability distribution in the clusters. We concatenated all K word-cluster vectors into 3×100 dimensions and weighted it with inverse document frequency. Then, we summed all the words' topic vectors in the news articles to obtain the document vector. Since it can be observed that some attributes' values are very close to zero, we calculated percentage sparsity threshold parameters and deleted the zero attributes which results in the SCDV. For more details of the calculation of percentage sparsity threshold parameters, please refer to [5] in the references.

Finally, we incorporated the document vector of news articles with the score (SCAR) into the training data set.

In this process, Rwordseg packages for R as well as a morphological analysis tool called Ansj were used to separate the articles into words. In order to emphasize the identification of some terminological words, we utilized several cell dictionaries about bonds and stocks in economics and finance fields. The cell dictionary was provided by Sogou, the most widely used Chinese input method editor in China. In order to use skip-gram, we employed a word vector package for R.

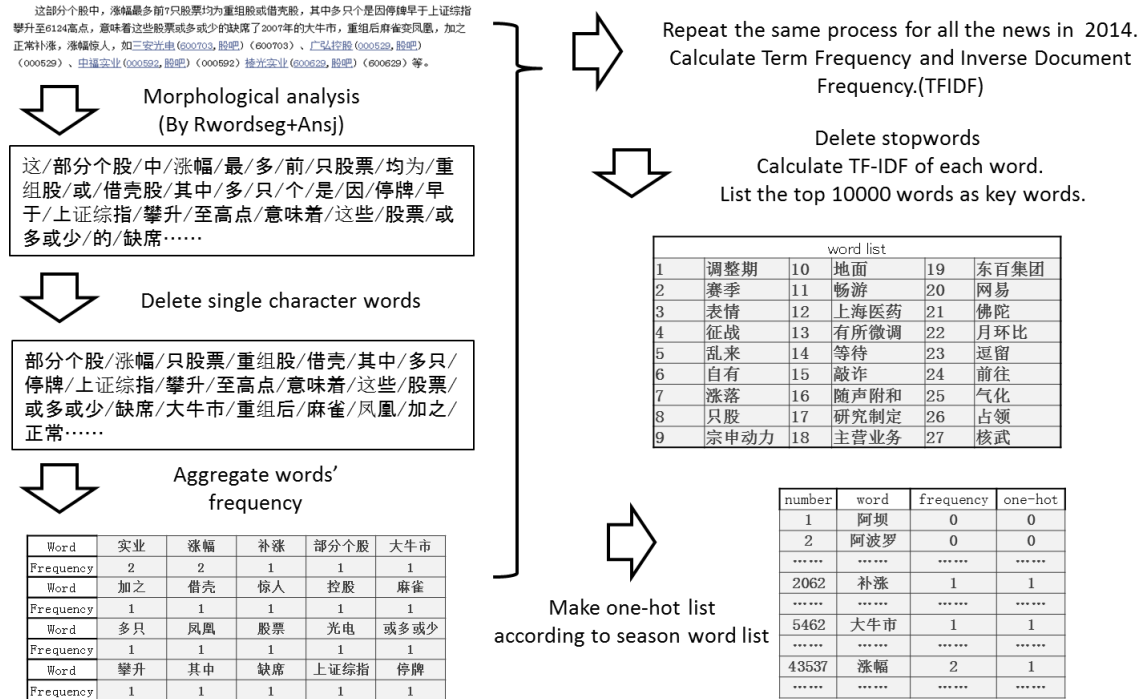


Figure 5 Process of making one-hot word list

In order to make a comparison, we also made news articles into one-hot lists using the process described in Figure 5. We calculated the TF-IDF value of the whole word list and used it to evaluate relative importance. The top 10,000 words were placed in the keyword list for further analysis. Referring to the keyword list, we created a frequency list and a one-hot list to represent each news article. In this research, a frequency list shows how many times the same words appeared in one news article. For one-hot lists, even if the same word appears multiple times in one news article, it will only be counted once. Finally, we incorporated the one-hot lists of news with the score (SCAR) into the training data set.

2.2.3 Method

In this study, we calculated 9,054 news article scores. We used 8,148 news articles as training data and 905 news articles as the validation dataset among all the news published in 2014. To determine the polarity of a word, we used a SVR (Support Vector Regression) learner to train the data for a regression model.

For the method of using SCDV to represent the news articles, we set the word-topics vector (made by concatenating all the three word-cluster vectors weighted according to its inverse document frequency) as input to the trained support vector regression models to create the word polarities.

For the method of using one-hot lists to represent the news articles, since the hyperplane from the support vector regression indicates the boundary between positive and negative, we measure the polarity of a word according to its distance from the hyperplane.

3 Results

3.1 Model

Using the word lists with polarities and the trained SVR model, we used a validation dataset to predict responses for observations (Table 1). The polarity sign predicted by the fitted model is compared to the sign of the real score of the news in the validation dataset. As table 1 show, the model using SCDV has a comparatively high accuracy of predicting the polarity sign rather than the model using one-hot lists.

Table 1 The Model's Accuracy of Predicting the Polarity Sign

Sector	support vector regression models (one-hot list)	support vector regression models (SCDV)
In sample test	50.8%	72.10%
Out of sample test	52.2%	70.60%

3.2 Polarity

By using the method mentioned in section 2.1.3, we made the polarity dictionary in two ways. First, let us begin with the method of using SCDV. As a result of putting the word-topics vector (made by concatenating all the three word-cluster vectors weighted according to its inverse document frequency) into the trained support vector regression models to create the word polarities, the calculated polarities varied from 1.84 to 1.71 and there is no word calculated to be minus. We simply ranked the calculated polarities and , as a result, words like the 20th ranked "自强" (Self-reliance), the 26th ranked "速战速决" (Quickly fixed), and the 30th ranked "喜气洋洋" (Jubilant) and some other words were extracted as optimistic. Negative words such as the 1st ranked "吃后悔药" (Regret deeply), 7th ranked "贬低" (depreciate), 22th ranked "不受欢迎" (unwelcome) were extracted as negative words. Since the variability of the word's polarities is quite narrow, improvement for the whole method is needed.

Turning now to the method employed for one-hot lists. Keywords with a positive polarity, the 1st ranked "拔高" (Pull up), the 7th ranked "安然无事" (Unscathed), and the 10th ranked "全面发力" (Full power) and some other words were extracted as optimistic. Keywords with negative polarity, the words used for expressing the feelings and psychological state such as 7th ranked "深表" (bitterly), 13th ranked "减仓" (deleveraging), 18th ranked "被禁止" (Prohibited) were extracted as negative keywords. Meanwhile, words with a negative meaning, such as "踟蹰不前" (Hesitate to move forward) at 2nd in the positive list appear to have a relatively high polarity in the positive.

Different ways of improvement can be enumerated, including revising training data and refining feature selection. Revision of the training data could take the form of training models with larger numbers of data samples, or using news articles written by reporters with higher credibility. A more precise calculation of Sparse threshold could be achieves by refining feature selection.

Using the word list and classification algorithm, we can estimate stock price fluctuations that follow the release of news articles. Since reading all the news published on the site is time-consuming, this kind of predictive ability helps investors make decisions.

4 Conclusions

In this research, we propose a method of making a financial polarity dictionary with SCDV. We used daily data from the China stock market and news data from the Shanghai market A shares and Shenzhen market A shares of mainland China. We attempted to calculate the degree of positivity or negativity of words emerging from the news.

We looked at the daily return of the stocks that were mentioned in the news articles by using support vector regression (SVR). We made a comparison of word polarity made by compiling one-hot wordlists based on the same news articles. As a result, we found that, compared to the model using one-hot word lists, the SVR model using SCDV had a relatively high accuracy rate for predicting polarity. Varieties of polarities seem limited and the way of calculating polarities from models needs to be improved. These results help uncover the relationship between textual information and stock markets and allow predictions to be made regarding stock price fluctuations, which can be helpful in decision making for investors.

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Estimating the Synergy Effect and Measuring its Impact through M&A by Using Fuzzy C Means

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Abstract To keep up with rapid changes in the business environment, Japanese companies have been required to conduct business restructuring in recent years. In this paper, we classified companies by using Fuzzy C Means, and estimated the synergy effect of multi-business companies based on that classification. In addition, we investigated the influencing factors inside companies when making a decision to sell a business, focusing on divestment through M&A. As the result of empirical analysis, we identified that companies are always conscious of their business performance or synergy effect, and the larger companies are more conscious of the synergy effect than the smaller companies. As the conclusion of this thesis, we determine that we can explore factors to consider when a company makes a decision to sell their business through the measurement of the synergy effect.

Key words Corporate Finance, Fuzzy C Means, Synergy Effect, Divestiture, Logit Model

1 Introduction

To keep up with rapid changes in the business environment, Japanese companies have required to conduct business restructuring in recent years. Formerly, it was a passive state for them to divest one of their businesses through M&A. Currently, more and more Japanese companies have been conscious of the benefits brought from divestment through M&A. Therefore, divestment is one of the positive strategies in sustaining their business. The time at which the companies think about selling their business is often a response to corporate's performance deterioration, in addition to restructuring conducted during acquisitions or bankruptcies. (John, Lang and Netter, 1992) indicated that, as a response to companies with their deteriorating performance, divestiture and subsidiary sales were the highest, followed by employment reduction and debt reduction.

Regarding multi-business companies, the word "conglomerate discount" is frequently used. This means that companies tend to be undervalued by the stock market compared with the pure-play companies. It is confirmed by (Berger and Ofek, 1995) in the United States and by (Nakano, Kubo and Yoshimura, 2002) in Japan. Although the multi-play companies are easy to receive negative evaluations in the stock market, synergy effects are said to be advantageous. Indeed, some multi-play companies have high evaluations. Such companies also have a higher enterprise value. While it has been said that companies need to be more conscious of their shareholders, it is thought that the multi-business companies have been more careful than before about their business structure and synergy effects. In this paper, we analyze the relationship between the synergy effects of the multi-business companies and M&A such as business transfer. The purpose of this study is to identify influential factors on making a decision to sell a business, focusing on divestment through M&A.

In this paper, we grouped Japanese companies by using Fuzzy C Means and calculated the synergy effects of the multi-play companies. After calculating the synergy effects, we analyzed the factors of the companies which sell their business through M&A, from the viewpoint within the companies, adding EBITDA/Asset and Debt/Asset to the synergy effects.

The remainder of the paper is organized as follows: In chapter 2, we delve into the previous research. In chapter 3, we describe data employed in this analysis. In chapter 4, we show our method. In chapter 5, we show how we conduct empirical analysis. In chapter 6, we show our result. Finally, we summarize this paper and describe the issues and discussions of this paper in Chapter 7.

2 Related Work

Corporate divestiture and asset purchase are methods that transfer a part of business from a company. There are various ways such as spin-off¹, curve-out², etc. in corporate divestiture and asset purchase. A lot of surveys verified that those methods improve the company's performance. The concentrating to other business and/or the removing of adverse effects of other business is the general reason why divestment can improve the company's performance and/or value. (Denis and Shome, 2005) researched the concentration of a company's main business. (Denis and Shome, 2005) says that companies which have reduced assets concentrate on more and more their business, resulting in the improvement of their productivity. (Dittmer and Shivdasani, 2003) researched the removing of adverse effects of other business. As in (Dittmer and Shivdasani, 2003), the divestment decreases a conglomerate discount. Furthermore, the improvement of business performance becomes bigger when investing in the remaining business after divestment. (Berger and Ofek, 1995) researched diversification. According to (Berger and Ofek, 1995), diversification decreases enterprise value. In addition to this, a proper diversification such as a tax deduction or an increase in debt ratio leads to more profits.

3 Data

We choose the companies listed on the first section of the Tokyo Stock Exchange as our target in this study. The number of the companies is 1210. The term for analysis runs from 2002 to 2016. Data was obtained from Nikkei NEEDS. In this paper, we exclude 1) companies that belong to the financial, securities and insurance industries, 2) companies that belong to the complex services, public service and classification-incompetent industries, and 3) companies about which we could not acquire data.

We obtained information about M&A from RECOF M&A Database. M&A database from RECOF offer M&A data, group M&A data, and M&A related data such as split or subsidiary stock acquisition data etc. We use only M&A section data to discover the features of companies that sell their businesses through M&A in this paper.

We construct the new industrial classification by Fuzzy C Means. In addition to this, we conduct empirical analysis and identify influence factors on making a decision to sell a business through M&A. The variables used are shown in Table 1 below.

Table 1 Descriptive statistics

Variable name	Mean	Median	Min	Max	Firm size	Sample size
Operating profit margin	0.059	0.048	-3.319	0.689	1,210	18,150
Capital adequacy ratio	0.487	0.482	-0.473	30.592	1,210	18,150
Total asset turnover	1.059	0.935	0.003	222.450	1,210	18,150
Sales growth	0.035	0.025	-0.895	100.058	1,210	18,150
Synergy effect ₍₋₁₎ /Enterprise value ₍₋₁₎	-0.035	0	-1.987	0.866	1,210	18,150
EBITDA ₍₋₁₎ /Sales ₍₋₂₎	0.105	0.087	-1.462	2.439	1,210	18,150
Debt ₍₋₁₎ /Asset ₍₋₂₎	0.527	0.528	0.022	5.551	1,210	18,150

4 Method

4.1 Estimation of Synergy Effect

We explain how to estimate the synergy effects used in this paper. We define the difference between the theoretical value (the sum of the values of business (segment) owned by a company) and the company's enterprise value. To estimate

¹ Carve out is a strategy, which involves the sale of equity or ownership shares in a division or unit, allowing the business to have a cash inflow up front. (Brealey, Myers and Allen, 2016)

² Spin-off involves having the business unit become a standalone or independent business, with its own shareholders and management, instead of selling just a share of the business unit as in carve out. (Brealey, Myers and Allen, 2016)

the synergy effects, we compare the difference between the pure-play companies and the multi-business companies.

We define companies with multiple businesses as the multi-business companies, and companies with only one segment as the pure-play companies. Only in the case of the multi-business companies, we can divide a company's value into the two parts: the sum of the segment's values, the value of synergy effects by combination of segments. Figure 1 shows the overall image. If the difference is positive, we call it a positive synergy effect, and if the difference is negative, we call it a negative synergy effect.

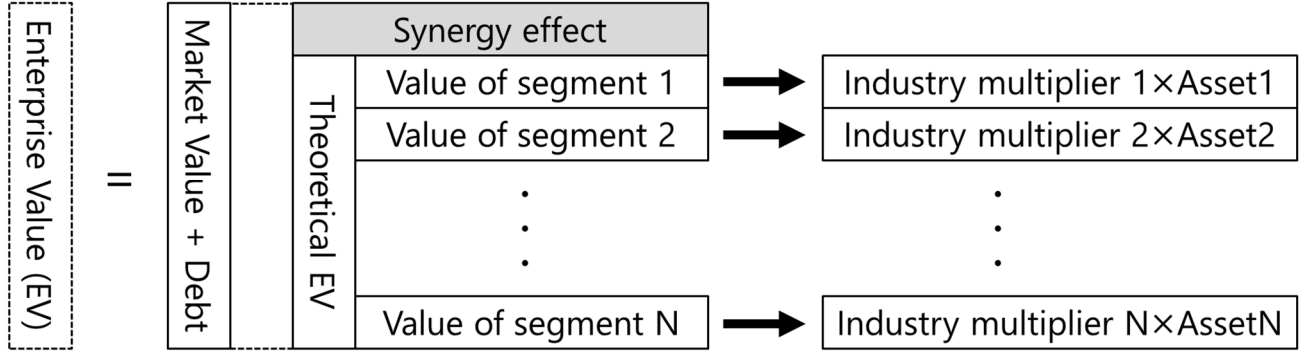


Figure 1 Image of synergy effect

We can calculate the enterprise value of a multi-business company i by market capitalization and its liability as shown in equation (1).

$$Enterprise\ value = market\ capitalization + liability \quad (1)$$

We can calculate the value of synergy effects as shown in equation (2), dividing the enterprise value into the value of synergy effect and the sum of the segment's value.

$$Value\ of\ synergy\ effect = Enterprise\ value - \sum\ value\ of\ segment \quad (2)$$

We define the value of each segment j owned by a multi-business company i by asset value of segment j and the average industrial multiplier ($IndM_{ij}$) to which segment j belongs as shown in equation (3).

$$Value\ of\ segment\ ij = multiplier\ of\ segment\ j\ (IndM_{ij}) \times asset\ value\ of\ segment\ j \quad (3)$$

We calculate an average industrial multiplier to which segment j belongs, using the pure-play companies which belong to segment j as shown in equation (4).

$$\begin{aligned} & multiplier\ of\ segment\ j\ (Industrial\ multiplier: IndM_{ij}) \\ & = median\left(\frac{Enterprise\ value\ of\ pure - play\ company}{Asset\ of\ pure - play\ company}\right) \end{aligned} \quad (4)$$

We calculate the value of synergy effects from the difference between the enterprise value totaling market capitalization and its liability as shown in (1) and the theoretical enterprise value calculated by replicating from the pure-play companies which belong to the same industry as segment j of the multi-business company i as shown in (3) and (4).

5 Analysis

In this paper, we identified the influential factors on making a decision to sell a business by using a logit model. The dependent variable for the logit model is a dummy variable that is set to 1 when the companies sold through M&A in each year, and 0 when it is not sold. The term for analysis runs from 2002 to 2016. The target companies of the analysis are 1,210 companies listed on the First Section of the Tokyo Stock Exchange.

The basic explanatory variables for the analysis are EBITDA/Sales, Debt/Asset, and Synergy effect/Enterprise value. We chose EBITDA/Sales as one of the explanatory variables as we thought that those companies had sold a business through M&A because of business deterioration. It is thought that companies with lower EBITDA/Sales will divest their business through M&A. We chose Debt/Asset since we thought companies with deterioration of business in terms of Debt/Asset would decide to divest through M&A in order to overcome the deterioration of business. With regard to Synergy effects/Enterprise value, we thought the multi-business companies with lower synergy effects would sell its no-synergy-effect business through M&A and such action was thought to enhance its synergy effects. The synergy effects of the multi-business enterprises use a variable calculated in equation (2) above, assuming that the pure-play enterprises are 0. In other words, synergy effects have not occurred.

In addition to these variables, we added two dummy variables and analyzed them. The variables added are 2007 Dummy and Scale 50. The 2007 Dummy is a dummy variable that is set to 1 after 2007. The aim of this variable is to identify changes by year. Scale 50 is a variable that is set to 1 in any case where the company's market capitalization is larger than the median market capitalization value in each year. The aim of this variable is to recognize the change by the size of a firm.

In terms of EBITDA/Sales and Debt/Asset, Synergy effect/Enterprise value, the numerator in the ratio is measured in year -1 and the denominator in year -2. This is because it is thought that the divestment of business is not decided by the results of a single year, but based on the results of multiple years. The period analyzed was over the 15 years from 2002 to 2016.

In this paper, we basically chose the optimal model from the fixed model, random effect model and the pooling model by using a log-likelihood test and the Hausman test. According to (Ota, 2013), however, the Hausman test is said to have some limitations, since the test is established under strict constraints. We can use a fixed effect model not only when there is a correlation between explanatory variables and unobservable company specific effects, but also when there is no correlation. Therefore, in this paper, when the Hausman test cannot be performed effectively, we will adopt a fixed effect model. Particularly in case of logit model, we analyzed by using conditional logit.

6 Results

The results of the logit model analysis are as shown in Table 2. Looking at the results of model [1] in table 2, the Debt/Asset is statistically significantly positive, and the Synergy effect/Enterprise value is statistically significantly negative. The fact that the Debt/Asset is positive implies that companies with higher proportion of debt in the balance sheet tend to sell their business at M&A. In addition, the fact that Synergy effect/Enterprise value is statistically significantly negative suggests that companies with lower synergy effects tend to make the decision to sell their businesses. When comparing the results of this paper with the results seen in (Schlingemann, Stulz and Walkling, 2002), which analyzed in the same way as this paper for the 15 years from 1979 to 1994, the results of both agree that companies may be selling through M&A in order to overcome deteriorating business performance and/or situation. Therefore, when analyzing over a long period of time, it can be said that the influential factors for companies to make a decision to sell their businesses are almost the same as in the past.

Model [3] is a model that adds 2007 dummy variables and confirms the interaction with Debt/Asset and 2007 Dummy. The results of the interaction variable were not statistically significant. The influence of proportion of debt does not appear to change from one year to the next. The proportion of debt always affects the decision to divest a business, but the degree

of its influence is relatively constant. Model [4] is a model that adds 2007 dummy and confirms the interaction with Synergy effect/Enterprise value. The results of the interaction variable were not statistically significant. This suggests that the impact of a lower Synergy effect on decision-making has not changed by year, as in the case of Synergy effect/Enterprise value. In other words, the ratio of Synergy effects always has an impact on decision-making with regard to divestment.

Model [6] is a model that adds a Scale 50 dummy and identifies the interaction with Debt/Asset and Scale 50. The outcome of the Debt/Asset is statistically significantly positive. The result of the interaction variable is statistically significantly negative. This suggests that the impact on the company making a decision to sell the business depends on the scale of enterprise. The smaller the company's size, the more the company takes into consideration the proportion of debt when they make decisions to sell their businesses. Conversely, the larger the company, the less proportion of debt influences decision-makings.

Model [7] is a model that adds Scale 50 dummy variables and confirms the interaction with the Synergy effect/Enterprise value and Scale 50. The outcome of the interaction variable is statistically significantly negative. This suggests that the impact of synergy effects on decision-making depend on the scale of the enterprise, as in the case of debt. That is, the results of model [7] suggest that larger companies tend to take into account synergy effects when they make a decision to sell their business, compared with smaller companies. In model [8], we added an interaction variable between 2007 Dummy and Synergy effect/Enterprise value, interaction variable between Scale 50 dummy and Synergy effect/Enterprise value. From this result, it can be inferred that the impact of synergy effects on decision-making depend on a company's scale, not on time factors. Finally, we analyzed model [9] with interaction variable of 2007 Dummy, Scale 50 dummy and Synergy effect/Enterprise value. The interaction variable was not statistically significant.

On the whole, companies are constantly conscious of their business performance or the composition of their business with regard to business divestiture decision-making. The results of empirical analysis also imply that larger companies are more conscious of synergy effects than smaller companies when it comes to divestiture.

Table2 logit regression results

The dependent variable = M&A and Whether or not sold									
Term=2002-2016									
	model	model	model	model	model	model	model	model	model
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
EBITDA ₍₋₁₎ /Sales ₍₋₂₎	-0.066	-0.081*	-0.080*	-0.080*	-0.726	-0.063	-0.744	-0.084*	-0.086*
Debt ₍₋₁₎ /Asset ₍₋₂₎	0.184***	0.138***	0.167**	0.138***	0.819***	0.290***	0.803***	0.134***	0.136***
Synergy effect ₍₋₁₎ /Enterprise value ₍₋₂₎	-0.119***	-0.118***	-0.116***	-0.102*	-0.473***	-0.128*	-0.162	-0.028	-0.040
2007 Dummy		-0.486***	-0.470***	-0.483***				-0.483***	-0.371**
2007 Dummy × Debt ₍₋₁₎ /Asset ₍₋₂₎			-0.095						
2007 Dummy × Synergy effect ₍₋₁₎ /Enterprise value ₍₋₂₎				-0.030				-0.031	-0.009
Scale 50					0.101	0.140	0.086	0.126	0.224
Scale 50 × Debt ₍₋₁₎ /Asset ₍₋₂₎						-0.156*			
Scale 50 × Synergy effect ₍₋₁₎ /Enterprise value ₍₋₂₎							-5.968*	-0.147*	-0.145
2007 Dummy × Scale 50 × Synergy effect ₍₋₁₎ /Enterprise value ₍₋₂₎									-0.007
R-square	0.001	0.005	0.005	0.005	0.001	0.002	0.005	0.005	0.005
Sample Size	18,150	18,150	18,150	18,150	18,150	18,150	18,150	18,150	18,150
Dependent variable : 1	1,293	1,293	1,293	1,293	1,293	1,293	1,293	1,293	1,293
Dependent variable : 0	16,857	16,857	16,857	16,857	16,857	16,857	16,857	16,857	16,857

(Note 1) Statistical significance is denoted with ***, **, and * for 1%, 5% and 10% percent rejection levels, respectively.

(Note 2) Values are partial regression coefficients.

(Note 3) All regressions are Fixed effect models.

7 Conclusion and discussion

In this research, in addition to estimating the synergy effects through constructing a new industrial classification, we attempted to investigate some factors that affect decision-making with regard to business divestiture. As a result of empirical analysis, we found that companies are always conscious of their business performance or composition of their business when they make a decision to divest their business. Moreover, the larger companies are more conscious of synergy effects when they make a decision to sell their business. In conclusion, we can discover what factors companies consider when making business-divestment decision through the measurement of the synergy effects.

Finally, we would like to present three issues in this paper. First, we do not consider the content of M&A. In this paper, we handled M&A as a whole. However, the word “M&A” has various meanings, such as transferring the business or accepting other’s capital alliance, and so on. And in the case of divestment through M&A, not only general companies, but also a fund or a consortium of companies will acquire a business. By analyzing with a more strict definition or case of divestment, we may be able to identify new factors that affect decision-making. Therefore, it is necessary to analyze by carefully examining those factors. Secondly, we need to make a more extensive analysis, which includes other factors. In this paper, we select EBITDA/Sale, Debt/Asset and Synergy effect/Enterprise value. There are still a lot of reasons why companies make a decision to divest their business. Therefore, we would like to and need to conduct analysis including various factors in the future. Finally, investigating the analysis method is the most important issue. Therefore, it is necessary to investigate the optimum method for verifying the hypothesis in the future.

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A Common-Weight DEA Approach to Evaluate the Performance Efficiency of Power Plants

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Abstract

Data envelopment analysis (DEA) has been employed to evaluate the relative efficiency of plants. This study aims to develop an approach based on common weights DEA and common weight global Malmquist productivity index (MPI) to evaluate relative performance of power plants. An empirical study with eight thermal power plants in Taiwan was used for investigation. The results have shown practical viability to find different insights of the plant efficiencies comparing to conventional DEA approach. Thus, the proposed approach can provide alternative findings to support the decision makers to investigate the performance efficiency of the power plants.

Keywords data envelopment analysis, common-weights, productivity change, Malmquist productivity index.

1 Introduction

Most of performance measurements are difficult to find the strict standards for evaluation, and thus rely on relative comparisons, cross sectional or time periods. For the former, a group of limited number of candidates can be selected and must be evaluated in a fair and consistent manner at the same time point. The latter is used to evaluate and compare a unit with itself at various time points. The results must identify the unit with best performance and the units with declining performance in order to make the necessary actions for improvements. In practice, multiple input factors and output factors are used to evaluate the performance efficiency. Data envelopment analysis, first introduced by Charnes et al. (1978), is a linear programming approach that does not require the predetermined weights of the input and output factors. DEA has been employed to evaluate the performance of decision making units (DMUs) in various contexts (Golany and Roll, 1989; Emrouznejad et al. 2008; Chen and Chien, 2011; Liu et al., 2013). In addition, Caves et al. (1982) proposed a Malmquist productivity index based on DEA framework to measure the productivity change of a DMU in time-series. Pastor and Lovell (2005) developed a global MPI which is obtained from all DMUs of all periods.

A number of studies have been done to employ DEA and MPI for evaluation in power industry. In particular, Chien et al. (2007) applied conventional DEA to investigate the performance efficiency of thermal plants. In the research, the CCR DEA and Malmquist productivity index were used to investigate eight thermal plants in Taiwan based on different multipliers. In addition, the authors also developed DEA models to evaluate the relative operating efficiency of 22 electricity distribution districts of Taiwan power company (TPC) in Taiwan and identified specific improvement directions for the inefficient districts. The authors also investigated the reorganization of the districts and the proposed organizational changes for improving their operating efficiency. Therefore, the authors conducted further study to improve the operational efficiency of the poorest district based on DEA analysis. Furthermore, we also developed effective data mining methodologies to help TPC for fault location on power distribution feeder to reduce the impact of electricity shortage and thus improve operational efficiency (Chien et al., 2002; Peng et al. 2004).

Using different sets of weights is suitable to classify the DMUs as efficient or inefficient. However, Rezaee et al. (2012) showed that the conventional development analysis may fail to discriminate among DMUs and the resulting efficiency scores may not be meaningful. Cook et al. (2014) addressed several issues related to using data envelopment analysis that if the conventional DEA is used as a pure benchmarking approach, the meaning of efficiency as a distance to the frontiers may no longer be valid. They also noted that the DEA score may no longer be referred to as production efficiency. Han et al. (2015) stated that the conventional DEA model is difficult to analyze the advantages and disadvantages of the DMUs. Munisamy and Arabi (2015) showed that the conventional DEA model used for calculating MPI are unable to distinguish the various technologies employed by the DMUs. Moreover, conventional DEA methods are unable to calculate the interval scale efficiency (Kao et al., 2011).

Thus, common weights (CW) can be employed to overcome these shortcomings (Roll and Golany, 1993; Cook & Zhu, 2007; Davoodi & Rezai, 2012). An idea of preferred order of factors for assessment of all DMUs is the first paper on common weights (Roll et al., 1991). Based on the common-weights DEA model, every DMU's efficiency is calculated on the same benchmark or facet that allows all DMU can be compared and ranked. Amin and Toloo (Amin and Toloo, 2007) proposed a method to determine a common set of weights for all DMUs. Liu and Peng (Liu and Peng, 2008) proposed a methodology to determine one common set of weights for performance indices of only DEA efficient DMUs. Kao (2010) applied common-weights DEA and MPI to evaluate the performance efficiency of Taiwan forests after reorganization. His model aimed to minimize distance between DMUs and ideal solutions. Wang and Chin (2010) proposed a method for cross-efficiency evaluation, which seeks the common set of weights for all DMUs. Omrani (2013) proposed an optimization approach to find common weights in DEA with uncertain data.

DEA models and MPIs based on common weights have been used widely for evaluating and ranking the relative efficiency of decision making units (Liu & Peng, 2008; Kao, 2010; Omrani, 2013; Kao & Hung, 2005; Cook and Zhu, 2007; Jahanshahloo et al., 2010; Lotfi et al., 2013; Hatami-Marbini et al., 2015). However, few studies have been done on the relative efficiency and the productivity change of power plants. Thus, this study aims to develop an approach based on common weight DEA and common weight global Malmquist productivity index (MPI) to investigate the performance of power plants and conducted the same empirical study with eight thermal power plants in Taiwan which we investigated based on conventional DEA and MPI. The results have showed some different performance efficiencies of the plants compared to conventional DEA approach. Moreover, the study aims to diversify methods and to aid the decision makers to enhance the performance efficiency of the power plants.

The rest of this paper is organized as follows. Section 2 addresses the fundamentals and methodology of this study including common-weights DEA model and Malmquist productivity index. Section 3 describes an empirical case on the productivity changes of thermal power plants in Taiwan. Section 4 summarizes the results and discussions. Finally, section 5 concludes with the contributions and future research directions.

2 Fundamental and Methodology

2.1 DEA model for power plants

This section addresses distance function and DEA model for evaluation. The process of electricity generation transforms resources into energy. A transformation model was constructed by Chien et al. (2007) as follows.

With a given observation set $Q = \{(x_1, y_1), (x_2, y_2), \dots, (x_{|R|}, y_{|R|})\}$, where $x_h \in \mathfrak{R}_+^n$ and $y_h \in \mathfrak{R}_+^m$ for $h \in R$ as the input vector and the output vector respectively, the empirical production technology $\hat{\Gamma}$ derived from the observation set can be expressed as a set of linear inequalities in nonnegative variables as follows.

$$\hat{\Gamma} \equiv \left\{ \begin{array}{l} (x, y) : \sum_{k \in R} x_k \tau_k \leq x, \sum_{r \in R} y_r \tau_r \geq y, \\ \sum_{k \in R} \tau_k = 1, \tau_k \geq 0, k \in R \end{array} \right\} \quad (1)$$

For any (x_k, y_k) corresponding to the empirical production technology $\hat{\Gamma}$, the output distance function, $D_O(x_k, y_k)$, can be estimated as follows.

$$\begin{aligned} [D_O(x_k, y_k)]^{-1} &= \text{Max} \theta \\ \text{Subject to} \\ \sum_{h \in R} x_{lh} \lambda_h &\leq x_{lk} \quad l = 1, \dots, n \\ \sum_{h \in R} y_{gh} \lambda_h &\geq \alpha y_{gk} \quad g = 1, \dots, m \\ \sum_{h \in R} \lambda_h &= 1 \\ \lambda_h &\geq 0, h \in R \end{aligned} \quad (2)$$

Assuming constant returns to scale, a popular output-oriented CCR DEA model for evaluating overall efficiency is as follows.

$$\begin{aligned} &\text{Max} \alpha \\ \text{Subject to} \\ \sum_{h \in R} x_{lh} \lambda_h &\leq x_{lk} \quad l = 1, \dots, n \\ \sum_{h \in R} y_{gh} \lambda_h &\geq \alpha y_{gk} \quad g = 1, \dots, m \\ \lambda_h &\geq 0, h \in R \end{aligned} \quad (3)$$

The ratio $1/\alpha^*$ is considered as the efficiency E_k^{CCR} (Banker, Charnes, and Cooper, 1984).

2.2 Common weights approach

2.2.1 Common-weights DEA

Step 1: Calculate the ideal efficiency for every DMU

Model (3) can be rewritten as input-oriented multiplier CCR DEA model for calculating ideal efficiency of DMU k as follows.

$$\begin{aligned}
E_k^{CCR} &= \text{Max} \quad \sum_{j=1}^m u_{jk} y_{jk} \\
\text{s.t.} \quad & \\
& \sum_{j=1}^m u_{jk} y_{jr} - \sum_{i=1}^n v_{ik} x_{ir} \leq 0, \quad r=1,2,\dots,R \\
& \sum_{i=1}^n v_{ik} x_{ik} = 1 \\
& u_{jk} \geq \varepsilon > 0, \quad j=1,2,\dots,m \\
& v_{ik} \geq \varepsilon > 0, \quad i=1,2,\dots,n
\end{aligned} \tag{4}$$

where u_{jk} and v_{ik} are weighting factors; and ε is a number.

Step 2: Derive a common set of weights

Based on the model by Kao (2010), a total least squared difference between the efficiencies obtained by Model (4) and the efficiencies based on a set of common weights model is constructed as follows.

$$\begin{aligned}
\text{Min} \quad & \sum_{r=1}^R (E_r^{CCR} - \sum_{j=1}^m u_j y_{jr} / \sum_{i=1}^n v_i x_{ir})^2 \\
\text{s.t.} \quad & \sum_{j=1}^m u_j y_{jr} - \sum_{i=1}^n v_i x_{ir} \leq 0, \quad r=1,\dots,R \\
& u_j \geq \varepsilon > 0, \quad j=1,2,\dots,m \\
& v_i \geq \varepsilon > 0, \quad i=1,2,\dots,n
\end{aligned} \tag{5}$$

where E_r^{CCR} is the ideal efficiency score of DMU r . The common weights are the optimal solution (v_i^*, u_j^*) obtained from Model (5).

Step 3: Calculate the common-weights efficiency of DMUs

The common-weights efficiency of DMU k is calculated as

$$E_k^{CW} = \sum_{j=1}^m u_j^* y_{jk} / \sum_{i=1}^n v_i^* x_{ik} . \tag{6}$$

2.2.2 Common-weights global Malmquist productivity index

Step 1: Calculate the ideal global efficiencies of every DMU k at every period l , \hat{E}_k^l

A mathematical model for calculating the global efficiency of DMU k at period l , \hat{E}_k^l , is as follows.

$$\begin{aligned}
\hat{E}_k^l &= \text{Max} \quad \sum_{j=1}^m u_{jk}^l y_{jk}^l \\
\text{s.t.} \quad & \sum_{i=1}^n v_{ik}^l x_{ik}^l = 1 \\
& \sum_{j=1}^m u_{jk}^l y_{jr}^t - \sum_{i=1}^n v_{ik}^l x_{ik}^t \leq 0, \quad r=1,\dots,R; t=1,\dots,T \\
& u_{jk}^l \geq \varepsilon > 0, \quad j=1,2,\dots,m \\
& v_{ik}^l \geq \varepsilon > 0, \quad i=1,2,\dots,n
\end{aligned} \tag{7}$$

where superscript t represents period t in T periods. Based on Model (7), the ideal global efficiencies of every DMU at all periods are calculated for next step.

Step 2: Derive a common-weights

Similar to the method to generate a set of common-weights for calculating the efficiency, a mathematical model based on minimizing the total squared difference between the global efficiency and the ideal global efficiency \hat{E}_k^l is constructed as follows.

$$\begin{aligned} \text{Min} \quad & \sum_{t=1}^T \sum_{r=1}^R (\hat{E}_r^t - \sum_{j=1}^m u_j y_{jr}^t / \sum_{i=1}^n v_i x_{ir}^t)^2 \\ \text{s.t.} \quad & \sum_{j=1}^m u_j y_{jr}^t - \sum_{i=1}^n v_i x_{ir}^t \leq 0, \quad r = 1, \dots, R; \quad t = 1, \dots, T \\ & u_j \geq \varepsilon > 0, \quad j = 1, 2, \dots, m \\ & v_i \geq \varepsilon > 0, \quad i = 1, 2, \dots, n \end{aligned} \quad (8)$$

The optimal solution (v_i^*, u_j^*) is generated based on Model (8) is used to calculate the common-weights global MPI in Step 3.

Step 3: Calculate the common-weights global MPI for DMU k

Based on the common set of weights derived by Model (5.8), the global MPI based on common weights for DMU k is calculated as Formula (9).

$$MPI_k^{CWG} = (\sum_{j=1}^m u_j^* y_{jk}^{t+1} / \sum_{i=1}^n v_i^* x_{ik}^{t+1}) / (\sum_{j=1}^m u_j^* y_{jk}^t / \sum_{i=1}^n v_i^* x_{ik}^t) \quad (9)$$

3 Case Study of Taiwan Power Company

This study employed the common weights approach to evaluate the relative efficiency of Taiwan power plants that is compared with the results obtained by conventional DEA.

3.1 Problem description and input data

The problem is to evaluate the efficiency of Taiwan power company which has 8 plants including HSIEH HO, HSINTA, PENGHU, LINKOU, SHENAO, TUNGHSIAO, TALIN, , and TAICHUNG. These plants are considered with the same outputs and inputs factors as shown in Table 1. The input factor are used for the evaluation including the total installed capacity, the total employee, and the total production cost. The total energy generation is used as the output factor. Table 1 shows the annual data from year 1994 to 1999 of the plants.

Table 1 The Annual Data of Eight Plants from 1994 to 1999

DMUs (year_Plant)	Inputs			Output
	Total installed capacity (MW)	Total employees (people)	Total production cost (thousand NT dollars)	Total energy generation (million KWH)
1 94HSIEH HO	2,000,000	471	12,426,374	12,844,387
2 94LINKOU	785,000	411	3,740,374	3,134,802
3 94SHENAO	400,000	304	1,797,876	1,627,436
4 94TAICHUNG	2,480,000	601	10,702,695	15,634,561
5 94HSINTA	2,100,000	633	9,454,532	14,292,521
6 94TALIN	2,572,000	616	12,038,804	10,582,045
7 94TUNGHSIAO	1,434,800	502	6,279,922	5,351,084
8 94PENGHU	49,000	133	397,607	177,834
9 95HSIEH HO	2,000,000	463	11,137,805	12,164,582
10 95LINKOU	785,000	401	3,442,390	3,376,350
11 95SHENAO	400,000	300	2,163,748	2,695,445
12 95TAICHUNG	2,480,000	689	8,525,404	15,625,863
13 95HSINTA	2,100,000	628	8,775,653	14,372,381
14 95TALIN	2,572,000	596	15,370,834	13,106,630

15	95TUNGHSIAO	1,415,800	496	5,888,324	5,284,628
16	95PENGHU	49,000	136	384,854	185,272
17	96HSIEHHO	2,000,000	452	11,357,979	11,308,192
18	96LINKOU	785,000	396	4,122,219	3,609,760
19	96SHENAO	400,000	295	2,707,973	2,718,372
20	96TAICHUNG	4,130,000	748	14,562,602	20,989,734
21	96HSINTA	2,100,000	658	10,073,417	14,369,615
22	96TALIN	2,572,000	587	15,322,094	13,482,091
23	96TUNGHSIAO	1,415,800	500	6,842,696	5,820,682
24	96PENGHU	49,000	134	447,771	203,563
25	97HSIEHHO	2,000,000	441	13,176,426	11,366,716
26	97LINKOU	785,000	389	4,133,172	3,591,961
27	97SHENAO	400,000	284	2,604,523	2,433,095
28	97TAICHUNG	4,680,000	763	17,086,873	27,276,122
29	97HSINTA	3,450,000	672	10,765,872	13,933,042
30	97TALIN	2,572,000	571	15,366,966	12,118,518
31	97TUNGHSIAO	1,415,800	489	7,376,071	6,434,761
32	97PENGHU	68,000	127	550,454	215,350
33	98HSIEHHO	2,000,000	430	13,796,449	10,861,879
34	98LINKOU	1,085,000	374	3,739,516	3,353,206
35	98SHENAO	400,000	278	2,714,390	2,495,479
36	98TAICHUNG	4,680,000	773	19,263,112	31,882,084
37	98HSINTA	3,942,000	694	9,673,218	12,807,162
38	98TALIN	2,572,000	557	16,293,807	12,489,778
39	98TUNGHSIAO	1,415,800	487	8,043,396	6,302,397
40	98PENGHU	74,000	128	761,849	229,887
41	99HSIEHHO	2,000,000	416	14,623,243	12,278,147
42	99LINKOU	1,085,000	360	3,736,215	3,124,663
43	99SHENAO	400,000	260	2,903,658	2,707,368
44	99TAICHUNG	4,680,000	782	18,494,116	33,039,905
45	99HSINTA	4,625,950	690	10,066,447	13,719,380
46	99TALIN	2,572,000	546	15,062,788	12,249,144
47	99TUNGHSIAO	1,628,500	478	9,086,701	7,621,805
48	99PENGHU	74,000	124	831,826	248,335

3.2 Input and output factors

According to the guidelines in the TPC Responsibility Center System (TPC, 1998) and Profitability Center System (TPC, 1998), this study uses total energy generated as the output factor and total installed capacity (MW), total number of employees, and total production cost as input factors in the DEA models. The total energy generated is the major output since the function of the plants is to supply electricity to meet demand. Installed power generation capacity is a fundamental input factor that differentiates plant productivity. Meanwhile, total number of employees is an important input, and, in fact and indeed, personnel cost is also a critical input factor in state-owned enterprises. Production cost, including operating expenditures, fuel expenditures and maintenance expenditures, is the input factor that covers the cost of supporting and maintaining plant operations. The value is derived from annual reports and adjusted by the wholesale price index (WPI), similar to the well-recognized producer price index (PPI), to constant dollars.

Table 1 lists the annual data of eight plants used in this study from 1994 to 1999. Using annual data can reduce the influence of seasonal effects. Moreover, considering six time periods can effectively evaluate the productivity change of the plants along the time.

4 Results and discussion

The proposed models were run on Lingo for solving the current instance. The efficiencies of the power plants, which are considered as different DMUs at different time periods, based on the CCR DEA and Common-weights DEA as shown on Column 3 and 4 respectively in Table 2. In Column 3, according to Model (4), each

DMU derived its best multipliers to calculate the efficiency. For example, the weights of 95TAICHUNG and 99TAICHUNG are $v1 = 1.10E-08$, $v2 = 6.61E-05$, $v3 = 1.09E-07$, $u = 6.40E-08$, and $v1 = 7.22E-08$, $v2 = 4.32E-04$, $v3 = 1.75E-08$, $u = 3.03E-08$ respectively.

Even with the same plant in different periods but they used the different weights to evaluate for their performance efficiency. In other approach, Common-weights DEA in column 4, based on Models (4) and (5), all plants used the same or common weights ($v1 = 0.6871$, $v2 = 0.1E-07$, $v3 = 0.0039$, $u = 0.0995$) to compare and evaluate each other. In general, the performance efficiencies of DMUs based on CW DEA are less than one based on CCR DEA method. As can be seen on Column 3 in Table 2, there are two DMUs with the same score of 1 that means both are efficient. However, based on CW DEA, only one DMU TAICHUNG in year 1999 is efficient as shown on column 4 of Table 2. The efficiencies of DMU TAITUNG in 1995 are different by two methods, where it indicated efficient has changed into inefficient according to CW DEA and ranked 10. As illustrated in previous section of new approach and with the differences of the result between two approaches implies that decision makers should base on the proposed common weights approach to avoid mistakes or to have better decisions in improving the performance efficiency of the power plants.

Table 2 Efficiencies of the Power Plants

Year	DMUs	CCR DEA Efficiency	CW DEA	
			Efficiency	Rank
94	94HSIEHHO	0.9097	0.8983	9
	94LINKOU	0.5657	0.5631	37
	94SHENAO	0.5763	0.5746	35
	94TAICHUNG	0.8930	0.8912	11
	94HSINTA	0.9640	0.9611	5
	94TALIN	0.5828	0.5804	32
	94TUNGHSIAO	0.5283	0.5270	39
	94PENGHU	0.5141	0.5024	41
95	95HSIEHHO	0.8615	0.8538	13
	95LINKOU	0.6092	0.6078	31
	95SHENAO	0.9545	0.9468	7
	95TAICHUNG	1.0000	0.8951	10
	95HSINTA	0.9694	0.9682	2
	95TALIN	0.7218	0.7137	22
	95TUNGHSIAO	0.5287	0.5281	38
	95PENGHU	0.5356	0.5241	40
96	96HSIEHHO	0.8009	0.7932	18
	96LINKOU	0.6514	0.6466	27
	96SHENAO	0.9626	0.9477	6
	96TAICHUNG	0.8019	0.7216	21
	96HSINTA	0.9692	0.9647	3
	96TALIN	0.7425	0.7342	20
	96TUNGHSIAO	0.5823	0.5795	33
	96PENGHU	0.5885	0.5718	36
97	97HSIEHHO	0.8050	0.7933	17
	97LINKOU	0.6481	0.6434	28
	97SHENAO	0.8616	0.8494	15
	97TAICHUNG	0.8921	0.8269	16
	97HSINTA	0.7147	0.5747	34
	97TALIN	0.6674	0.6599	25
	97TUNGHSIAO	0.6438	0.6393	29
	97PENGHU	0.4486	0.4384	45
98	98HSIEHHO	0.7693	0.7568	19
	98LINKOU	0.4895	0.4390	44
	98SHENAO	0.8837	0.8699	12
	98TAICHUNG	0.9744	0.9623	4

	98HSINTA	0.7267	0.4641	42
	98TALIN	0.6878	0.6788	23
	98TUNGHSIAO	0.6305	0.6245	30
	98PENGHU	0.4400	0.4249	46
99	99HSIEHHO	0.8696	0.8535	14
	99LINKOU	0.4564	0.4091	48
	99SHENAO	0.9587	0.9413	8
	99TAICHUNG	1.0000	1.0000	1
	99HSINTA	0.7496	0.4243	47
	99TALIN	0.6746	0.6675	24
	99TUNGHSIAO	0.6629	0.6570	26
	99PENGHU	0.4754	0.4567	43

On the other hand, the eight plants are evaluated based on each period as shown in Table 3. HSINTA and TAICHUNG are the large plants which their capacities in year 1994 were 2,100,000 MW and 2,480,000 MW respectively. As shown in Table 3, the HSINTA power plant was efficient and be the best performance one in the first three year from 1994 to 1996, but became inefficient after that year. In contrast, TAICHUNG was efficient in the last three years after increasing its capacity, although its efficiency score was only 0.745 in year 1996. In addition, small plant PENGCHU had poorly performance with lowest efficiency. A medium plant, LINKOU, it did not perform well in 1994, but by changing operations, i.e. reducing the total employees and increasing total production cost and total energy generation, it has increased more efficiency scores.

Table 3 Efficiencies Based on the Common-Weights DEA and CCR for Each Period

DMU	94	95	96	97	98	99
HSIEHHO	0.9439	0.8891	0.8280	0.9430	0.7667	0.8436
LINKOU	0.5861	0.6276	0.6690	0.7660	0.4591	0.4098
SHENAO	0.5964	0.9818	0.9830	1.0000	0.8822	0.9305
TAICHUNG	0.9266	0.9208	0.7450	1.0000	1.0000	1.0000
HSINTA	1.0000	1.0000	1.0000	0.6970	0.4900	0.4270
TALIN	0.6047	0.7449	0.7670	0.7870	0.6912	0.6630
TUNGSHIAO	0.5478	0.5452	0.6000	0.7640	0.6397	0.6532
PENGCHU	0.5267	0.5438	0.5750	0.5010	0.4181	0.4456

Furthermore, operating during six-year time, production technology of plants might have changed. The global Malmquist productivity index based on common-weights is used for evaluating the productivity changes. For calculating the annual changes, a base time period is set as year 1994. According to Model (8), a common-weights for global MPI was derived. Since M_k^{CWG} of all power plants in all periods are calculated based on the same frontier facet or multipliers, so they can be compared together. The productivity changes can be seen clearly from Figure 1. In general, after six-year period, four plants have increased their productivities, and the last four plants have reverse direction. With slight enlarge in total installed capacity at the end year, TUNGSHIAO has increased their productivity more than 20 percent in 1999. SHENAO with unchanged total installed capacity and 40 employees cut-down is the best plant in which its productivity change has increased significantly 64 percent compared to year 1994. This means the plant has changed in way of operations to maximize the efficiency.

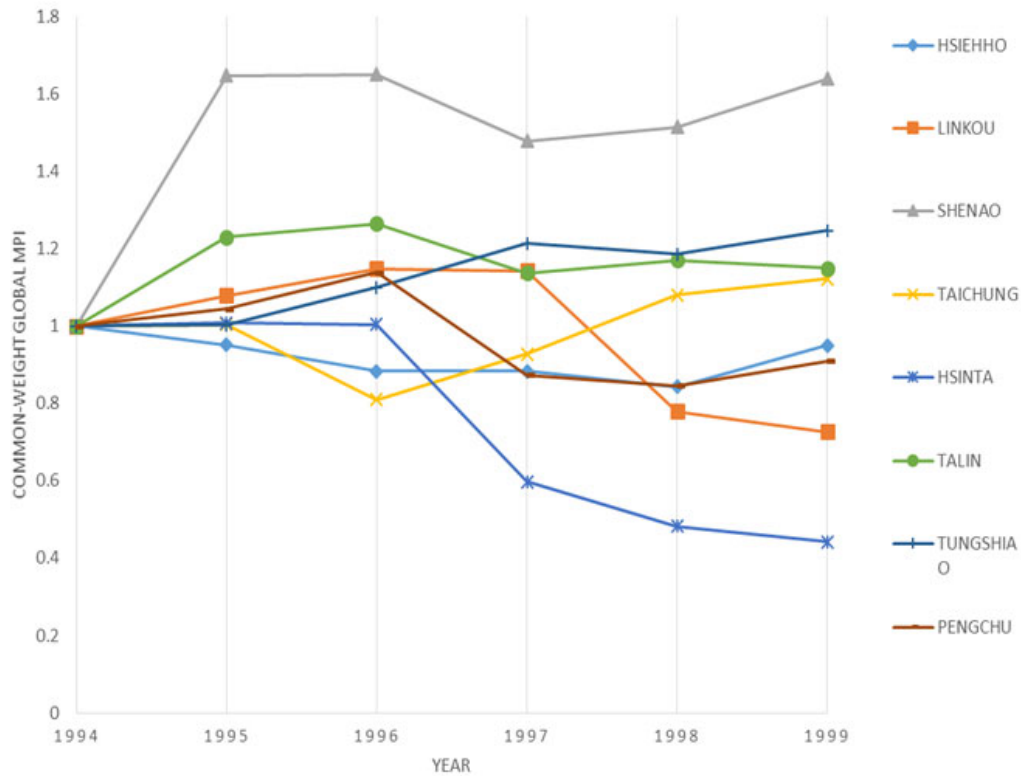


Figure 1 The Productivity Changes of Plants over Years

According to Chien et al. (2007), PENGCHU had increased its productivity up to 50 percent in 1998. However, based on common weights global MPI, it decreased 8 percent compared to year 1994. Similarly, TAICHUNG was evaluated 11 percent increase in 1996, but in new approach, it decreased 8 percent at this year. These differences are caused by using the different weights for calculating the efficiency in the conventional approach. For more detail, PENGCHU used $v_1 = 0.1351$, $v_2 = 0.1E-06$, $v_3 = 0.1E-06$, $u = 0.0198$ to calculate the performance efficiency in 1998, but in 1994, another weights are $v_1 = 0.2041$, $v_2 = 0.1E-06$, $v_3 = 0.1E-06$, $u = 0.0299$ be used. Similarly, TAICHUNG plant used two different set of weights in 1996 and 1994 including $v_1 = 0.0896$, $v_2 = 0.0004$, $v_3 = 0.0211$, $u = 0.0476$ and $v_1 = 0.2508$, $v_2 = 0.5E-05$, $v_3 = 0.0059$, $u = 0.0064$ respectively. That means they were not compared at the same facet, so the result might be not proper. Thus, calculating the MPI of a DMU based on different frontier facets may derive misleading result. In addition, calculating proposed MPI base on the same facet that makes them comparable.

5 Conclusion

This study proposed an approach based on common-weights DEA and common weights global MPI to evaluate and compare the performance efficiencies and the productivity changes. The common set of weights is obtained by minimizing the total squared difference between the ideal efficiency and that of each DMU obtained from the common set. Comparing to conventional DEA, this approach has provided a common basis for comparison. Indeed, the proposed approach was compared with the conventional DEA and MPI based on an empirical study conducted for evaluating relative performance of power plants in Taiwan. The results have shown the advantages of the common-weights approach to compare all DMUs based on a common frontier facet. Furthermore, the different results between the proposed approach and conventional DEA approaches can also

provide more insights to support the decision makers for evaluating the performance efficiencies and productivity changes.

In addition to comparing the relative performance indices of power plants from the common weights DEA and common weight global MPI, more studies should be done to employ the proposed approaches in various decision contexts. This study used non-linear model to obtain the common set of weights that is complicated. Future study can be done to develop better approach to generate the common weights. In addition, DEA approach has been extended to evaluate the efficiency of systems with the same process repeatedly. More studies can be done to employ the proposed common weights approach for evaluations in these systems and thus improve this approach in different settings.

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Room A

Session – 11

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A Review of Talent Adaptive Concept and Proposed Accelerated Talent Adaptation Framework in Civil Servant Exchange Policy in Malaysia

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Abstract: Befitting the current practice in developing talent thru mobility, the government allow civil servants to work in different division; ministry; or department; after three to five years working in a specific post, following request for transfer or promotional activities. However, job transition requires relevant civil servants to learn new tasks and procedures during adaptation by reading through government documents as well as learning industrial knowledge that usually acquired by being on the job and takes longer time before the civil servants are fully ready to perform their job duties. Using eight-dimensional adaptive performance establish by Pulakos et. al (2000) as the foundation, this study intends to explain the critical factors in job adaptation as well as building suitable framework that speed up talent adaptation process. Through case study in a government ministry and semi-structured interview to selected respondents, accelerated adaptation framework for civil servants is proposed.

Keywords: Talent, Adaptation, Civil servant.

1. Introduction

In talent management, it has been found that job burnout contributes to high employee turnover where by transferring out of the organization, the effect of job burnout can be resolved. Following the practice and in order to ensure deliverance of good job performance, government officers are allowed to move internally or externally following 3 to 5 years or 8 years following initial job placement. However, following transfer to a new place, the employee needs to go through a series of boarding/orientation and training in order to face new challenges following the change.

Job mobility is an important aspect for young employees' career development (Topel & Ward, 1992). In order to ensure that internally and externally mobile officers would be able to perform well in new tasks, development of talent is fundamental to alleviate the effects of job transition. For talent development that fit organizational values, the concept of corporate university has been introduced as a process where employees undergo learning processes to

deliver better job performance as well as boost business delivery (Phillips & Phillips, 2004; Zulhasni et. al, 2015). Other than corporate university, the concept of team learning has also been introduced where it has been proven that team leader coaching and team members communication helps in group learning (Schaubroeck et al., 2016). However, having to embark on series of learning takes time and incur cost to an organization where there is more prevailing necessity to have government officers especially those in junior management level and in small organization to be able to perform their duties instantly and this situation necessitates other option in talent development approach.

2. Individual talent adaption and performance

In a review by (Lee et al., 2014), there are six clusters relating to career within the field of management studies are highly influential to be studied, namely, international careers, career management, career choice, career adaptation, individual and relational career success and life opportunities. It is also proven that there is a connection between adaptation to work and job performance. Performance of an individual, team or organization cannot just be attained through utilizing a structured performance management system but also through implementing good performance management processes (Rahim et. al, 2015). Concentrating on just performance management structure can produce work anxiety where the practice of not clearly giving feedback for performance, inconsistencies in performance management implementation, spending insufficient time for performance management, understanding roles in performance management as well as competence of individual manager were found to be underlying problems for performance (Blackman et al., 2015).

Most studies have concentrated on psychological aspects of adaptability in work environment where exploring further, a theory for career adaptability has been proposed where employees are thought to be able to run through job tasks well and experience better transition to changes in work environment (Savickas, 1997). Career adaptability has positively significant impact to job performance (Ohme & Zacher, 2015). Studies also focus on individual adaptation by establishing adaptive performance to study the underlying behavior in job adaptation (Campbell et al., 1993; E. Pulakos et al., 2000). There are also a few studies were carried out in the area of organizational adaptation where, for example, a study has shown that organizational adaptation affects work performance rather than individual's adaptation (Dollard et al., 2013; Zulhasni & Nooh, 2015). Findings of this study outlines the issues and

factors that can enhance civil servant's talent development in adapting to new work environment in Malaysian government ministries.

3. The challenges of talent adaptive for Malaysia civil servants

World's labor participation rate has decreased from 65.669% in 1990 to 61.941% in 2017 (International Labour Organization, 2017). From this number, Malaysia's total labor participation rate has increased from 67.7% or 14.2 million in 2016 to 68% or 14.5 million in 2017 (Department of Statistics Malaysia, 2018b). This number has recently increased where as of March 2018, total labor participation rate is 68.2% or 15.24 million people (Department of Statistics Malaysia, 2018a). The increase in number shows that more and more individuals are entering the workforce and thus involved in learning to undertake job tasks.

Of the total number of labor participation, 10.5% or 1.6 million are civil servants where 33.8% of total operating expenditure or 28.04% of total budget of year 2018 is spent on emolument alone (Ministry of Finance Malaysia, 2017). Of this number, 387,000 are in managerial level all across Malaysia (Public Service Department, 2016). Every year, a government agency can receive up to 30 to 500 newly placed individuals who are newly recruited, promoted or transferred. These individuals are then exposed to changes that has been identified as one of the major challenges in a workplace requiring employees to be more susceptible to changes.

Seeing the number of individuals involved with changes and considering the huge amount of expenditure allocated to pay civil servants, it is important to identify elements that can produce better performance of civil servants. Plus, since research work is scarce in improving adaptive performance processes, it is also important to establish a framework to accelerate civil servant's adaptation process which will be able to help those in managerial level in government ministries across Malaysia.

4. Concepts and Frameworks of Talent Adaption Performance

Campbell et. al (1993) has proposed and tested job performance models containing eight factors. Performance in this study are perceived as individuals' behaviors and actions that mostly related to achieving the goal of the organization and must be at least able to be observed (Campbell, 2012). The model proposed is as in the following Table 1.

Table 1 Campbell's taxonomy of performance

No	<u>Taxonomy</u>
1.	<u>Job-specific task proficiency</u> Degree of core substantive or technical tasks which are the principal to employee's job that have been carried out.
2.	<u>Non-job-specific task proficiency</u> Degree of tasks that are not core to job description
3.	<u>Written and oral communication</u> Written and oral presentations carried out when performing job
4.	<u>Demonstrating effort</u> Consistency in employee's effort throughout employment including spending extra time to finish tasks and willingness to work under unfavorable work conditions
5.	<u>Maintaining personal discipline</u> Abiding by the rules and avoidance of negative behaviors including absenteeism
6.	<u>Maintaining peer and team performance</u> Supporting colleagues including helping with work and training as well as able to work and lead a team
7.	<u>Supervision/ leadership</u> Influencing subordinates to perform in work, setting goals for subordinates, coaching and being role model
8.	<u>Management/ administration</u> Other elements not directly related to supervision such as sharing set goals with organization, managing employees and resources, monitoring progress, solving problems and overcome crisis.

Based on theory by Campbell et. al (1993), an eight-dimensional model of adaptive performance was developed (E. Pulakos et al., 2000). Campbell (2012) argued that this model focus on cognitive or behavioral processes is different though complementary to those models that define performance as “a set of substantive content factors”. Another area of research interest built from Pulakos et. al model is theory of individual capability. Ployhart and Bliese (2006) developed Individual ADAPTability (I-ADAPT) theory as a widely applicable measure of individual adaptability construct for various research and development use, as shows in Figure 1. Following the theory, the authors defined individual adaptability as “individual's ability, skill, disposition, willingness, and/or motivation, to change or fit different task, social, and environmental features.” The study also established that adaptability is not the same as adaptive performance when regarded as adaptive performance.

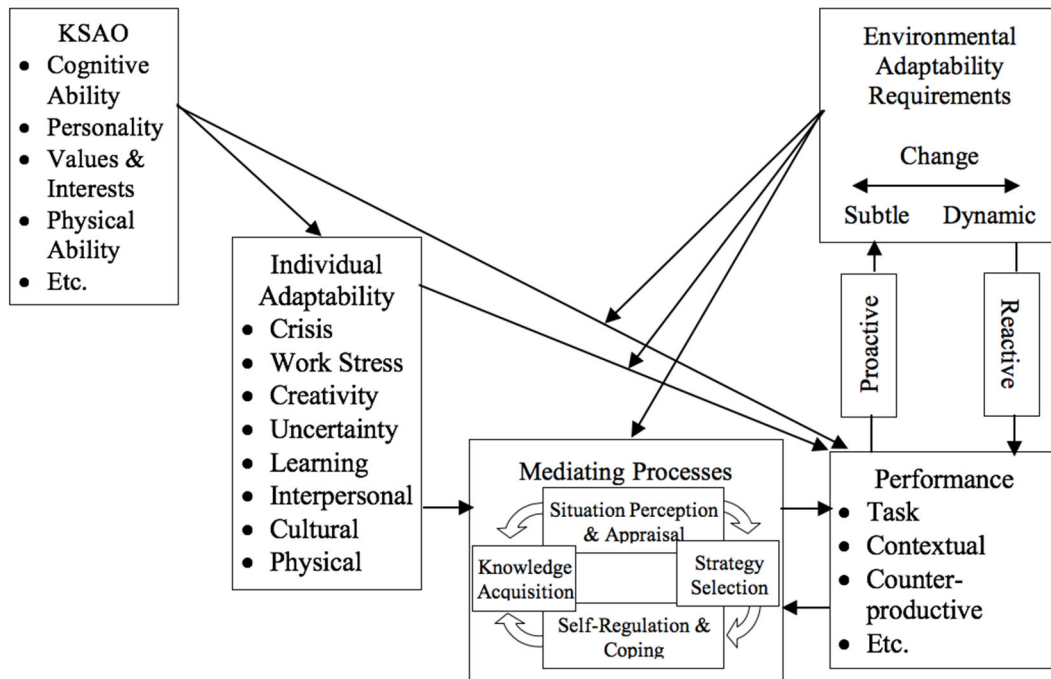


Figure 1 I-ADAPT Theory

Savickas (2005) developed career construction theory that is useful in adaptation of individuals with environment where it underlines social expectation to prepare for, enter and participate in work environment as well as handling career transitions, as shows in Figure 2. It consists of three components; life themes, vocational personality and career adaptability. Life themes addressed the vocational behavior, as of the theme that matters to the individual and other people from the individual work and contribution. Vocational personality concerned the action that the individual wants to do and this related to career related abilities, needs, values and interests. Career adaptability laid out orientation, exploration, establishment, management, and disengagement as principal types of behaviors that is during transition in a new work environment. These behaviors can be modeled as a cycle. Career adaptability also consists of attitude, beliefs and competencies or ABCs of career construction which are grouped into four dimensions of adaptability that are concern, control, curiosity and confidence (4Cs).

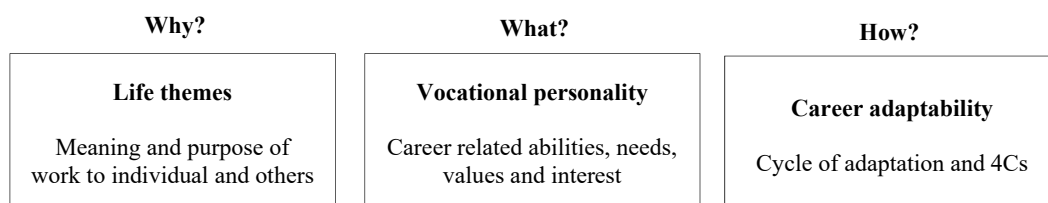


Figure 2 Career construction theory

Although not implicitly addressing adaptive performance, Figure 3 shows a framework integrating adaptability as a principles of high performance government has been established (Blackman et al., 2015). The framework was established to guide performance management process implementation at organizational or sub-organizational levels where the framework is formed to consider roles of individual, team, organization and governance to overcome the hurdles with current practices in performance management.

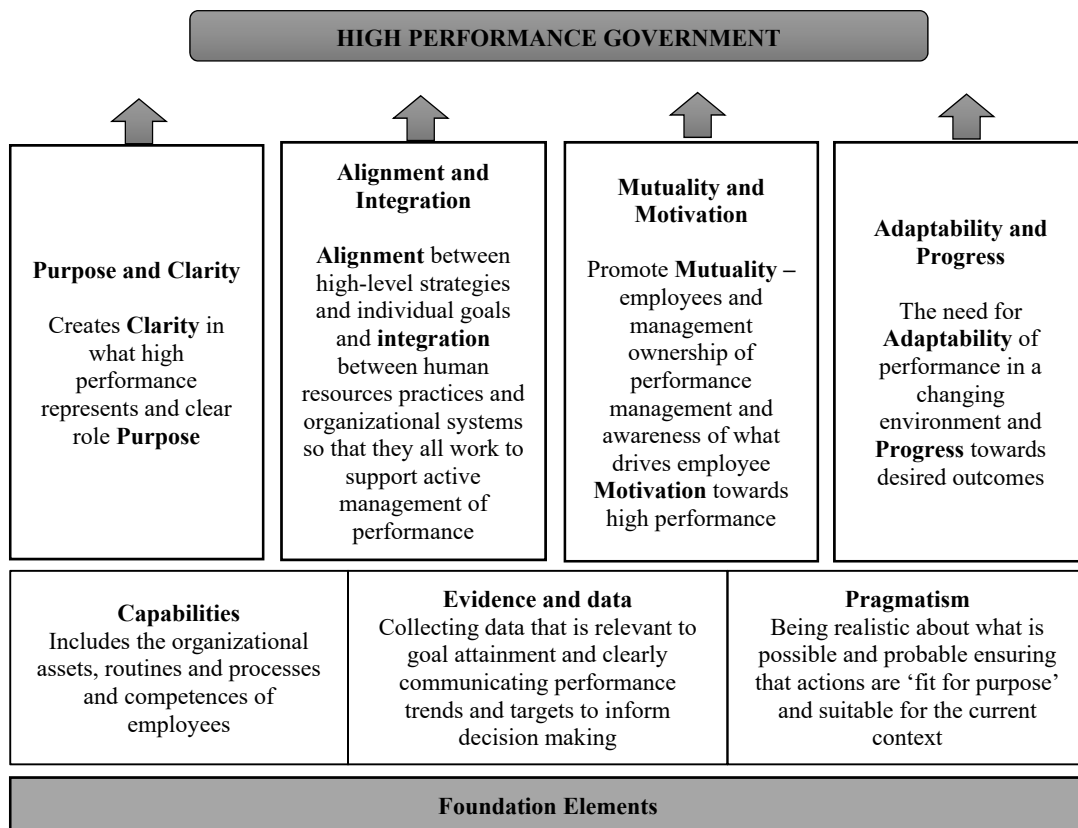


Figure 3 Framework for high performance government (Blackman et. al)

The objective of the framework is high performance as performance management outcome. The principles of purpose and clarity, alignment and integration, mutuality and motivation, as well as adaptability and progress are the principles that the framework should achieve and the three foundation elements of capabilities, evidence and data, and pragmatism are the critical factors to be implemented. The authors also considered high performance governance as one of the levels in its high-performance management model in the study on top of the existing literatures on individuals, teams and organizations to establish the connection of high performance systems encompassing all players in public service.

Blackman et.al. (2015) further clarify the four principles to enabler of high performance. “Clarity and purpose” are to addressed ambiguity with performance management implementation where there should be shared understanding, clear and simple goals, understanding each employer’s role and contribution as well as meaning of high performance. “Alignment and integration” answer the question to why each individual and group work is important to organization’s goals as well as making use of HR and management practices to attain alignment and high performance. “Mutuality and motivation” outline the need of a shared view of beneficial outcomes to the individual and organization while maintaining alignment and ensuring the importance of each individual’s work is known. “Adaptability and progress” represent the ability of the individual, team and organization to adapt to change and keep check on their progress against a simple and clear performance measures.

The foundation elements of the framework, namely “evidence and data” helps in reaching organization’s high performance by collecting and supplying performance data relating to the organization’s goal that will be used to inform decision-making. In order to achieve high performance, the authors also emphasized the need to develop competencies and necessary “capabilities” at employee, manager and leader levels. Last but not least, the foundation element “pragmatism” expresses the need for being realistic to the current scene and possibilities as well as what can be produced from available resources.

5. Proposed Accelerated Adaptation Framework

Following the critical factors in adaptability and review of the existing adaptive performance framework, the following framework is proposed in addressing learning tasks, technologies and procedures for civil servants. Considering Pulakos et. al (2000) eight-dimensional model of adaptive framework, Ployhart and Bliese (2006) I-ADAPT, Savickas (2005) cycle of adaptation and Blackman et. al (2015) framework for high performance, the following framework was proposed, as shows in Figure 4.



Figure 4 Proposed Accelerated adaptation framework for Malaysian civil servants

The proposed framework investigates further one of dimensions in Pulakos et. al (2000) eight-dimensional adaptive performance model, namely learning new tasks, technologies and procedures. By focusing on the dimension, the framework focuses in the first two phase of Savickas' cycle of adaptation namely orientation and exploration since this is when civil servants should have learnt about their new jobs. The elements in every stage and level of adaptation framework is attained from previously describe Ployhart and Bliese (2006) I-ADAPT theory, Demerouti et. al (2017) critical element of job crafting as well as Savickas (2005) 4Cs for individual level, Christian et. al (2017) model for team level and Ployhart and Turner (2014) model for organizational adaptation framework. Blackman et. al (2015) framework are also included to add in the elements and governance level. The framework is design such that it will help each individual to adapt quickly to new places.

Orientation here includes introducing organization to the public servants either through onboarding process or briefings. The stage also includes the role of the organization to introduce the new civil servants to the team he or she will be working closely with and the organization that he or she is working for, as well as letting them adjust their personal career goals with the organization's goals. This need to be done by clearly stating the goals of the orientation process so that civil servants are aware of what they can learn during the orientation process. In order to learn about the team and organization, civil servants as individuals should be open and embrace the current culture. The team will then need to be welcome the new member to their team in order to work in harmony. Governance is also important since they

have to perform their duties based on documents set up by the government where the roles pertaining to the civil servants need to be stated clearly as not to create confusion.

Exploration will start as quick as the second week of the starting date of job postings. Exploration includes the civil servants to learn about how they can contribute to their team, organization and the government as well as learning what they will get back in return for achieving the organizational goals. In order to quickly adapt, civil servants as individuals should be passion about their work, as well as having curiosity and seeking resources to learn about their work. The civil servants can also refer to the more experience in his or her team and ask for advices and guidance. The organization can help the individual by providing a platform to share materials where the government can make the work process easier by providing an integrated database of government data.

Conclusions

Malaysia government agency always developing individual's talent by transferring them with new department and exposed to changes. One of the major challenges for the talent in a new workplace to adapt quickly with the changes and performance accordingly at new working environment. The talent needs to go through a series of activities and tasks in order to face new challenges following the change efficiently. Therefore, this paper explored the critical connection between adaptation to work and job performance. The talent adaptation process needs to be supported by structured performance management system and implementing good performance management processes. In specific, the scope of research is focus on the issues and factors that can enhance civil servant's talent development in adapting to new work environment in Malaysian government ministries.

According to Pulakos et al. (2000) there are applied model in adaptive performance at individual level in order to change or fit different task, social, and environmental features. The findings from the literatures leads to support individual talent to prepare in participating new work environment as well as handling career transitions. This able to help talents to quickly align their abilities, needs, values and interests according to the new environment. The literature also discussed about the research focus in the form of framework with the purpose of guidance in the process in performance management. The significant impact of having the implementation framework helps talent to overcome the hurdles with current practices in performance management. Furthermore, individual talent able to push themselves towards high

performance outcome with the improvement and enhancement of talent competencies development that based from available resources in the new environment.

Finally, this paper proposing adaptive performance framework that based from the literature review. It guides talent in adapting in new organization from learning tasks, technologies and procedures for civil servants. The process of adaptation is expected to be as fast adoption as within second week of report duty in the new environment. The proposed framework support talent to learn about how they can contribute to their team, organization and the government as well as learning what they will get back in return for achieving the organizational goals. The recommendation of the next step of research is to test and fine tune the proposed framework at human resource department on managing and supporting talent adoption in new job transfer as case study approach. Semi structured interview is planning to help to collect data feedback from study population is civil servants of federal common user service scheme of a government ministry.

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Influence of Talent Management and Organizational Training on Employee Retention in Manufacturing Sector in Penang - Malaysia

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Abstract: Employee retention on the other hand is an effort by a business to maintain a working environment which supports current staff in remaining with the company. Training and talent management is being viewed as a tool to support the organizational competence through employee development, career development, performance enhancement and succession planning. The purpose of this project paper was to investigate the influence that talent management (talent training and career development) has on retention of manufacturing personnel in Penang, Malaysia. The research method is based on the quantitative method to design questionnaire, gather and analyze the data. The researchers explored particular aspects in talent management such as training budget, training period and career development, and how they influence retention in Malaysia. The outcomes of the current research showed that all three factors have a positive influence on the manufacturer employee's retention. The study concludes that policy strategies to improve career development will contribute significantly to retention of employees in Malaysia.

Keywords: *Talent Management; Organizational Training; Career Development, Employee Retention*

1. Introduction

In Penang city, some companies swiftly acknowledged the concept of human capital organizational knowledge and they view firm training is an important way to enhance organizational knowledge and development. But still several training regressive glitches existed in the way of employee retention [1]. Consequently, in order to comprehend and overcoming these issues, an enhanced human resource management is needed. Penang has developed for within decades of manufacturing involvement proved by the existence of the international organizations like Renesas, Intel, Osram and Bosch, the innovators in manufacturing Regions which indicate to remain and continued to enlarge their industries in Penang city.

Armstrong, [2] argues that talent management is all the actions to attract, motivate, grow and retain the talented persons in the organization. It improves the ability, flexibility and availability and hiring process of remarkable staffs who may disproportionately help performance of organization [3].

On the other hand, employee retention is a determination by the organization to retain current employees by maintaining a supportive environment. Any practice which increases the workforces' loyalty to their organizations [4]. Hongoro, and Normand [5] argues that competition, and the growing pressures for innovative ideas in any business, make organizations additional incentive to hire, inspire and retain the talented employees. Talent retention was a serious challenge in most of the organizations in both developed and developing countries.

Cheese, Thomas & Craig, [6] explains that the talent management has become more complicated in a new business realm. Talent acquisition is also more difficult these days while it is easier lose them. Talent management competences are highly incorporated and associated with the organizations' business strategies and implanted in different processes to This study will reveal the challenges/ gaps that mission are having in managing and retaining employees. This information is important for the human resource departments, ministry of labor and the government in identifying ways to strengthen talent management strategies and consequently manufacturing industry in Penang Malaysia. The study will help the administrators and particularly HR managers to explore strategies to improve employee retention.

1.1 Career Development

The concentration of career development is on the development and growing of employees as the key occupational strategies by preserving employee's career pathways, training, competencies, mentor and demand measurable results [7]. At the present time, staffs are more aware and sensitive about their careers and they are more willing

in career development and progress in every organizations. Career development became one of the important factors for any business to retain its talents through preparation and growth occasions [8]. Most of the staff's reply on career growth and promotion development positively in numerous organizations that are expending career managing programs to design and progress the employee careers [8].

Flynn, Mathis, Jackson, & Valentine [9], remark staffs from all levels, continually are seeking for career development occasions and this affects employee's retention. They argued that professionals and employees aged under thirty years old, positioned career development opportunity beyond compensations as their retention concerns. There are substantial effects of employee trainings and developments on their career developments [10]. Appropriate trainings, education and career expansion for employees are indications for higher employee commitment. Chaudhary, Rangnekar and Barua [11], indicated that organizations that help in developing employee's self-confidence by offering suitable trainings and educations from the human resource department, shows improvements in workers commitment which leads to greater worker retention. Moreover, employees who have more engagements delivered by preparation and improvement prospects are more likely to stick with the organizations for a more period of time [12].

From side of career development practices, companies try to prepare the employee's career planning. By understanding the individual career planning, the organizations human resource plans the employee to perceive and join effort among the different employees and company.

1.2 Training Budget

Substantial amount of financial and non-financial resources needed for organizational training. The time that is dedicated to training can be used to productive activity in organization. Cost of designing and delivering training, coordinating with human resource department and organizing the location, all have financial burden on of organization. Meanwhile the return of investment of training is also ambiguous. It has been seen that several companies paid lot of financial resources to training and they didn't get a good enough result, it means the amount of training budget is not necessarily have a worthy and productive outcomes. Samuel, M. O., & Chipunza, C. [13], supposed training as the cash, period, and work that can be used for organizational training. It can be understood that arrangement of training expenditure derives from the viewpoint of training process. Normally, training program mostly consist of three groups such as training plan, training expansion, and training application. Training budget mostly included in these three groups. Firstly, it contains the expenditure on training plan for example the determination of management. Then, it contains the expenditure on training progress, like the struggle that trainers have for training progression. Lastly, it's the expenditure of training application such as investment in HR., physical resources, and fiscal resources throughout this process. The HR department endorses a training budget comprise the expenses for training staff salaries, suitable training services, training resources, hardware and the price of external consultants. It may be more efficient for companies to contract out some training needs to vendors or benefit from advances in training technologies to decrease training expenses. It is vital that the training budget sufficiently insurances the realistic expenses related with the training methods in businesses. Therefore exertion, time, and money that is dedicated to training, is training expenditure. He separated training budget into two sections which are indirect budget and direct budget. He regards direct budget as the expenditure which has original invoice record. The highly applicable expenditure consists of the material, human resource, and financial resources during training program. Indirect expenditure in other hand, is divided into three parts such as charge of training management, the cost of temporary employees or lecturers or extra expenditure of training [13].

1.3 Training Period

As the necessity of training workers and its expansion is growing, it can be claimed that budget and time are obtainable in businesses, need for old-fashioned methods of training such as formal training courses is decreasing. To meet this gap between the need for training and its availability, it have been recognized a variety of training durations and approaches for worker growth that can offer longer leaves than the law requires. By using these methods in a deliberate and thoughtful way, performance of workers and business will be enhanced [14]. Organization must choose the types and method of training which includes on-the-job training, group training and behavior modelling. Different training methods used throughout the training and improvement program will also affect the training outcomes after the training period finishes. Consequently, effective training design is required to the employee to adapt and understand easily. Moreover, training period will greatly affect the employees, interest and focus so short yet precise training duration is recommended [14].

The training period can improve company performance and effectiveness by developing training plans within the process of training. Firms must excellently keep and use capitals to capitalize on productivity base on the situation of organization. Consequently, training period and its strength are vital scopes learning elements. Though, the writings in literature about training period affecting employee retention are still insufficient [15].

1.4 Conceptual Model

The model demonstrates how the independent variables (career development, Training Budget and Training Period) influence the dependent variable (Retention) and the moderating effect of psychosocial factors. Figure 1 shows the Conceptual Framework of Study.

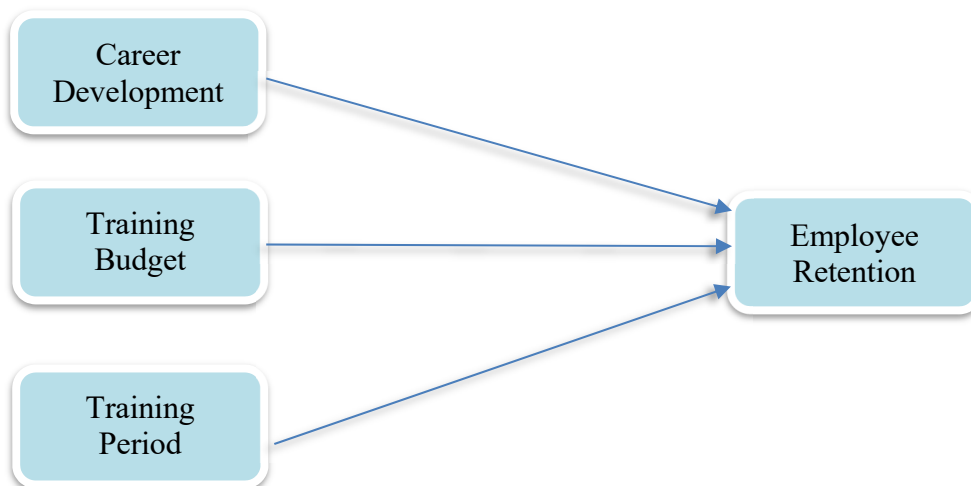


Figure 1: The Conceptual Framework of Study

2. Data Analysis

This study used quantitative method to gather and analyse the data. Collected data from questionnaire have been analyzed, with the provision of SPSS 22 computer software. Queries in the survey were simple and direct to inspire respondents to comprehend better and response it as decent as possible.

The gathered data has been entered to IBM SPSS software version22 for statistical analysis, and results are presented in this chapter. Descriptive analysis, reliability test and inferential analysis (Multiple Regression and Pearson Correlation Analysis) will be done to analysis data. Out of 200 distributed questionnaires, 123 questionnaires were gathered, representing a response rate of 84 per cent. Though, only 105 were completed. Uncompleted questionnaires were omitted and did not considered for the analysis.

2.1 Test of Normality

One of the assumptions of regression analysis is normal distribution of variables. Variables which ate not normally distributed, may cause issues in the test. Consequently, to investigate normality of data, the skewness and kurtosis test is used. If the value of skewness and kurtosis is between -2 and +2, it can be established that the data is measured to be normally distributed. Table 4.1 displays that all values of skewness and kurtosis are among -2 and +2. Consequently, data is normally distributed [16].

Table 1: Skewness and Kurtosis Values

	N	Skewness	Kurtosis
Career Development	105	0.178	-1.525
Training Budget	105	0.288	-1.551
Training Period	105	0.699	-.882
Employee Retention	105	0.733	-1.58
Total	105		

The descriptive analysis to define the demographic features of participants. Table 2 shows Respondents' Demographic Profile.

Table 2: Respondents' Demographic Profile

Characteristics	Percentage (per cent)
Gender	
Female	31.4
Male	68.6
Age	
Below 25 years old	14.6
26-30 years old	45.2
31-35 years old	20.3
36-45 years old	15.7
46 years old and above	4.2
Educational level	
High School Graduate	8.2
College Graduate	6.1
Bachelor Degree	79.8
Master's Degree	4.9
Years of Occupation	
Below 1 year	10.1
Above 1 year less than 3 years	33.5
Above 3 years less than 5 years	37.4
5 years and above	19.0
Total Respondents	105

2.2 Reliability of instrument

This study used Cronbach's alpha for reliability test as an instrument that allows the researcher to generate consistent results through analyses of the reliability. The measurement of Cronbach's Alpha is indicated as a number zero to one. The closer Cronbach's Alpha coefficient to 1, the better the internal consistency of the items in the scale [17]. Most of the researchers generally consider that an alpha of 0.7 as lowest acceptable value, though lower coefficients also may be acceptable, but it was depending on the research objectives [18]. The reliability test result for each variable is shown in the table 3.

Table 3: Reliability Test Result for Each Variable

Variables	Construct	Number of items	Cronbach's Alpha
Dependent Variable	Employee Retention	5	0.879
Independent Variables	Career Development	8	0.889
	Training Budget	4	0.763
	Training Period	6	0.918

Table 3 shows that all variables Cronbach’s alpha is reliable because all variables have Cronbach’s alpha value more than 0.7. Therefore, all the variables have good internal consistency reliability that indicated that all variables in this study satisfactory.

2.3 Regression Analysis

This study used multiple regressions analysis procedure was to check the relationships between independent variables and dependent variable. Moreover, it also assistances the researchers to separately check the relationship between variables. Multiple regressions analysis describes the relationships among variables and to forecast values of the dependent variable (Y) based on values of independent variable (X), is multiple regressions analysis. Dependent variable (Y) is a measure or a variable that is to be predicted or explained [19]. Table 4 shows the results of multiple regressions analysis.

Table 4: Multiple Regression Result

Independent Variables	Unstandardized Coefficients (B)	Standardized Coefficients (Beta)	T value	P value
Constant	0.854	0.766	2.703	0.007
Career Development	0.485	0.552	1.221	0.023
Training Budget	0.330	0.384	3.106	0.002
Training Period	0.321	0.373	12.181	0.000

Table 4 shows that all independent variables were correlated with dependent variable (Employee Retention). However, results show that the strength of relationships between all the four variables are less than 0.7, which means that this is no multicollinearity among seven independent variables.

In additions, among the three independent variables, career development has the most effect on employee retention in this study because it was the strongest influence on employee retention where standardize beta is 0.552.

Table 5 ANOVA test results

Model	Sum of Squares	DF	Mean Square	F	P value
Regression	410.992	3	129.897	65.373	0.000
Residual	645.457	308	2.096		
Total	1056.449	311			

In table 5, the mean square of F-test is 129.897 and the p-value is less than 0.05. It shows that there are constructs influence which are explaining the talent management and employee retention significantly. Consequently, null hypothesis is rejected and alternative hypothesis is accepted. In other words, it has enough evidence to conclude that the factors influence will significantly explain employee retention.

3. Conclusion

The current research concentrated on examining the relationships between training period, training budget and career development on retention of manufacturing industry in Penang Malaysia. The key outcomes of the current research showed that all three factors have a positive relationship on the manufacturer employee's retention. It shows that manufacturers must emphasis on training and talent development more to upsurge the employee's retention in the organizations. There were a few studies and conclusions on talent management on worker retention in Malaysia therefore there are limited results to refer to. Additional investigators can do their studies on manufacturer employees " retention with other talent management behavior. The study concludes that policy strategies to improve career development will contribute significantly to employees retention in Malaysia.

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Master Design for Football in Japan Concerning 2002 FIFA World Cup Korea/Japan

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Abstract: 2002 FIFA World Cup Korea/Japan was held in 2002. Football is popular sports now in Japan. However, the 1980s when Japan announced invitation of World Cup was "the winter times of football" in Japan. The number of audience of the Japanese Football League had decreased. And Japan national team had not been able to readily earn the right to participate in Olympics and World Cup. Then two ideas were devised to solve such situation. They were to invite World Cup and to establish a professional league. After that, Japan and Korea stood as a candidate for the 2002 World Cup. In invitation activities for the World Cup site, both Japan and Korea fiercely battled with all their energies. However, this invitation activities was caught up to an internal power struggle in FIFA as well as the competition of two countries. This form was the composition of "Japan and FIFA President João Havelange" vs. "Korea and The Union of European Football Associations (UEFA)". And Havelange placed "joint hosting plan" on the agenda in the FIFA board of directors on May 31, 1996, and the board members decided the joint hosting. Both Japan World Cup organizing committee (JAWOC) and Korea World Cup organizing committee (KOWOC) had made a great deal of effort to prepare and operate to succeed the joint hosting World Cup. The Asia's first World Cup was jointly held in Japan and Korea from May 31 to June 30, 2002. The Japan national team had achieved the best 16 in the second appearance. The Korean national team had advanced to the best 4. The 2002 World Cup, joint-hosted by both Japan and Korea for the first time, had deepened friendly relations between the two countries.

Key words: Business model, 2002 FIFA World Cup Korea/Japan, Japan Football Association, joint hosting

1 Introduction

2002 FIFA World Cup Korea/Japan was held 16 years ago. Football is popular sports now in Japan. However, the 1980s when Japan announced invitation of World Cup was "the winter times of football" in Japan. The number of audience of the Japanese Football League (JFL) had decreased. And Japan national team had not been able to readily earn the right to participate in Olympics and World Cup. Then, two ideas were devised to solve such situation in the Japan Football Association (JFA). They were to invite World Cup and to establish a professional league.

Japan economy entered into recession in the 1990s, which was said to be "lost decade". One of successful projects at this time was promotion of football. Several past studies and books have addressed management of Japanese football and 2002 FIFA World Cup Korea/Japan. There are, for examples, Ichiro Hirose "J League no Management" (Management of J League), Toyo Keizai Inc., 2004, Zyozi Okada 'Wadaisouzou no Shikakedukuri J League' (Setting a creation of discussion in J League), "Marketing Kakushin no Zidai 1 Kokyaku Souzou" (The Age of Innovation in Marketing, Creating Customers), Yuhikaku Publishing, 1998. And other general books are Yasuo Kawabata

“Nikkan World Cup no Kakusyo” (Memorandums of World Cup Korea/Japan), Kodansya Company, 2004, Hiroshi Ohshima “Nikkan Kickoff Densetu World Cup Kyouusai heno Nagaki Mitinori” (The legend of Kickoff in Japan and Korea, the long way to jointly-hosted World Cup), Shueisya Publishing Company, 2002, and Hiroshi Takeuchi “2002nen no Fair Play” (Fair Play in 2002), Kyodo News, 1996. But there is no historical research papers and book. I researched a development of Japanese football in a viewpoint of business history. This paper is mainly based on interview surveys of Junji Ogura (Supreme Advisor of JFA) and Hiroyuki Hamaguchi (professor of Hiroshima University of Economics) and historical documents of JFA.

2 Hard times of football in Japan in the 1980s

A football team of Japan won a bronze medal by the Olympics in Mexico in 1968. However, after that, Japanese football enters the slump period. Japanese representatives continued to defeat preliminary matches in Olympics and World Cups. As a result, the popularity of football had been floundering, too. The number of one game’s average attendance in the Japan Football League (JFL) was 7,491 people in 1968 and dropped in 1,773 in 1977. JFL was organized by amateur teams of corporations and other organizations. Then, JFL recovered its popularity a little in the 1980s. One of the reasons was why Japanese representative made a spectacular showing in an elimination round of World Cup. If Japanese representative made another one win, they could participate in the World Cup in Mexico. The number of average audience became 3,647 in 1985 (Kawabata (2004), p.21, JSL Activation Committee (1998), p.23).

But in the last decisive battle with Korean representative in Mexico World Cup preliminary, Japanese representative was defeated and didn’t realize their earnest wish. They lost the games to Korean teams by scores of one to two (Tokyo) and 0 to one (Seoul).

Then, Tadao Murata thought about what to do seriously to earn the right to appear in the World Cup. He had acted as the supporting head of the Japan national team. His answer was "to become a host country for the World Cup". However, this idea had some problems. It is true that a host nation can participate in the World Cup, but Japan lacked both competency of football and necessary stadiums. However, this sudden proposal was based on some reasons.

João Havelange, the 7th president of The Fédération Internationale de Football Association (FIFA; French for "International Federation of Association Football"), publicly declared in the mid-1980s “The first World Cup of the 21st century will be held in Asia”. And he suggested that Japan was a strong candidate area. In addition, both sports business and sports marketing had developed widely in that time, as seen in the Los Angeles Olympic Games. His proposal was appropriate for an expansion strategy of sports business. Murata visited the FIFA headquarters in Zurich in November, 1989 to realize his idea and indicated his intentions of the candidacy.

On the other hand, there was second activity to make football active in Japan. The

Japan Football League Activation Committee established in JFL in 1988.

Junji Ogura, who had been assigned overseas posting in Furukawa Electric Co., Ltd., come back to Japan from London in 1987. After return home, he took office as the director of Furukawa Electric Football Club and accepted the position of the chairman of the committee in the same year. The members of the committee had lively discussions about the future of football in Japan and made the master design of it. In fact, their plans established a foundation for development of today's football in Japan. To put it concretely, they discussed training of national team and how to make the football business in Japan activate. Their conclusion was to establish a professional football league. Then, "Super league" (K-League now) had been already established in Korea in 1984 and contributed to strengthening of competitiveness. This greatly affected to found a professional league in Japan.

Furthermore, the committee thoroughly examined the invitation of World Cup for development and reinforcement of football. And they thought that local governments provided existing facilities with all the necessary equipment and constructed new stadiums, if they could invite World Cup. Through the arguments of activation, the invitation of World Cup became linked to the establishment of professional league to upgrade both software and hardware.

3 Joint hosting of the World Cup

Murata visited Dentsu Inc. in 1990 to get support of the invitation activity. It is the biggest advertising agency in Japan, Dentsu established joint venture "International Sport and Leisure (ISL)" with Adidas in 1982. ISL was a Swiss sports marketing company and dealt with big sports events like Olympics and World Cup. It had adequate and practical abilities of managing operations of World Cup. The visit of Murata realized a support system for World Cup invitations. The cooperative organization with Dentsu carried out invitation activity.

"Japan bidding committee of 2002 FIFA World Cup" started in 1991. The first big work was requests of cooperation to local governments in Japan. The committee investigated their intention to participate in the World Cup invitation activities by a questionnaire in 1991. As a result, 30 local governments showed interest in the venue. Many local governments showed intention of the participation at this time. The reason is because the finance of each local government relatively remained firm in the early 1990s. The committee narrowed down the 30 candidates to 15.

On the other hand, the activation committee proposed "the activation plan of the Japanese Football League". It carried their projects out based on the plan. "J League" started in 1993. It was the first professional football league in Japan. J League immediately created a football boom and largely increased the spectators at a game. The new league succeeded in marketing, too. The committee consequently gained confidence about the invitation of World Cup with the success of J League. In addition, the beginning

of professional league improved the competition level of Japanese players. And it contributed to the reinforcement of national football team. As a result, representatives of Japan began to produce good results in their games for the preliminary match of World Cup.

The team representing Japan fought successfully through the first elimination round in Asia. And they would be able to participate in the U.S.A. World Cup, if they had made one win in the last preliminary game. However, the game ended in a drawn match with Iraq in 1993. The Iraqi representative scored a game-tying goal by a corner kick in second half injury time. The Japan team had missed World Cup first opportunity by this drawn game with Iraq. This is called "The tragedy of Doha" in Japan. This result disappointed participants engaged in invitation activity very much. It is said that Japan could host the 2002 World Cup alone, if Japan representative made one win and participated in the World Cup in 1994.

On the other hand, the Korean representative could earn the right to appear in the World Cup by a draw of Japan fortunately. After that, Korea soon declared the candidacy of the 2002 World Cup to chase after Japan. The person who expressed it was Chung Mong-joon, who was newly inaugurated as Korean Football Association's chairman. And the Asian Football Confederation (AFC) election was held to nominate for FIFA's vice-chairperson in AFC general meeting (Kuala Lumpur) in May, 1994. In the result, Chung won the election by 11 votes. Murata stood as a candidate, too, but he got only two votes. As the result of election, Murata took responsibility by resigning vice-chairman of JFA. However, he continued to support invitation activity as a director of JFA positively afterwards. He was good at languages and had a lot of overseas contacts in the football world.

JFA planned a personnel reshuffle and appointed new directors. Ken Naganuma took office as JFA's chairman and chairman of executive committee in Japan bidding committee in 1994. And Junji Ogura became a secretary-general. Because invitation activities became busy, Hiroyuki Hamaguchi was temporarily transferred to the bidding committee from Dentsu Football Division in October, 1994 and took office as an international director. In addition, "2002 World Cup Japanese invitation Diet member league" was formed in December, 1994 because the government supported invitation activities. 344 members of the Diet participated in this league without distinction of the ruling and opposition parties. Members of the House of Representatives were 258 people and members of the House of Councilors were 86 people in May, 1996. The chairperson was former Prime Minister Kiichi Miyazawa.

In invitation activities for the World Cup site, both Japan and Korea hold their ground. Japan and Korea fiercely battled with all their energies. However, this invitation activities was caught up to an internal power struggle in FIFA as well as the competition of two countries. This form was the composition of "Japan and FIFA President João Havelange" vs. "Korea and The Union of European Football Associations (UEFA)". The intense

invitation battle of the two countries worried many people and groups surrounding them. Both Japanese and Korean politicians, economic communities, and AFC feared that two countries conflicts would develop into serious problems. And they had come to express Japan-Korea joint hosting plan. In this atmosphere, UEFA Chairman Lennart Johansson stated "Japan-Korea co-hosting plan" at a press conference on May 23, 1996. And President Havelange placed "joint hosting plan" on the agenda in the FIFA board of directors on May 31, 1996, and the board members decided the joint hosting. Havelange proposed this plan earlier than Vice-chairman Johansson to protect his political status.

The Japanese committee accepted this decision. And the World Cup hosting preparatory committee was established on July 1, 1996. Takeshi Naganuma, the chairman of executive committee, and Junji Ogura, the secretary general, visited the FIFA headquarter on September 18, 1996. They talked together with FIFA Secretary-General Sepp Blatter and submitted the proposal of the Japanese side about the joint hosting with Korea. The biggest problem in the preparatory committee was work to narrow down the hosting local cities to 10 from 15. This work was difficult and sever. When they chose the hosting cities, they evaluated their ability to hold and considered local balance. They set objective standards and put the ability of each city into numbers.

The second FIFA working group meeting was held on November 6, 1996. At the beginning, Vice-chairman Johansson said without prior approval that the finals is played in Japan and the opening is held in Korea. This unilateral decision extremely surprised those concerned in both Japan and Korea. Because this problem would be in trouble, FIFA executives except Japan and Korea had determined it before the meeting. Second problem was to set the order of name. The order of official name in such as World Cup and Olympics is determined in alphabet. However, Korean side never approved that Japan was first order and Korea was second. Japanese side received the claim of Korean side. After all, the official name was decided in "2002 FIFA World Cup Korea/Japan". After this meeting, Hiroyuki Hamaguchi and Suzuki Tokuaki had the first meeting with the Korean preparatory committee in Seoul on December 4, 1996. The atmosphere in first discussion was extremely tense. History recognition was taken in this meeting in working-level talks. It is said that the relations of both were not good at first. But persons concerned with Japan and Korea had to meet many times and had dealt with business matters of co-hosting works. After a series of meetings, each other's human relations would be built. Only after they formed this relationship of mutual trust, their office works began to be under way.

Japan team played a match against Korea team in the 1997 French World Cup last elimination round of Asia (Seoul, Jamsil stadium). Whereas Korean representatives had already earned the right to appear in the World Cup, supporters of Korean side sent out a support message to the Japanese team. It was a banner strung across the stadium with "LET'S GO TO FRANCE TOGHTER". People connected to the Japanese preparatory committee watched this message. And they would believe to succeed joint hosting of the

two countries firmly. Then, Japan World Cup organizing committee (JAWOC) was established on January 16, 1998.

The 16th FIFA World Cup was held in France in June, 1998. Japanese representative participated in the World Cup for the first time. Then, President João Havelange resigned in FIFA general meeting on June 8, 1998.

And Blatter won election to the chairman against UEFA's Chairperson Johansson and took office as the 8th chairman of FIFA. He became a successor of Havelange.

FIFA, JAWOC, JFA, Korea football association (KFA), Korea World Cup organizing committee (KOWOC) signed the 2002 FIFA World Cup organization groups contract in the FIFA headquarters on August 26, 1999. But this "contract" caused many problems. The contract aimed to possess the exclusive hosting rights by FIFA and restricted their activities of both JAWOC and KOWOC in every scene of such as acquirement of sponsors, ticketing, accommodations.

The draw of confederation qualification was held in Tokyo International Forum on December 7, 1999. The final qualifying draw was carried out in Busan Exhibition and Convention Center (BEXCO) on December 1, 2001. These were plans to enliven the World Cup beforehand.

A big trouble threatened those concerned. ISL, a marketing partner of FIFA, collapsed in May, 2001 with debts of £153million. Following the problem, FIFA decided to establish a new service agency owned 100% by FIFA to handle the marketing activities for all FIFA's events. FIFA marketing A.G was founded on June 1, 2001.

An incident of personnel dispute happened in JAWOC. Oita prefectural government and the Ministry of Internal Affairs and Communications (MIC) led to transfer three temporary assigned workers from Dentsu, including Hajime Adachi and Hiroyuki Hamaguchi on March 1, 2001. According to newspaper reports, MIC intended to play a key role and to manage the organizing committee themselves.

The 2001 FIFA Confederations Cup 2001 was held in May, 2001. This was a rehearsal match of the 2002 FIFA World Cup. Japanese representative was the runner-up in this games.

JAWOC was going to start reservation of tickets on October 2, 2000. However, FIFA requested to postpone acceptance of application on September 29 just before the start. Their official reason was why FIFA couldn't have sales through the Internet prepared by the scheduled time.

But FIFA truly wanted to monopolize reception information in Japan, Korea and foreign countries and manage all sales of tickets simultaneously throughout the world. Bankruptcy of ISL strongly influenced this postponement.

Even if 2002 fixed for World Cup started, problems of "undelivered tickets", "empty seats" had come up by mishandling of Byrom public limited company in U.K. FIFA was pleased to announce the appointment of Byrom as its official ticket service agency for the 2002 FIFA World Cup. But Byrom didn't have the ability to operate worldwide ticketing.

Therefore, JAWOC must have sold the tickets by not the Internet web site but the telephone reservation on the day before the game to solve the problem of vacant seats.

4 Conclusion: the later and present football in Japan

Both JAWOC and KOWOC had made a great deal of effort to prepare and operate to succeed the joint hosting World Cup. Taking this opportunity, the East Asian Football Federation (EAFF) was established on May 28, 2002. A purpose of the EAFF is to develop the football level and to promote international friendship through the sport in East Asia. The Asia's first World Cup was jointly held in Japan and Korea from May 31 to June 30, 2002.

Japan national team had achieved the best 16 in the second appearance. Korea national team had advanced to the best 4. The 2002 World Cup, joint-hosted by both Japan and Korea for the first time, had deepened friendly relations between the two countries. Also, people from around the world had heartwarming interchanges at venues and campgrounds. Due to the success of World Cup, Junji Ogura, Vice Chairman JFA, took over as FIFA Director by voting in AFC in August, 2002.

In September 2002, the FIFA Council had announced a comment to summarize the 2002 World Cup. They expressed the Japan and Korea jointly hosting of World Cup as "World Cup of Smiles" and honored its success. At the FIFA 100th Memorial General Meeting in May 2004, FIFA again gave the 100th Anniversary Achievement Award to Japanese and Korean fans at the 2002 World Cup.

Afterwards, Japanese football has continued to develop. The ideal in "The JFA Declaration, 2005" is "Through football, we realise the full benefits that sports can bring to our lives the soundness of our bodies, the expansion of our minds, and enrichment of our societies". Under the ideal, the JFA is currently working toward the realization of this declaration for the development of football in Japan.

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Room B

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Analysis of the Impact of a Safeguard Clause Inserted in the Philippines Patent Act on the Philippine Pharmaceutical Industry

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Abstract The Trade-Related Aspects of Intellectual Property Rights (TRIPS) requires all member countries of the World Trade Organization (WTO), including advanced countries and developing countries, to introduce a TRIPS-compatible patent law into their domestic laws. The Philippines, a member of the WTO, revised its patent law in 2008 and introduced product patents. The new Philippine patent law was intended to be TRIPS compatible and therefore an international standard law. However, the revised patent law included a specific safeguard clause, Section 22. This study analyzes the impact of this safeguard clause, Section 22, on the pharmaceutical industry in the Philippines in comparison to Section 3 (d) of the Indian Patents (Amendment) Act, 2005.

Keywords Intellectual Property, WTO/TRIPS, Developing Countries/Newly Developing Countries, Pharmaceuticals, Ever Greening, Societal Economic Impact, Access to Medicine

1 Introduction

As a result of the implementation of the World Trade Organization (WTO)'s Trade-Related Aspects of Intellectual Property Rights (TRIPS), which took effect in 1995, all members of the WTO, including advanced countries and developing countries, are required to introduce TRIPS-compatible patent law, including product patents, in their domestic laws. In 2008, the Philippines revised its patent law (The Intellectual Property Code of the Philippines) and introduced product patents. However, this new Philippines patent law contains a unique safeguard section. This unique safeguard section, Section 22 of the Philippines Patent Act, is similar to Section 3 (d) of the Indian Patents (Amendment) Act, 2005. This special clause Section 3 (d) has received a significant amount of attention because, on the basis of Section 3 (d), the Indian Patent Office has rejected several world-class patents (patents approved in many countries in the world), including the patent for Novartis's Gleevec. However, thus far, there have been no reports from the Philippines about the Philippine patent office rejecting any prominent world patents based on Section 22. This study focuses on Section 22 of the Philippines Patent Act and analyzes the impact of this section on the Philippines' pharmaceutical industry.

2 Background: Indian Patents (Amendment) Act, 2005 & Section 3 (d)

2.1 Indian Economic Development

India has achieved rapid economic development, and according to JETRO, India achieved 6.7% GDP growth in 2017 (JETRO website). According to the World Bank, India's GDP is forecasted to grow 6.7% in FY2017/18, and the growth will increase to 7.3% in 2018/19 (World Bank website).

2.2 The Indian Pharmaceutical Industry

During the period immediately following India's independence from Britain in 1947, the domestic pharmaceutical industry in India was non-existent (YAMANA Mika, 2007). Many foreign capital pharmaceutical companies occupied the Indian market, and they sold medicines at much higher prices compared to other countries (MINATO Kazuki, 2007). However, beginning in the 1970s, the Indian pharmaceutical industry began developing rapidly (BHOJWANI H.R., 2005), and in 2017 the Indian pharmaceutical industry was ranked third in the world in terms of sales volume (IBEF "Pharmaceuticals," 2017).

2.3 IPR protection framework and implementation in India

India, a developing country, did not have any product patent law when TRIPS took effect in 1995, and after a ten year grace period, India revised its patent law in 2005 and introduced product patents (WTO website). However, this new patent law, the "Indian Patent (Amendment) Act 2005," included a unique safeguard clause called Section 3 (d) (WIPO Website). On the basis of Section 3 (d), the Indian patent office rejected prominent world patents such as Novartis' Gleevec (Supreme Court Decision, 2013). Previous studies have demonstrated that Section 3 (d) reduced the negative effect of the introduction of product patents (MITSUMORI Yaeko, 2010)

This study analyzes the impact of Section 22 of the Philippines Patent Law on the pharmaceutical industry in the Philippines.

3 Philippine Economic Growth and the Pharmaceutical Industry

3.1 Economic growth

The Philippines has maintained a healthy GDP growth rate over the past three-year period between 2015 and 2017. Real GDP growth rates were 6.1% in 2015, 6.9% in 2016, and 6.7% in 2017. Table 1 illustrates the main economic indicators of the Philippines between 2015 and 2017.

Table 1. Philippine Economic Indicators

Items	2015	2016	2017
Real GDP Growth Rate	6.1 (%)	6.9 (%)	6.7 (%)
Nominal GDP	293 (\$1B)	305 (\$1B)	313 (\$1B)
Nominal GDP per capita	2,863 (ドル)	2,924 (ドル)	2,976 (ドル)
Indices of Industrial Production	△4.3 (%)	6.2 (%)	△0.8 (%)
Consumer Price Index	1.4 (%)	2.2 (%)	2.9 (%)

(Source: JETRO)

On April 12, 2018, the World Bank released its outlook and stated that the Philippines would maintain a 6.7% growth rate in 2018/2019 and that, subsequently, the growth rate would moderate to 6.6% in 2020 (World Bank website).

3.2 The pharmaceutical industry in the Philippines

The pharmaceutical market in the Philippines was valued at US\$3.3 billion in 2013 (Espicom, 2013) and it is projected to grow at an annual rate of 6.6% over the next six years, to reach US\$4.5 billion by 2019 (Espicom, 2013). Fig. 1 illustrates the growth trend for the Philippine pharmaceutical market between 2010 and 2019.

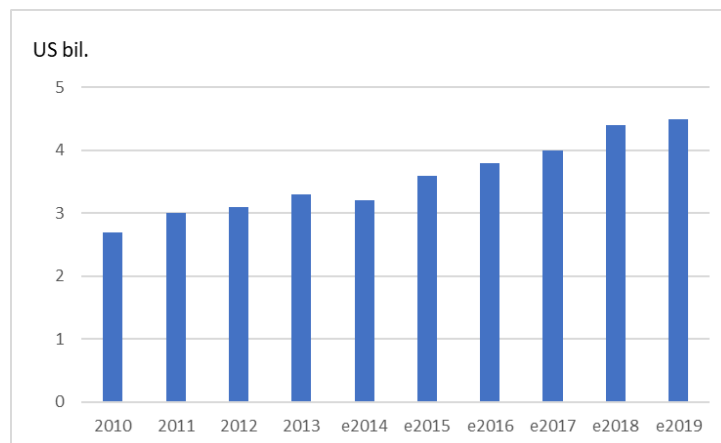


Figure 1. The Pharmaceutical Market in the Philippines

(Source: Espicom Worldwide Pharmaceutical Market forecast to 2019)

3.3 The pharmaceutical market in the Philippines by category

In the Philippines, Generic Drugs occupy 43% of the market, while Patented Drugs and OTC occupy 30% and 27%, respectively (Espicom, 2013). Fig. 2 clarifies the Pharmaceutical Market in the Philippines by category.

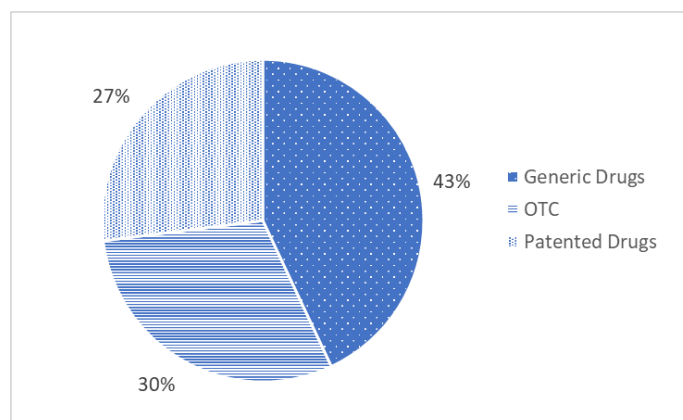


Figure 2. The Philippines Drug Market by Category

(Source: Espicom Worldwide Pharmaceutical Market forecast to 2019)

As part of its effort to secure access to medicine for people in the Philippines, the Philippine government encouraged the use of generic medicine. Partly because of these efforts, the sales of generic drugs have increased, and they are expected to grow by 7.4% over the next six years, while sales of OTC and patented drugs are expected to grow by 4.6% over the same period (Espicom, 2013).

3.4 The Philippine pharmaceutical companies vs. Mega-Pharma

In the Philippine pharmaceutical market, the so-called Mega-Pharma (the very big global pharmaceutical companies) occupy 70% of the market share, and the remaining 30% is held by local pharmaceutical companies. The top three foreign pharmaceutical companies are GSK, Novartis, and Sanofi. United Laboratories, Interphil Laboratories, and Pascual Laboratories are the largest Philippine pharmaceutical companies (METI, 2015). Table 2 contains a brief description of these three companies.

Table 2. Large Pharmaceutical Companies in the Philippines

United Laboratories	The largest pharmaceutical company in the Philippines. Founded in 1945. Sales revenues in 2013 were 87 billion yen. Employees: 3100.
Interphil Laboratories	The largest contract manufacturer in the Philippines. Founded in 1978. Listed on the Philippines Stock Market. Has contracts with over 50 companies and manufactures over 1200 medical products from two factories near Manila.
Pascual Laboratories	The third largest pharmaceutical company in the Philippines. Manufactures and sells supplements, vitamins and functional nutritional food items. Having a factory in Balagtas. Of their products, 75% are their own and the remaining 25% are manufactured on assignment.

(Source: METI FY2015 Medical Technology, Service Center Promotion Program, and Medical International Expansion Country Report: The Philippines)

3.5 Import vs. export of pharmaceutical products

As there are only a limited number of pharmaceutical companies in the Philippines that have an advanced manufacturing capability, pharmaceutical companies mainly import raw materials and finished products from other countries. Subsequently, imports exceed exports in pharmaceutical trading in the Philippines (Espicom, 2014). Fig. 3 illustrates the recent trends in the Philippine Pharmaceutical trade.

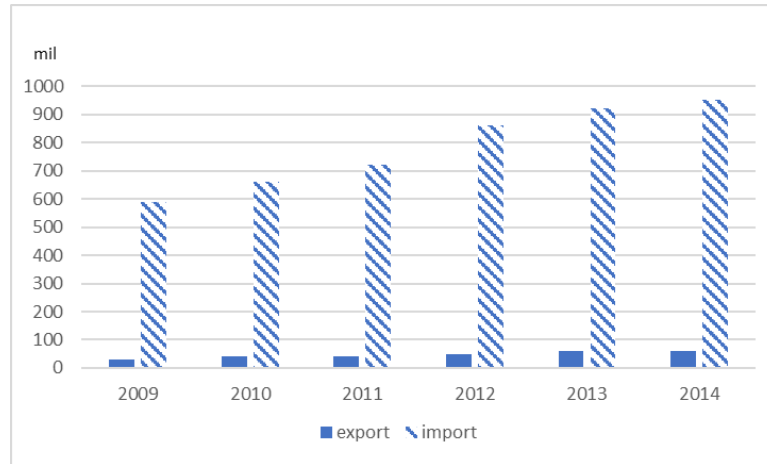


Figure 3. Imports and Exports of Pharmaceutical Products in the Philippines
(Espicom, 2014)

Alternatively, foreign-owned companies appoint Philippine pharmaceutical companies with advanced manufacturing capabilities to produce their pharmaceutical companies. However, there is only one contract manufacturer in the Philippines with the necessary advanced technology to produce products for foreign capital firms, and subsequently, the firm, Interphil Laboratories, received assignments from over 40 foreign companies.

4 IPR Practices in the Philippines

4.1 The Philippines Intellectual Code

After the Philippines won independence from the U.S. in 1946, the Philippine government enacted the Philippine Intellectual Property Code. As mentioned above, the Philippines revised the law in 2008 due to enforcement of TRIPS (WIPO website: Philippines). This new patent law in the Philippines was supposed to be TRIPS compatible. However, the Philippine Intellectual Property Code contained a unique safeguard clause, Section. 22 as follows:

Sec.22 Non-Patentable Inventions. The following shall be excluded from patent protection:

22.1. Discoveries, scientific theories, and mathematical methods, and in the case of drugs and medicines, the mere discovery of a new form or new property of a known substance, which does not result in the enhancement of the known efficacy of that substance, or the mere discovery of any new property or new use for a known substance, or the mere use of a known process unless such known process results in a new product that employs at least one new reactant.

For the purpose of this clause, salts, esters, ethers, polymorphs, metabolites, pure form, particle size, isomers, mixtures of isomers, complexes, combinations, and other derivatives of a known substance shall be considered to be the same substance, unless they differ significantly in properties with regard to efficacy (JPO website: Philippines Intellectual Property Code Republic Act).

Section 22 of the Philippines Intellectual Property Code is very similar to Section 3(d) of India's Patents (Amendment) Act, 2005. It is said that the Philippine government decided to insert Section 22

after observing the Indian government’s successful insertion of Section 3 (d) into India’s 2005 Patents (Amendment) Act.

4.2 Patent practices in the Philippines

As mentioned above, the Philippines enacted its patent law, the Philippine Intellectual Property Code in 1947, after it won independence from the U.S. The Philippine Patent Office (IPO) accepts IPR applications, examines them, and grants patent rights (IPO website).

According to the IPO, a patentable invention is any technical solution to a problem in any field of human activity which is new, inventive, and useful. An invention may relate to a product (e.g., machine, device, article of manufacture, composition of matter, or microorganism), process or method (e.g., method of use, method of manufacturing, non-biological process, or microbiological process), computer-related invention, or to an improvement of any of the foregoing (IPO website, about patents).

According to the IPO, the office received 3,098 patent applications and granted 1,998 patents in 2016. However, most of the applications were submitted by foreign residents (2,844 non-residents versus 254 residents), and most of the granted patents were applied for by foreign residents (1,967 non-residents versus 31 residents) (IPO website, statistics).

Figures 4 and 5 illustrate the trends in patent applications and grants in the Philippines between 2003 and 2017.

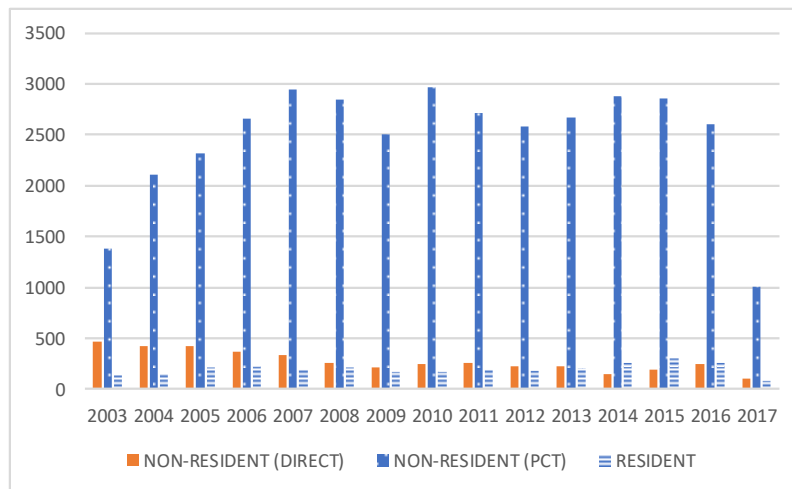


Figure 4. Patent Applications in the Philippines between 2003 and 2017

(Source: IPO website)

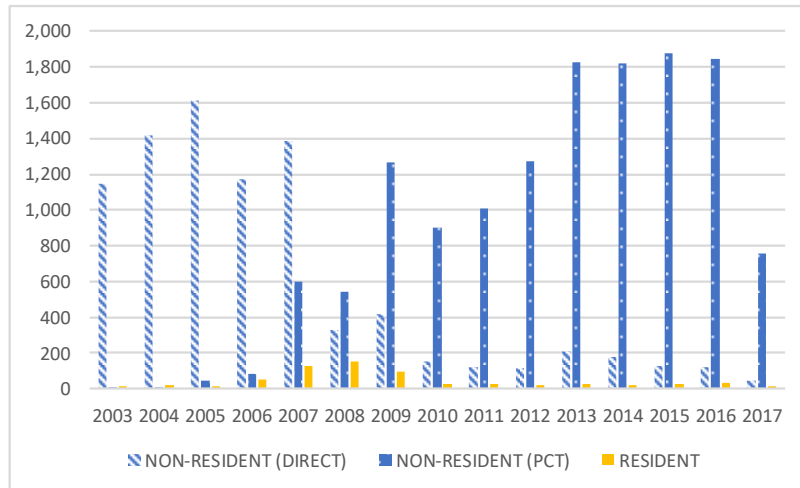


Figure 5. Patents Granted in the Philippines between 2003-2017

(Source: IPO website)

IQVIA, an information business specializing in pharmaceuticals, compiled the number of pharmaceutical-related patent applications and granted patents in the Philippines between 1997 and 2016. According to IQVIA, in the Philippines 699 patents were applied between 1997 and 2016, and 616 patents were granted during the same period. Figures 6 and 7 illustrate the number of pharmaceutical-related patent applications in the Philippines and the number of pharmaceutical related patents granted in the Philippines respectively (IQVIA, 2017).

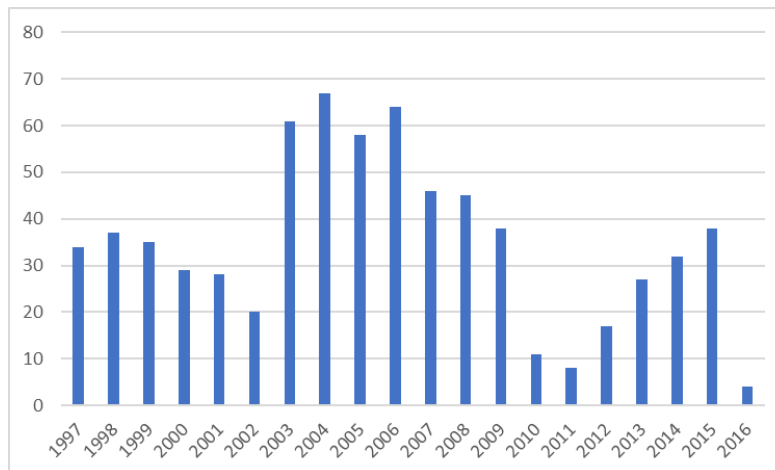


Figure 6. The Number of Pharmaceutical-related Patent Applications in the Philippines

(Source: IQVIA)

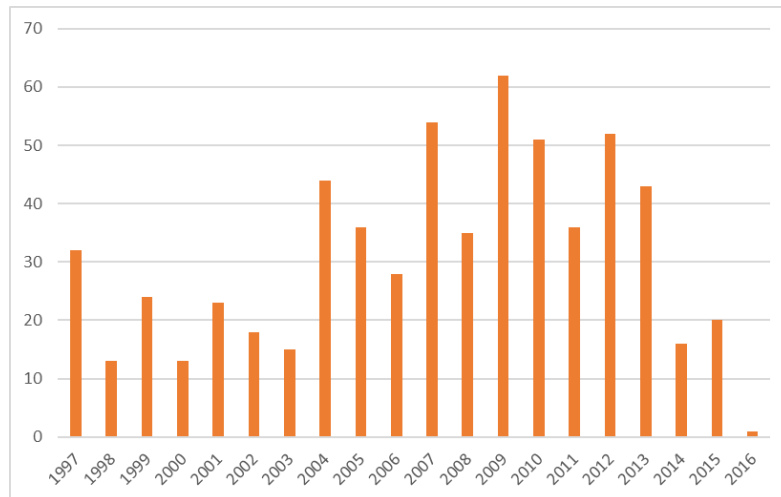


Figure 7. The Number of Pharmaceutical-related Patents Granted in the Philippines

Source: IQVIA

5 Discussion

The Philippines inserted Sec. 22 into the Philippines Intellectual Property Code after observing India's successful insertion of Section 3 (d). In India, Section 3 (d) caused controversy partly because the Indian patent office rejected patent applications based on Section 3 (d) and partly because the Indian Patent Office issued compulsory licenses based on Section 3 (d).

However, Section 22 of the Philippine Intellectual Property Code did not give rise to significant controversy as had been the case with India's Section 3 (d).

There are two possible reasons for the phenomenon:

First, Section 22 of the Philippine Intellectual Property Code is less rigorous regarding the application of the patentability requirements than is India's code. The IPO compiled the Examination Guidelines for Pharmaceutical Applications Involving Known Substances. The Guidelines note that efficacy may refer to therapeutic efficacy or any of the advantageous properties (for instance, bioavailability, stability, and solubility among others) exhibited by the new form of a known substance.

The other reason is that domestic pharmaceutical companies in the Philippines do not have any research and development functions and so they tend not to apply for patents.

IQVIA, an information business specialized in pharmaceuticals, compiled the number of pharmaceutical related patents in the Philippines between 1997 and 2016. According to IQVIA, the top 10 companies that submitted patent applications to the IPO in the Philippines were Novartis, BI, BMS, Bayer, Schering Corp., Abbott, Pfizer, AstraZeneca, Roche, GSK, and Merck & Co. No companies from the Philippines are included in this list (IQVIA 2017).

Accordingly, even if the IPO were to reject patent applications submitted by a foreign organization, there are no Philippine pharmaceutical companies capable of producing the generic versions of the medicine by themselves.

6 Conclusion

In the wake of the enforcement of TRIPS, all member countries were required to adopt strong

patent laws. However, to protect its domestic pharmaceutical industry, India inserted a unique clause, Section 3 (d), into its patent legislation. Other countries, inspired by the success of India's Section 3 (d), also inserted similar clauses into their patent laws. The Philippines was one such country. Unlike India's Section 3 (d), the Philippines' version, Section 22, did not give rise to significant debate.

This study found two reasons for that phenomenon: (a) The Examination Guidelines for Pharmaceutical Patent Applications Involving Known Substances, compiled and executed by the IPO, and (b) a weak Philippine pharmaceutical production industry.

The Examination Guidelines compiled by the IPO led to a less rigorous application of the patentability requirements than was the case in India, and subsequently it was relatively unlikely for foreign-owned companies not to obtain patents.

As described above, the domestic pharmaceutical industry in the Philippines is much smaller, and its capability is much lower than India's. Thus, even if the IPO were to reject patent applications submitted by foreign-owned companies, domestic companies are not capable of producing pharmaceutical products. Hence, the Philippines' Section 22 has not engendered significant controversy.

However, the Philippines is one of the frontier countries designated by the IMS, and the Philippine pharmaceutical industry has an opportunity to develop with an annual growth rate of 3.8% over the next five years. If this happens and the domestic industry gathers momentum, Section 22 of the Philippine Intellectual Property Code could begin to have a significant impact.

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Intellectual Property Analysis: Patent Quality among Japanese Chemical Sectors

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Abstract:

Patents and chemical industry complete each other. Most chemical companies around the world used patent as their protection for inventions and innovations. There are no doubts of qualities of patents in the chemical industry, however do all the chemical industry sector produce high quality patents? This study will identify the differences in patent quality among four chemical industry sectors which are agricultural chemical (1), commodity chemical (2), diversified chemical (3), and specialty chemical (4). This study used forward patent citation as a measurement of patent quality and analysed it by using Kruskal-Wallis test to see the similarities or differences between each sector. This research has found that there are no similarities in patent qualities in chemical industry sectors thus the quality of patent for each sector are different. Hence, in this research great emphasis will be made on its globally in relation to aspect of patent management and different characteristics of each chemical industry sector.

Keywords: Patent quality; chemical industry sector; forward patent citation; Kruskal Wallis analysis

1 INTRODUCTION

Chemical Industry is an industry that heavily depending on product innovation to keep their competitive advantage (Heinzelbecker, 2005). Relationship between chemical industry and innovation not a new thing. Intellectual property especially patent mostly known to protect inventions and innovations. Chemical company all over the world keep using patent protection as their protector for technology or invention. As May 2018, World intellectual property office or WIPO recorded more than 1.4 million of patent applications related to chemical industry between 2012 until 2016 and data from Japan patent office (JPO) shows there are more than 40,000 patents filed during the same period. As an industry player in chemical industry along China and the United States, Japan also use patent protection for prevent others infringe their creation.

Technology development is concentrated in high-income countries and Japan are belong to one of them (Lohse, 2014). Japan's innovation especially patents not only great in number but also comes with better quality compared to other countries (Dutta, Lanvin, & Wunsch-Vincent, 2016). No wonder chemical industry ranked second in japan manufacturing industry after deliver more than 43 trillion Yen shipments in 2014 (JCIA, 2016). Previous research in Japanese chemical industry only focus on manufacturing capabilities (Kikkawa, 2011) and market potential for small and medium enterprise (Hirano, 2014). Several researchers did focus on Japan's chemical industry but very limited research that focus on patent quality. Thus, this research focused on the quality of patent among chemical industry sectors in Japan.

2 LITERATURE REVIEW

• Intellectual Property – Patent

According to Trott (2012) in his fifth edition of Innovation Management and New Product Development book, there are four main types of intellectual property (IP) which are patents (1), copyright (2), registered designs (3) and registered trademarks (4). Each of IP types have their own distinct features which also offers different kind of protections. Patents are granted to individuals and organizations that can lay claim to a new product or manufacturing process, or to an improvement of an existing product or process, which was not previously known (UKIP, 2007). The rationale behind the granting of a temporary monopoly by the state is to encourage creativity and innovation within an economy (Trott, 2012). UK Intellectual Property Office (UKIP)

stated that the granting of a patent gives the 'patentee' a monopoly to make, use or sell the invention for a fixed period of time, which in Europe and the United States is 20 years from the date the patent application was first filed. In return for this monopoly, the patentee pays a fee to cover the costs of processing the patent and more importantly publicly discloses details of the innovation. Not everything in the world are patentable. However, there are some exclusions from patents especially for discoveries (as opposed to inventions), scientific theory and mathematical processes under the Patent Act 1988.

Recent studies on patents are usually focused on the technology or knowledge transfer (Ji, Lim, & Park, 2016; Kavusan, Noorderhaven, & Duysters, 2016; Noailly & Shestalova, 2017), and the effect of patents activities on firm performance (D. Kim, Kim, & Kim, 2018; McCarthy & Aalbers, 2016). Noailly and Shestalova (2017) in their research used patent citations to identify knowledge spill-overs in renewable energy technologies where they find out that knowledge spill-overs not only occurred in the same technology field it is also occurred to different fields of technology. Patent citation analysis study also can be used to identify the potential of technology transfer deal (Ji et al., 2016). Kavusan *et al.* (2016) also investigate on possibilities of knowledge transfers happen by referring to similarities in the patent applicant fields of technology, and previous experiences with alliances that related to patent activities. Relationship between patents activities and firm performances also been discussed in several researches. McCarthy and Aalbers (2016) shows that geographic distance of between patent assignee and assignor, and cross-borders patent transfer influence post-acquisition innovative performance. A study in renewable sector also suggested that patent protection is an important factor for firms in improving their economic value (D. Kim et al., 2018).

- **Quality of patent**

Quality also an important aspect for a patent. Empirical study shows that high-quality patent can improve company performance (Hall, Jaffe, & Trajtenberg, 2005). A research by Trappey et al. (2012) focused on improving patent quality analysis by setting up new quality indicator. They used investment, maintenance, and litigation as the primary patent quality indicators. Co-ownership of patent also significantly improve the quality of a patent (Briggs, 2015; Kavusan et al., 2016). Extensive research on quality of a patent also have been done by Chen and Chang (2010) where they used four indicators to measure patent quality. Relative patent position, revealed technology advantage, Herfindahl–Hirschman Index of patents, and patent citations are four indicators used by them. A study by Sterzi (2013) in UK academic patents found that quality of a patents also different when compared into the status of applicants. He concluded that patents belong to companies are higher quality than patents belong to universities for short and middle-term.

Mostly used variable in previous research for classification of patent quality is patent citations. Citations provide researchers with a historical trail about the development of technology and provide a means to assess and rank the importance of individual patents. There are two types of technology development flow in patent citation which are backward citation and forward citation (Briggs, 2015; Gress, 2010; Nagaoka, Motohashi, & Goto, 2010). Forward patent citations are highly correlated with the value of the invention (Aristodemou & Tietze, 2018; Caviggioli & Ughetto, 2016; Chen & Chang, 2010; Goto & Motohashi, 2007; Hall & Harhoff, 2012; G. Kim & Bae, 2016).

- **Chemical industry – Patent Activity**

The chemical industry supplies chemical products and raw materials to various industries and its products are widely used in plastics, pharmaceuticals, cosmetics, textiles, detergents, paints and agrochemicals, thereby making the chemical industry a major contributor to the development of other industries and to the improvement of people's lives. (JCIA, 2011). Patent citation analysis study in European chemical and pharmaceutical sectors found that most of patent applied in European Patent Office (EPO) are citing patent from chemical companies in the United States (Criscuolo, 2003). However, there is a research found that chemical industry in emerging economies are did not using IP at all in their business where companies are reluctant to registering the intellectual property of innovations and keep maintaining industrial secrecy (Thomas, 2018).

In this current state, Japan's chemical industry can be considered a pivotal industry for the next generation (Hirano, 2014). According to Japan Chemical Industry Association (JCIA), in 2014 there are four out of top 30 chemical companies in the world are come from Japan. Japanese chemical companies research and development intensity is the highest in the world (JCIA, 2016; Windisch, 2014). Data from Ministry of Internal Affairs and Communications of Japan in 2014 shows chemical industry invest more than 2.6 trillion yen in research and development and at the same period Japan Patent Office report that more than 9,000 patents are granted. On average, the level of patents quality in chemical industry are high (Goto & Motohashi, 2007).

3 HYPOTHESES

This study is proposing to use this hypothesis for testing. This study assumed that, as all the companies compete and belong to the same industry which is chemical industry, thus there are no differences in the patents

quality for each sector in chemical industry. Agriculture chemical, commodity chemical, diversified chemical and specialty chemical should have the same level of patent quality.

- H-null = There are no differences in patent quality among Japanese chemical sectors. @ Patent quality among Japanese chemical sectors are the same.

To reject H-null hypothesis, this alternate hypothesis is made.

- H1 = There are differences in patent quality among Japanese chemical sectors. @ Patent quality among Japanese chemical sectors are not same.

4 METHOD AND SAMPLE

Patent data for this study are come from year 2004 until 2013. The time period end at 2013 because of the availability of the forward citation data. Patent application that filed after January 2014 at JPO did not have enough forward citation in order to be analysed. This is mostly because of the period of patent application is quite time consuming. The minimum time for a patent to be granted is set at 18 months from the patent application date. Quality of a patent can be measured by using patent citation. Patent with high citations can be considered as patent with high quality. Quality of patent are measured by using forward citation frequency. In this study, a patent should be cited more than 5 times in order be classified as high-quality patent.

$$Company Patent Quality = \frac{\sum Company Patent Application minimum 5 forward citations}{\sum Company Patent Applications} \quad (1)$$

Samples for this study are selected from Japanese chemical companies from year 2006 to 2013. To identify chemical companies, Thomson Reuters Business Classification (TRBC) and Japan Standard Industrial Classification (Rev. 13, October 2013) Structure and Explanatory Notes are used. For TRBC classification, chemical companies that are classified under the basic materials sector and chemical industry group are used. Market-oriented system is used in order to classified companies in TRBC. The market-oriented system tracks the primary business of a corporation and reflects global industry practices by grouping together correlated companies that offer products and services into similar end markets. By using Japan Standard Industrial Classification, chemical companies that belong to *Division E* Manufacturing are selected. *Division E* comprises establishments engaged in manufacture and wholesale of new products by rendering physical and/or chemical changes to organic or inorganic substances. Chemical industry is divided into 4 different sectors. Agriculture chemical, Commodity chemical, Diversified chemical and Specialty chemical.

There are 163 listed chemical companies in total for Japan. Most of chemical companies in Japan belong to Commodity sector which up to 110 companies and there are 13 companies belong to agriculture chemical, 13 companies to diversified chemical and 27 companies for specialty chemical.

5 ANALYSIS AND DISCUSSION

Not all listed companies in Japanese chemical industry apply for patent application from 2004 until 2013. As this study evaluated quality of patent, companies that did not have any patent applications are excluded from this study sample. Only 152 companies have minimum one patent and they are the sample for this research. As figure 1 show, 103 companies with minimum a patent are belonging to commodity chemical sectors while 26 companies are for specialty chemical sectors. Diversified chemical companies resulted with 13 companies and 10 remaining companies that hold a patent in chemical industry sector is agriculture chemical.

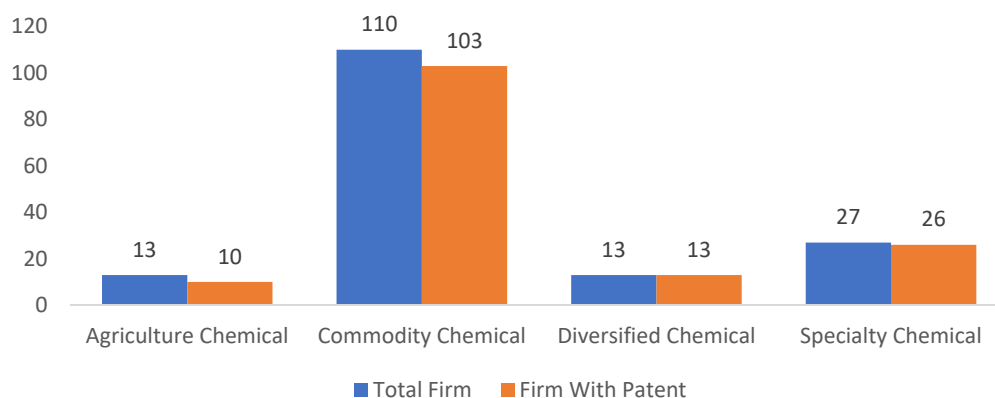


Figure 1: Chemical Industry by Sectors

Total patent application for listed chemical companies in Japan is accumulated at 190614 patent applications. Commodity chemical sector rank first as the most active patent applicant with more than 120000 patent applications for this study period. The least active patent applicant came from agriculture chemical sector which is only at 1524 patent applications

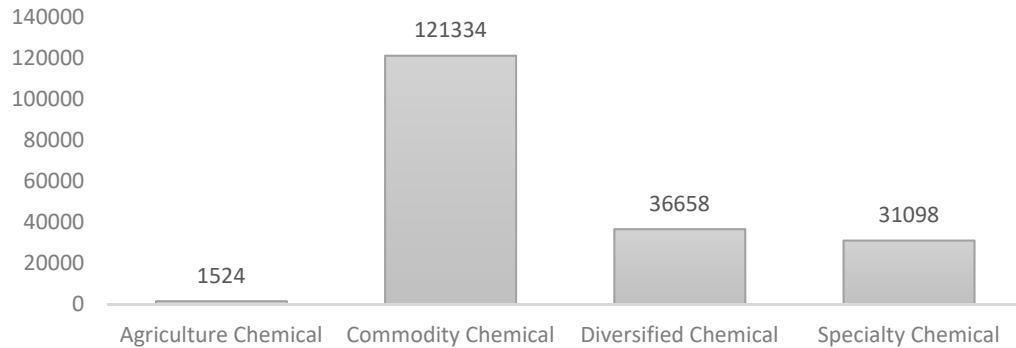


Figure 2: Patent Application in Chemical Industry by Sector

On an average, companies in specialty chemical sector (25%) are leading in the patent quality if compared to companies from commodity chemical sector (21%), diversified chemical sector (20%), and agriculture chemical sector (17%). The top companies in the rank for this study dominated by commodity chemical sector. 24 out of top 38 companies are from commodity chemical sector. With average more than 35% patent classified as high-quality patent, commodity chemical sector patent clearly leading in the Japanese chemical industry. There are only one company from agriculture chemical sector, three companies for diversified chemical and 10 companies from specialty chemical sectors.

Table 1: Kruskal-Wallis input data

Industry	R	n_k	R^2
Agriculture	1022	10	1044484
Commodity	7956	103	63297936
Diversified	1110	13	1232100
Specialty	1540	26	2371600
DF = 3	$N = 152$		$X^2 = 7.81$

However, not all companies in commodity chemical sector possess high quality patent. 24 companies out of 38 companies from the bottom are came from commodity chemical sector. There are six agriculture chemical sector companies belong to the bottom of the rank and only three companies from specialty chemical sector did not perform well in this study. Last but not least, five companies classified in diversified chemical sectors perform poorly for patent quality study.

This study used Kruskal Wallis test to compared the quality among all four sectors as this test are capable to compare the distributions of scores on a quantitative variable obtained from 2 or more groups. The critical value for this study is set at $X^2(df = 3, p = 0.05) = 7.81$.

$$H = \frac{12}{N(N+1)} \left(\frac{R_1^2}{n_1} + \frac{R_2^2}{n_2} + \frac{R_3^2}{n_3} + \dots + \frac{R_k^2}{n_k} \right) - 3(N+1) \quad (2)$$

$$H = 7.9678$$

After followed Kruskal-Wallis, $X^2 = 7.81$, $p < 0.05$ test on Japanese chemical sectors patent quality, the percentage of high quality patents displayed at each chemical sector is summarized in Table 3. The distributions of quality of patents displayed were significantly different among the four types of sectors. H-stat value for this study is higher (7.9678) than value which is set at degree of freedom 3 and p-value for this study came out at 0.0467 which is lower than 0.05.

Table 3: Quartile values for the percentage of quality by each of the four types of chemical sectors

Patent Quality	Chemical Sector Type			
	Agricultural Chemical	Commodity Chemical	Diversified Chemical	Specified Chemical
Median	0.1447	0.2083	0.185	0.2355
Q1	0.0970	0.1584	0.1302	0.1969
Q3	0.2089	0.2639	0.2644	0.3020

Thus, this study managed to reject H-null hypothesis and concluded that there are differences in patent quality among chemical sectors in Japan.

6. CONCLUSION AND FUTURE RECOMMENDATION

The purpose of this study is to analyse the patent quality among Japanese chemical sectors. Based on analysis of patents data, the quality of patents among Japanese chemical sectors are varied. Each sector shows different patent quality as commodity chemical sectors being the best chemical sectors in Japan. Thus, further studies in patent quality for each sector are needed. Future studies should put more focus on why there are differences in patent quality even though they are from the same industry. Do each sector got different approach in intellectual property strategy especially patent strategy? Are different strategies for Intellectual Property being used for Japanese chemical industry?

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Appendix

Industry	Ranking	Quality %	Co. ID
Agriculture Chemical	2	50.00%	10
	64	22.56%	7
	67	22.27%	2
	105	16.77%	6
	115	15.13%	13
	119	13.81%	3
	131	11.54%	12
	137	9.09%	11
	139	7.69%	9
	143	2.04%	1
Commodity Chemical Sector	3	50.00%	51
	4	50.00%	70
	5	50.00%	89
	8	41.18%	21
	9	41.01%	94
	10	40.00%	52
	11	37.14%	43
	12	35.94%	107
	13	35.71%	33
	15	35.46%	69
	17	33.33%	20
	18	33.33%	24
	19	33.33%	55
	23	30.97%	105
	25	30.37%	67
	27	29.64%	35
	28	29.56%	22
29	29.47%	60	
Industry	Ranking	Quality %	Co. ID

Industry	Ranking	Quality %	Co. ID
Commodity Chemical Sector	99	18.25%	119
	100	17.93%	78
	101	17.78%	72
	103	17.09%	115
	104	16.95%	34
	107	16.74%	16
	108	16.67%	96
	109	16.63%	117
	110	16.13%	113
	111	15.97%	25
	112	15.94%	61
	113	15.75%	36
	114	15.50%	32
	116	14.71%	82
	118	14.29%	39
	120	13.79%	44
	121	13.77%	14
	123	13.27%	90
	124	13.21%	116
	125	13.04%	97
	128	12.47%	92
	129	12.12%	50
	130	11.68%	93
	132	11.36%	59
	133	10.36%	104
	134	9.94%	30
	136	9.61%	56
	138	7.84%	37
Industry	Ranking	Quality %	Co. ID

Commodity Chemical Sector	31	28.99%	28
	33	28.57%	40
	34	28.57%	87
	35	27.97%	123
	37	27.37%	111
	38	27.18%	46
	39	27.08%	26
	40	26.74%	54
	44	26.04%	108
	45	25.81%	122
	46	25.62%	48
	47	25.51%	98
	48	24.64%	118
	49	24.57%	88
	50	24.54%	79
	51	24.44%	65
	53	23.71%	91
	54	23.47%	68
	55	23.30%	49
	57	23.12%	81
	58	22.75%	73
	59	22.68%	101
	60	22.68%	58
	63	22.57%	76
	65	22.52%	19
	66	22.37%	64
	68	21.88%	95
	69	21.79%	27
	70	21.73%	106
	71	21.68%	99
	73	21.43%	41
	74	21.43%	86
	76	21.15%	15
	77	20.83%	66
	79	20.51%	110
	81	20.06%	47
	82	20.00%	80
	85	19.61%	42
	87	19.05%	18
	88	18.97%	57
	89	18.90%	103
	90	18.75%	102
	91	18.66%	121
	92	18.57%	77
	93	18.56%	45
	94	18.52%	75
	96	18.43%	63
	98	18.29%	17

Commodity Chemical Sector	140	5.88%	71
	141	4.17%	53
	142	2.30%	23
	144	0.00%	62
	145	0.00%	74
	146	0.00%	100
	147	0.00%	109
	148	0.00%	112
	149	0.00%	120
	Diversified Chemical Sector	6	50%
22		31%	124
36		28%	135
42		26%	129
56		23%	130
80		21%	125
95		18%	126
97		18%	133
122		14%	131
126		13%	127
127		13%	134
150		0%	132
151		0%	136
Specialty Chemical Sector		1	55%
	7	47%	144
	14	35%	143
	16	35%	161
	20	32%	155
	21	31%	141
	24	30%	148
	26	30%	159
	30	29%	156
	32	29%	153
	41	27%	158
	43	26%	162
	52	24%	152
	61	23%	140
	62	23%	139
	72	22%	142
	75	21%	138
	78	21%	157
	83	20%	147
	84	20%	145
	86	19%	163
	102	17%	137
	106	17%	151
	117	15%	149
	135	10%	146
	152	0%	150

Factors Affecting Intellectual Assets Management in SMEs

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Abstract SMEs give positive contribution to the economy growth and play an important role in the development of both industrialized and developing countries. Intellectual assets management is believed to be very important especially in technology-oriented SMEs. However, SMEs are unlikely to invest in creating a strong IP position unless they are aware of the value of managing their intellectual assets and of the appropriate tools that can be deployed to this end. Furthermore, due to their smaller company size, SMEs often refrain from using registered IPRs despite their widely recognized importance for innovations and appropriation. They prefer informal protection practices as they found them more familiar, cheaper, less time-consuming and more effective than IPRs. This paper aims (i) to understand the current practice of intellectual assets management in SMEs; (ii) to investigate the awareness of SMEs to the importance of intellectual assets management to their company; and (iii) to examine the application of trade secret protection as part of intellectual assets management in SMEs.

Keywords SMEs, Intellectual Assets Management, Trade Secret, Confidential Information

1 Introduction

SMEs give positive contribution to the economy growth and play an important role in the development of both industrialized and developing countries. As drivers of technological creativity, SMEs boost their growth by promoting innovation across local and international economies (Stanley, 2009). Equivalently essential, they need to innovate continuously and faster than their rivals to ensure their survival in today's competitive and rapid changing environment. SMEs need to carefully choose strategies in order to appropriate the returns from innovation investments. This means, SMEs need to recognize, understand and manage their IP well in order to protect them. One of the ways is to delicately conduct an ideal intellectual assets management in the organization.

Intellectual assets management is believed to be very important especially in technology-oriented SMEs. This is very true indeed as intellectual assets can be seen as one part of company's most valuable assets. This is mainly because companies are relying on the intellectual assets to create value for the company. Intellectual assets may include skills, technical know-how and also IPR where they provide the foundation of competitiveness for SMEs (Yoshida, 2016). Intellectual assets management is much more than a process for patenting and licensing inventions. Successful intellectual assets management considers all intellectual assets. These assets include valuable information and trade secrets as well as patentable inventions. Intellectual assets management involves an integration between intelligence gathering, information protection, patent analysis and intellectual property licensing. As a result, companies practicing intellectual assets management process may achieve efficiencies in many business processes (Naomi, 2003).

However, SMEs are unlikely to invest in creating a strong IP position unless they are aware of the value of managing their intellectual assets and of the appropriate tools that can be deployed to this end. (Jennifer Brant et al, 2013). Furthermore, lack of awareness of the importance of IP and lack of competence in managing IP is a barrier to successful innovation in many countries. On top of that, existing advisory services offered to SMEs are often inadequate, as most of these services focus on patents (UNECE; Knowledge-Based Development, 2012).

Formal IP rights such as patent, trademark and copyright provide innovators a reward system to make ex-post profits by excluding imitators for a finite period. Despite their widely recognized importance for innovations and appropriation, SMEs often refrain from using registered IPRs. This may be due to their smaller company size when it comes to the awareness, acquisition and enforcement of IPRs and instead probably rely on informal methods such as secrecy. (Thoma, J. et al, 2013).

Most SME owner-managers preferred informal protection practices because they found them more familiar, cheaper, less time-consuming and more effective than IPRs. Thus, the majority of small business owners did not consider the use of IPRs as an impediment to the successful appropriation of innovation returns. Indeed, most owner managers were largely indifferent to the IPR system, since they felt that it neither facilitated nor hindered their innovative efforts. (Kitching, J. et al, 1998). However, the empirical work on trade secrets to date is relatively scarce. There is little research addressing whether and under what conditions firms in developing countries use trade secrets. (Barbe, 2016).

As a result, to address these gaps, this paper reviews existing literature and try to investigate how intellectual assets management play an important role in SMEs and to see the extent of preference to adopt trade secret protection by SMEs. The growing literature and discussion about intellectual assets management and trade secret protection in SMEs leads to the following research objectives:

- i. to understand the current practice of intellectual assets management in SMEs,
- ii. to investigate the awareness of SMEs to the importance of intellectual assets management to their company.
- iii. to examine the application of trade secret protection as part of intellectual assets management in SMEs.

2 Literature Review

2.1 SMEs

SMEs played a remarkable role in the development of several countries as they constitute a major part of the industrial activity both in developed or developing economies. Today, globalization is an emerging issue which can affect the growth of SMEs. SMEs may develop through the exchange of know-how and technology transfer or they may face failure due to the pressure from domestic and international market.

The term “SME” portrays a wider spectrum of definitions as there is no specific definition that may be taken as a reference. The definition varies from country to country. According to Berisha G et al (2015), they stated that SMEs are commonly divided into classes according to some quantitative measurable indicators. The most common criterion to distinguish between large and small businesses is the number of employees. On top of that, financial criterion such as annual turnover and annual balance sheet are also deemed to be important criterion in defining SMEs.

2.1.1 SMEs in Japan

Looking back on the history of development made by Japanese industries in the Post War Period, we can recognize the important roles played by SME (Yamashita, 2014). According to the Government of Japan, SMEs in Japan form the backbone of its high degree of technological development where they possess expertise and know-how. SMEs in Japan include all firms with less than 300 million yen in capital or less than 300 employees. SMEs employ 40 million people in total or one third of the total population of Japan, and span the entire range of industry including manufacturing, wholesaling and services, and are located throughout the country (Yoshida, 2016). According to the 2009 economic census, Japan had a total of 4.21 million enterprises, of which 4.20 million (99.7%) were considered SMEs. Among them, 3.67 million (87.0%) were considered small enterprises with fewer than 20 employees (Shimizu, 2013).

2.2 Intellectual Assets Management

Intellectual assets management is much more than a process for patenting and licensing inventions. Successful intellectual assets management considers all intellectual assets. These assets include valuable information and trade secrets as well as patentable inventions. Intellectual assets management involves an integration between intelligence gathering, information protection, patent analysis and intellectual property licensing. As a result, companies practicing intellectual assets management process may achieve efficiencies in many business processes (Naomi, 2003).

According to Yoshida (2016), the term “intellectual assets” refers to all management resources other than intangible fixed assets reported on the balance sheet. Intellectual assets include intellectual property rights, intellectual property and intangible assets, and provide the foundation of competitiveness for the enterprise. Recognizing, combining and utilizing them provide the source of generating corporate profits and growth. On top of that, these assets provide the foundation of competitiveness for SMEs.

Some intellectual assets can be protected in the form of legal right which may include patent, registered trade and service marks, and copyright. Alternatively, intellectual assets can be protected through informal practices that do not directly entail an attempt to create legal rights. (Kitching, J. et al., 1998).

Conventionally, although SMEs run their business by taking advantage of these unseen but unique strengths, they may not have a clear idea of their intellectual assets as unique management resources. Therefore, many of them have failed to consciously utilize intellectual assets, or present the contents appropriately in their dealing with business partners and financial institutions. For this reason, such assets have not received the due recognition they deserve.

2.2.1 Intellectual Assets Management in Japan

According to the Interim Report produced by SME Intellectual Asset-Based Management Forum, SMEs are facing with numerous challenges in securing human resources, achieving stable fund-raising and improving relations with business associates in today's competitive business environment. Despite these challenges, many of these SMEs appear to have sustained their business through utilizing technologies, integration capacity, customer or community networks, geographical advantage, trust, tradition and other strengths that have been accumulated through many years of sales activities as intellectual assets for generating profits. Although many SMEs in Japan are consciously taking advantage of these intellectual assets, there are still some of them who are tapping into their business strengths subconsciously or almost unconsciously.

2.3 Trade Secret

Apart from formal IP rights, firms commonly use alternative protection mechanisms such as trade secret to appropriate rewards to innovation (Hall, 2014). Often the trade secret is backed up with trademarks, patents, copyrights and designs, but it is the trade secret that is very significant to an enterprise.

A trade secret can be defined as information that is not generally known to those in the relevant industry, confers some sort of significant economic or commercial benefits on its holder, and is the subject of reasonable efforts in arriving at and to maintain its secrecy through reasonable steps (Kumar, 2012). A trade secret can only be protected by keeping it secret by continually performing administrative and security measures required by trade secret laws.

Secrecy in itself can confer commercial advantages over rivals, and often the continued commercial success of a business can depend on an adequate protection of its secrecy (Verma, 1998). SMEs in a wide variety of industry sectors are more likely to rate trade secrets as "very important" than all other types of IP protection. They consider trade secrets to be the most effective means for protecting returns on innovative products and processes rather than to forgo the use of patents because of their cost. Besides cost, firms are likely to rely on trade secrets to protect their innovations mainly because they can be protected for an unlimited duration and formal registration is generally not required.

However, although trade secrets are highly valuable to firms, its nature makes it vulnerable to misappropriation and theft as well. (David, 2012). Firms often store knowledge in the experience of individuals especially when such knowledge is tacit or hard to articulate. Therefore, the departure of employees can give away valuable sources of competitive advantage such as proprietary knowledge or technology, to immediate or future competitors if they are not managed carefully. (Younge, 2015). What is more, as firms venture and operate internationally, they become more vulnerable to trade secrets misappropriation by foreign parties as they take their trade secrets with them.

2.3.1 Trade Secret in Japan

Japan has introduced statutory protection of trade secrets in its Unfair Competition Prevention Act (UCPA) since 1991. According to the Institute of Comparative Law in Waseda University (2017), the protection of trade secrets received little attention even after the establishment of statutory protection, partly due to the notion that Japanese courts made it very difficult for information owners to successfully pursue misappropriation claims. The value of trade secret protection in Japan increased significantly when there were large-scale cases of misappropriation of valuable Japanese technology became public in the last years. On top of that, the general interest in trade secrets held by Japanese corporations has been increasing and accounts for a growing portion of their worth. However, unlike patents, once a trade secret

is made public, its value is immediately lost. For this reason, the Japanese government decided to strengthen deterrence measures that are available against trade secret infringement.

3 Data and Methodology

3.1 Questionnaire Development

A questionnaire has been developed and distributed to a number of companies. The questionnaire consists of three parts; the first part is related to basic questions which involves industry sector and company size, the second part is about intellectual asset management and the last part is related to trade secret practice.

For the first part, we referred to one of the ministries in Japan- Ministry of Economy, Trade and Industry (METI) as SMEs in Japan is located under this ministry. The second part involves intellectual asset management in SMEs where we try to investigate the current practice of intellectual asset management in SMEs particularly on the awareness of intellectual assets as well as their protections and we follow the questions from Krelitz (2014). For the final part, this paper aims to examine trade secret practice or the way SMEs protect their confidential information and we follow the questions from Kumar (2012).

3.2 Samples

Samples of this study are selected from SMEs in Japan particularly in Chugoku region. The respondents were reached by invention centre in Hiroshima. The methods used for our sampling process is purposive sampling as the questionnaire was distributed to the respondents mostly by hand. This paper is a preliminary research and so far, we had received a total of 60 responses.

4 Results

4.1 The Survey Results

The results from the questionnaire are discussed in this section. The first section clarifies the respondents attribute; intellectual assets management in SMEs is examined in the second section; the third section argues trade secret practice or the way SMEs protect their confidential information.

4.1.1 Respondents Attribute

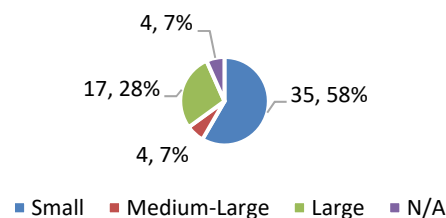


Figure 1 Number of SMEs According to Size

According to Figure 1, most of the respondents are small in size which represents 58% of the total respondents. The second highest respondents come from large companies which represents 28%.

Finally, there are only 7% from the respondents which come from medium-large companies and another 7% respondents did not state any answer.

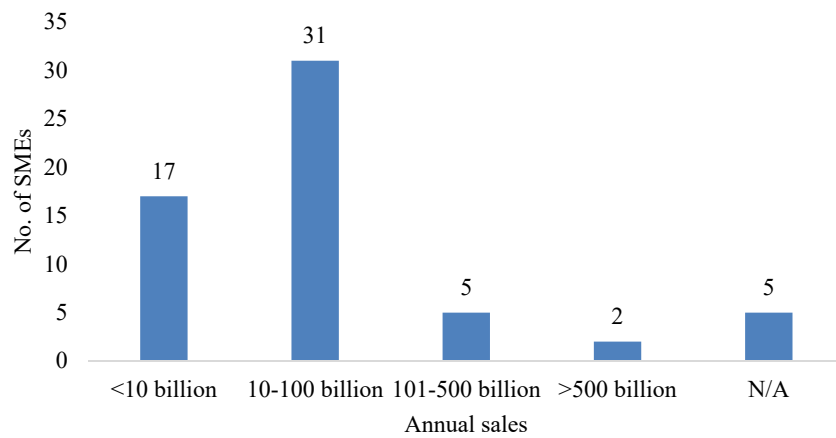


Figure 2 Number of SMEs According to Annual Sales

According to Figure 2, the highest number of the respondents have sales ranging from 10 to 100 billion yen per annum. Next, quite a number of respondents have sales below than 10 billion yen per annum. Finally, there are few numbers of respondents that have sales more than 100 billion yen per annum.

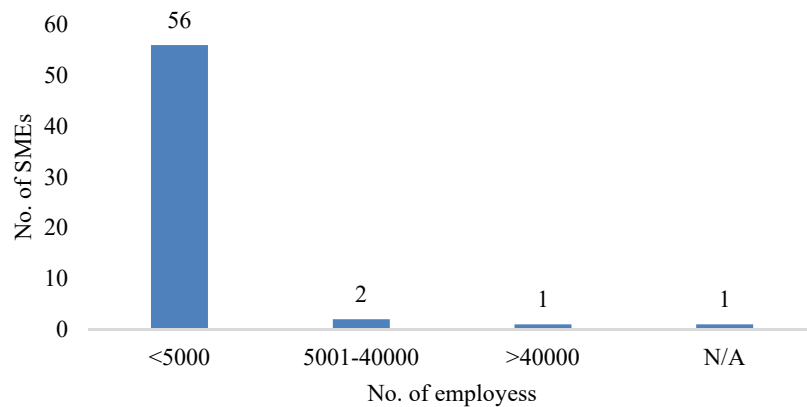


Figure 3 Number of SMEs According to Number of Employees

Furthermore, majority of the respondents have less than 5000 number of employees. There are few companies that have more than 5000 employees. This shows that most of the respondents are small in size.

4.1.2 Intellectual Assets Management

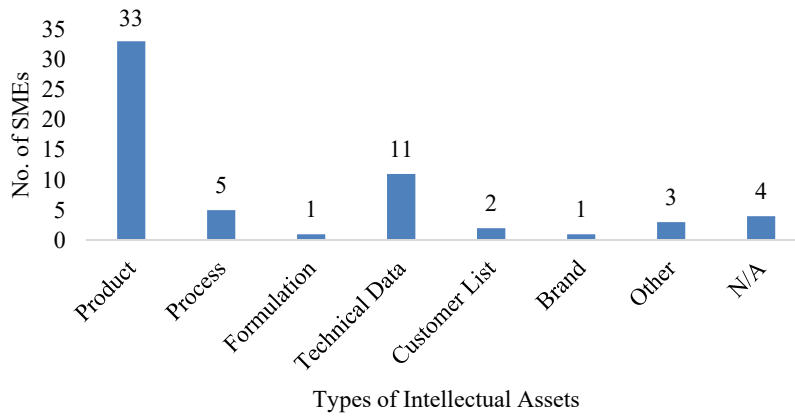


Figure 4 Number of SMEs According to Types of Intellectual Assets

Based on figure 4, we can see that majority of the respondents remarked products as the important intellectual assets that they possess, while the second most preferred intellectual asset is technical data. Few respondents stated process as their important intellectual assets. Other types of intellectual assets that were least preferred include customer list, formulation, brand and others.

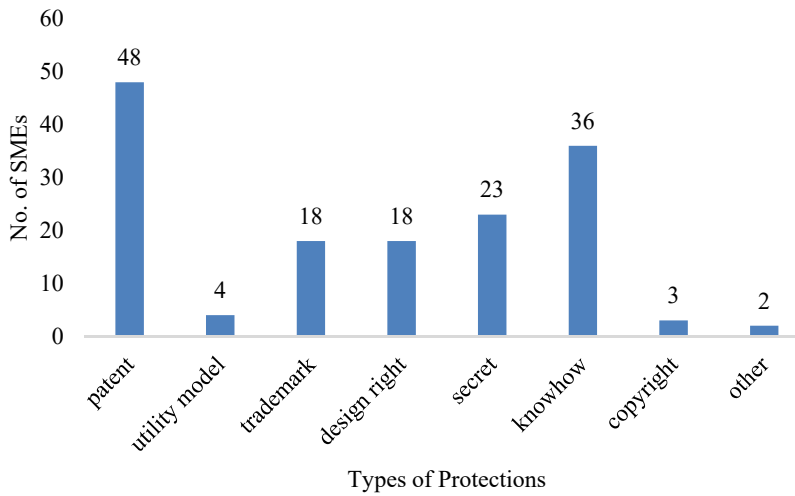


Figure 5 Number of SMEs According to Types of Protections

From the result above, it can be seen that SMEs in Japan are protecting their intellectual assets with various types of protection. The most popular protection measure adopted by them is patent, while the second most preferred protection is know-how. The result also portray that SMEs in Japan protect their intellectual assets by keeping it secret which means they are using trade secret protection in securing their intellectual assets. Other types of protections adopt by them include trademark, design right, utility model, copyright and others.

4.1.3 Trade Secret

In this paper, we conducted cross-tabulation analysis and chi-squared test to see the integration of trade secret protection as part of intellectual assets management in SMEs in Japan.

Table 1 Cross Tabulation and Chi-squared Test of Notification to Employee and Rule to Classify Confidential Information

rule to classify confidentia l information	notification to employees			Total
	-9. missi	1. yes	2. no	
1. yes	0 2.8 0.00	40 30.8 95.24	2 8.4 4.76	42 42.0 100.00
2. no	4 1.2 22.22	4 13.2 22.22	10 3.6 55.56	18 18.0 100.00
Total	4 4.0 6.67	44 44.0 73.33	12 12.0 20.00	60 60.0 100.00

Pearson chi2(2) = 34.7475 Pr = 0.000

We conducted a cross tabulation analysis and chi-squared test to see whether SMEs notify their employees in regards to their confidential information depends on the rule to classify the confidential information. Based on table 1, we can see that 40 SMEs that have rule to classify confidential information will notify their employees about their confidential information, but it is expected to have 30.8 SMEs by chance. By contrast, there are 4 SMEs that will notify their employees about their confidential information with no rule to classify confidential information, but it is expected to have 13.2. Thus, 9.2 more SMEs that have rule to classify confidential information will notify their employees about their confidential information than is expected by chance and 9.2 fewer SMEs with no rule to classify confidential information will notify the employees about their confidential information.

Hence, we can say that SMEs that have rule to classify confidential information are more likely to notify their employees about their confidential information than those who did not. In the sample of 60 SMEs, 95.24% of those having rule to classify confidential information will notify the employees in regards to the confidential information as compared with just 22.22% of those with no rule. This relationship between rule to classify confidential information and notification to employee is statistically significant, $X^2(2, N = 60) = 34.75, p < .01$.

Table 2 Cross Tabulation and Chi-squared Test of Notification to Employee and Measure to Keep Secret

measure to keep secret	notification to employees			Total
	-9. missi	1. yes	2. no	
-9. missing	3 23.08 75.00	0 0.00 0.00	10 76.92 83.33	13 100.00 21.67
1. <2	0 0.00 0.00	7 87.50 15.91	1 12.50 8.33	8 100.00 13.33
2. 2-3	1 4.55 25.00	20 90.91 45.45	1 4.55 8.33	22 100.00 36.67
3. 4-5	0 0.00 0.00	17 100.00 38.64	0 0.00 0.00	17 100.00 28.33
Total	4 6.67 100.00	44 73.33 100.00	12 20.00 100.00	60 100.00 100.00

Pearson chi2(6) = 46.7077 Pr = 0.000
 Cramér's V = 0.6239
 gamma = -0.5193 ASE = 0.209
 Kendall's tau-b = -0.3544 ASE = 0.147

We conducted a cross tabulation analysis and chi-squared test to see whether SMEs notify their employees in regards to their confidential information depends on the number of measures used by SMEs to keep secret. According to table 2, we can see that only 87.85% of SMEs with less than two measures to keep secret will notify their employee in regards to the company's confidential information, compared with 100% of SMEs with measures between four to five to keep secret.

Hence, we can say that SMEs that have higher number of measures to keep secret are more likely to notify their employees about their confidential information than those who have a smaller number of measures to keep secret. This relationship between number of measures to keep secret and notification to employee is statistically significant, $X^2(6, N = 60) = 46.71, p < .01$ and has a moderate relationship, tau-b between .2 and .49.

Table 3 Cross Tabulation and Chi-squared Test of Damage due to Information Leakage and Leak of Confidential Information

leak of ts	damage from information leakage			Total
	-9. missi	1. yes	2. no	
-9. missing	2 2.5 66.67	1 0.4 33.33	0 0.1 0.00	3 3.0 100.00
1. yes	0 7.3 0.00	6 1.2 66.67	3 0.5 33.33	9 9.0 100.00
2. no	17 13.9 100.00	0 2.3 0.00	0 0.8 0.00	17 17.0 100.00
3. don't know	30 25.3 96.77	1 4.1 3.23	0 1.6 0.00	31 31.0 100.00
Total	49 49.0 81.67	8 8.0 13.33	3 3.0 5.00	60 60.0 100.00

Pearson chi2(6) = 50.7406 Pr = 0.000

We conducted a cross tabulation analysis and chi-squared test to see whether damage due to information leakage depends on the leak of confidential information. Based on table 1, we can see that 6 SMEs that are experiencing information leakage will have to face damage caused by the leakage but it is expected to have 1.2 SMEs by chance. By contrast, no SMEs will have to face damage as there were no information leakage occurred, but it is expected to have 2.3. Thus, 4.8 more SMEs experiencing information leakage will have to face damage caused by the leakage than is expected by chance and 2.3 fewer SMEs facing damage as there were no information leakage occurred.

Hence, we can say that SMEs that are experiencing information leakage are more likely to face damage caused by the leakage than those who did not. In the sample of 60 SMEs, 66.67% of those experiencing information leakage will have to face damage caused by the leakage as compared with 0% of those with no rule. This relationship between leak of confidential information and damage due to information leakage is statistically significant, $X^2(6, N = 60) = 50.74, p < .01$.

5 Conclusion

In verifying the first objective of this paper which is to understand the current practice of intellectual assets management in SMEs in Japan, the results obtained from the questionnaire reveals that SMEs in Japan are protecting their intellectual assets with various types of protection where the most popular protection measure adopted by them is patent. However, the result also portray that SMEs in Japan consider trade secret as an important protection in securing their intellectual assets. For the second objective of this paper which is to investigate the awareness of SMEs to the importance of intellectual assets management to their company, we found that almost all respondents, 98.3% are fully aware of the importance of protecting their intellectual assets. For the final objective which is to examine the application of trade secret protection as part of intellectual assets management in SMEs, it seems that the respondents are practicing trade secret as part of their intellectual asset management. The results also justify that the respondents are well-informed to the consequences or damage occurred due to information leakage when practicing trade secret.

While our study is preliminary, we believe it opens the opportunity for further research investigating the integration of trade secret as part of intellectual asset management in SMEs. With respect to legal protection measure, we don't examine the reasons that some SMEs decided to secure by legal rights. It is interesting to know the factors which drive SMEs to think legal protection seriously.

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New Management Strategy based on Patent Analysis in FPGA field

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Abstract Semiconductor companies are constantly bounded by customer demands for smaller, lighter, faster and more powerful devices. They are continuously introducing new models and adding more features to enhance their devices. However, the product life-cycle curve in semiconductor devices today is shorter and steeper than ever before. With shortened life cycle, the high management executives are difficult to make a right decision which regions and technologies they need to focus more. In this paper, we propose a new management strategy for semiconductor companies to compete in this smart era by using patent analysis with link mining method. We focus on an advanced FPGA technology because this market is mainly driven by raising demand for optimization in Big Data analytics, growth of Internet of Things (IoT), huge adoption in smart-phone and held devices and growing adoption of Advanced Driver Assistance System (ADAS). We extract the information from Classification Patent Codes (CPC) that submitted by Intel, Altera and Xilinx suppliers using link mining as the analytical method. We analyze the metadata and create a graph theory to see the degree of the nodes. The experimental results show the technological structure and recommendation for the semiconductor management which regions they need to pay most attention. In conclusion, this patent analysis with the link mining method can help the top management predict where the business model of semiconductor industry will be shifted.

Keywords FPGA, Patent, Technology Structure Analysis, Link Mining, Graph Theory

1. INTRODUCTION

The semiconductor industry has evolved into one of the critical foundations for the global economy and this industry goes to keep up with developments in a world that is rapidly moving beyond smart. In the biggest semiconductor exhibition/conference, SEMICONWEST, the key phrase was “SMART STARTS HERE” last year, but this year is changing to “BEYOND SMART”. “Beyond smart era” means all things are digital, integrated and all connected without human intervention. It also means everything are smart and intelligent like smart home, smart phone, smart machine and others by using IoT (Internet of Things), Big Data or AI. Furthermore, it means experiencing the cutting-edge of changes driving the industry forward. One example of smart-era technology is IoT, which is a network of physical devices, home appliances and other items embedded with electronics, software, sensors, actuators and network connectivity which enable these objects to connect and exchange the data. Hence, the demand for collecting a large amount of data and processing the data in real time also increase. However, the industry is not without challenges and these challenges must be addressed if we want to continue on historic growth track. One of the problems, due to short product life cycle, the top management often confused in which market and field are the most worth for them to penetrate. In addition, in term of technologies the processing performance needs to be improved on both the edge- and the cloud-sides.

A semiconductor company must decide what areas it plays in and equally, what areas it does not play in. It requires a lot of more detailed works and faith to choose the right target market and segment, and devise a compelling, hard-to-imitate value proposition, backed up by internal resources and patience. It must focus equally on strategy and execution – in all areas of its business. It requires an increase in risk appetite, a change in mindset, an ability to make sense of the environment, and agility – and that is a long change journey to undertake. The top management needs to have three fundamental aspects of marketing which are analyzing market, targeting markets and finally finding the best way to sell semiconductor products to those market. Targeting and positioning are called sources of sustainable competitive advantage. To do market analysis, there are two major aspects which are identifying and segmenting the

market. The process of analyzing and targeting market can be applied by patent analysis with link mining method.

In addition, edge computing becomes an essential component of the data driven applications. Usually users install and run edge computing software in existing environments. The hardware can be dedicated or shared with other services. In many scenarios, it is common to use the system LSI called embedded System-on-a-Chip (SoC). It satisfies reducing power consumption and improve reliability. All the sensors talk to the local edge devices which manage the connectivity with the cloud. Amazon Web Service (AWS) and Microsoft Azure are examples of device edge software. A large amount of data will be transmitted from edge devices to the cloud to server installed on the cloud side. The real time processing to transmit data is very crucial. Hence, this will definitely increase the processing power. Therefore, in addition to high-performance CPUs, high performance GPUs and large capacity memories are required to perform parallel calculation. The SoC is the core of the edge devices, but it is difficult to apply to edge devices of small production because of high price and long lead time. In addition, servers on the cloud side mainly use Intel x86, AMD and NVIDIA GPUs have a lack of flexibility to support new protocols. To solve these problems, Field Programmable Gate Array (FPGA) has been proposed. FPGA market is growing in the rapid pace. Owing to its high adoption in smart phones and handheld devices, its implementation in wireless networks for increasing the bandwidth and growing demand for electronics components in automobile industry is driving the market growth. FPGA also can be used as the SoC and no limit on how many operations can be simultaneously executed by a computer. The development period of FPGA is also much shorter because the manufacturing process is unnecessary, and it relatively has lower power consumption. This FPGA technology is very suitable for implementing CPU accelerators and user protocols.

Intel (former Altera), Xilinx, Microsemi and Quicklogic are key players and supplier of FPGA. In recent years, Xilinx adds an ARM core to its FPGA to create FPGA SoC. Intel also has released a chipset for server combining its own CPU and FPGA and reference design for fog computing.

This paper focuses on capturing and finding the technological field where FPGA suppliers focus on. We extract the information from Classification Patent Codes (CPC) submitted by these suppliers and usage of link mining method as the analysis method. It is a method of abstracting the elements and their relationships in the analysis subject into the nodes and the edges to create a graph, and search its structural features. There are several kinds of graphs such as weighted / unweighted and directed / undirected-graphs. And there are various kinds of indices which represent the structural features such as order, centrality, cluster coefficient, transitivity, density, and so forth. We analyze the metadata and create the graph theory to see the degree of the nodes. This paper also analyzes the market and identifies which markets these suppliers should focus on.

2. RELATED WORKS

This chapter describes related work on our proposed method. Many market analysis about semiconductor industry has been made so far [1]. Introduction of Semiconductor Marketing book proposed FPGA has several attributes that provide companies competing in this space with defensible long-term positions in the market. The two main players in the FPGA area are Xilinx and Altera. The FPGA industry also benefited the foundries by helping the Taiwanese foundries take market share away from ASIC companies, primarily located outside of Taiwan. “Sustaining Moore’s Law Uncertainty Leading to a Certainty of IoT Revolution” by Ravi Batra [2] is precise in his analysis that it is very important for the semiconductor industry professionals to look for new ideas to sustain a progress of Moore’s Law.

Mark Bohr, a senior fellow in Intel manufacturing group, said that what started out as an observation become a guide for them that they needed to follow and if possible, they want faster than anyone else in the industry. He also doesn’t think Moore’s Law will end, it will evolve and change in terms of what they do. The semiconductor industry’s ability to innovate and develop ICs of one sort or another will continue for a long time. Masashi Shibata et al. [3] proposed the trend analysis of the technology development on FPGA with Machine Learning based on the public information. Thus, succeeded in revealing the companies’ technological transition and their differences and common points from the results of extracting the graphs’ features.

In term of technology, many technical analysis methods using the patent have been made so far [4 - 6]. They are performed for the purpose of business solution. TRIZ (Teoriya Resheniya Izobretatelskikh Zadatch) aims at performing technical development based on the structure of problem solving which appears repeatedly in the patent [7, 8]. Kawakami et al. propose the inconvenience idea gains support

system aid of inventive problem solving theory TRIZ [9]. Thus, many measures have been taken as having centered on the patent for a business solution.

Then, we look down about the patent analytical skills. One of the techniques of patent information analysis is the patent mapping. Kiriya made content analyses with this method [10]. Shide et al. performed finding the change of the positioning for customer of research and development activities of the company using the patents analyses [11]. Kimura proposed a technology evaluation method based on patent analysis for technology strategy planning [12]. As for the analysis of important information derived from patent analysis, Carpenter analyzed for important cited patents [13]. Muguruma showed the validity of the patent citation analysis to propose FCA (Forward Citation Applicant) map [14]. Sato et al., proposed the importance calculation method of the patent document based on the citation information [15]. Ogawa et al, proposed a basic patent extraction based on the citation information [16]. For citations, Albert conducted a validation of citation for important patent among the industry [17].

In place of which were performed heuristically so far, as for the patent classification, such as category of invention and problem, Tanaka proposed method of extracting the feature automatically [18]. Yamashita proposed a method of surveillance technology and specific method of patent classification with text mining [19]. Yamamoto et al, proposed a method to enhance the compatibility of the search by applying the information of related patent documents in search of academic papers. Yamamoto proposed a method to find the scientific papers with a variety of further information [20, 21]. Kleinberg extracted the topic and description of the relationship with graph theory [22]. Eto proposed a measure of co-citation based on structural units of the paper [23]. Ueda proposed the technical analysis with an active mining method that focuses on the cognitive processes of the patent examiner, utilizing patent classification such as IPC (International Patent Classification), FI (File Index), and F-term (File Forming Term) [24]. Thus, with the application of the technology of intelligent informatics, knowledge extraction is performed to the patent information.

Then, it looks down about the mining technology, which is one technique of knowledge extraction [25 - 27]. The relationship of analytical methods and technologies, technology analysis method using patent information is described. Structured technique using graph theory has been applied in various fields. For instance, chemical formula, WWW (World Wide Web), social network, statements with grammatical structure and dependency. A graph is made for expressing the structure of the object, and make it use for the analysis, finding the partial graph which occurs frequently from the set of graphs [28]. From the results of the related work studies, the relationship is able to describe using this method. This paper is employed link mining for the patent analysis.

3. EXPERIMENTAL CONFIGURATION

This chapter describes the configuration of this experiment. In general, patent information consists of metadata, such as application date, applicant, classification codes, literal information and graphic information. Classification codes include those used internationally, such as IPC, CPC and those used domestically such as ECLA, USPC, FI, F-term and so on. IPC and CPC indicate the technological fields of the main topics of the patent's claims.

CPC is the classifier that began granting from 2013 [29, 30]. It is retroactively assigned to patents which filed before 2013. It has a hierarchical structure like other classifiers. It is separated Section (Alphabet 1 character) - Class (2 digits) – Subclass (Alphabet 1 character) - Main group – Subgroup hierarchically. There are about 250 thousand groups in total. In this experiment, four alphanumeric characters up to subclass are used. Up to subclass, there are 649 categories.

Two kinds of CPCs are given to a patent. One is Head-CPC and the other is Sub-CPC. Head-CPC indicates the technology field which the patent mainly belongs. Sub-CPC indicates the technology field which is related to the patent. The number of CPC varies depending on the relevant technical field of the patent. For example, Intel's patent: 9,532,239 has 5 CPCs such as G01S 5/14; H04L 43/08; G01S 13/876; G01S 13/765; and H04W 24/02, and its Head-CPC is G01S 5/14. Here we focus on the US patent owned by FPGA suppliers: Xilinx, and Altera acquired by Intel in 2015. The analytical period is for 16 years from 2001 to 2016. The full text database of the U.S Patent and Trademark Office [31] is used as experimental datasets. Applicant: Altera, Xilinx, and Intel are used as search keywords. As a result, 3,884, 3701, 34,316 patents are obtained respectively. Among them, filed in 2001 through 2016, 3,302, 3,113, 26,949 patents are analysed.

At first, the patents are grouped by every 6 month. Then, for representing the technological structure of a patent, a directed graph is created for each patent. CPCs given to the patent are used as nodes, and edges are drawn between Head CPC and Sub CPCs. The edge's direction is Head CPC to Sub CPCs. There is no edge between Sub CPCs. The graph is unweighted graph. Fig.1. shows an example of the graph of each patent. Then, semi-annual graphs for each supplier are created by overlaying patents' graphs in every 6 month of application. The number of link appearance is accumulated for every appearance of the edge. Thus, the graphs are directed and weighted graphs.

In this experiment, we focus on the degree of each node of the graph. Degree represents the number of edges connected to a node. The nodes connected with more edges are considered to be core technologies at that time. In Fig.2, the size of a node indicates the number of the degree of the node. The thickness of an edge indicates the number of times, and the nodes have the relation as the Head CPC and the sub CPC. Therefore, 4 CPCs out of 11 have high degree. The graph is a directed graph. Therefore, the degree is calculated by adding inward degree and outward degree.

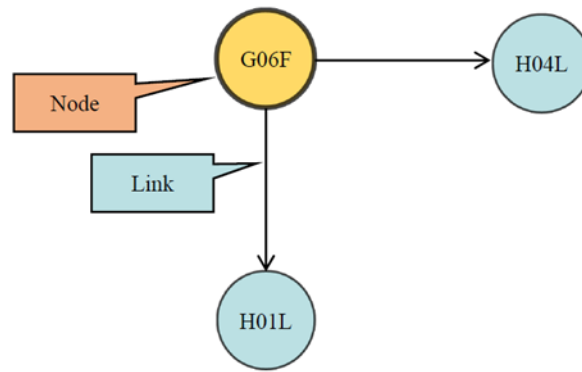


Figure 1 Directed graph of each patent.

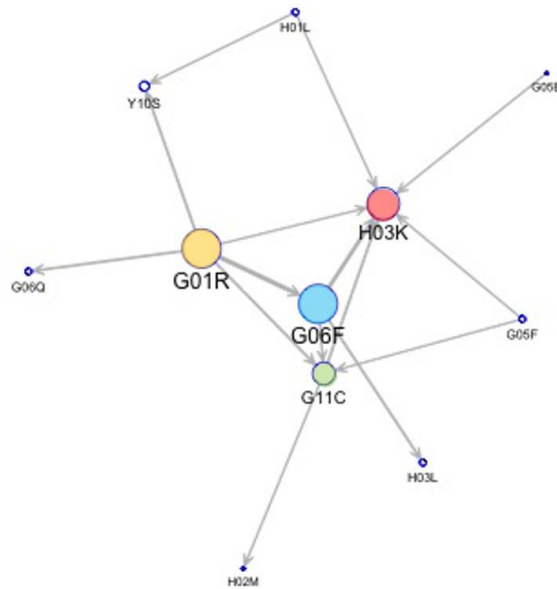


Figure 2 Semi-annual graph.

4. EXPERIMENTAL RESULTS

This chapter describes the results of the technological structure analysis. Table 1 shows the five CPCs which have the highest degree for each supplier for every 6 month. We analyze giant FPGA companies Altera, Xilinx and Intel, even though Altera is now part of Intel, we still compare their data to see where the business shift after Intel purchased Altera. All of the three companies have high degrees of G06F, H01L, and H04L throughout the period as shown in Fig. 3. This means the field of data processing, semiconductor device, and digital data transmission continue to be important for these companies throughout the period.

Table 1 High degree CPC list.

		Altera					Xilinx					Intel				
2001	fh	G01R	G06F	H03K	G11C	Y10S	G01R	G11C	G06F	H01L	G09G	G06F	H01L	H04N	H05K	H04L
	sh	G01R	G06F	H03K	G11C	G06Q	H03K	G06F	G11C	H01L	H03L	G06F	H01L	H04N	Y02B	Y10S
2002	fh	H03K	G06F	G11C	G01R	G05F	G06F	H03K	G11C	G06N	H01L	G06F	H01L	H05K	H04N	Y10S
	sh	H03K	G06F	H01L	G01R	H03L	H03K	G06F	H03L	H04L	G11C	G06F	H01L	H05K	H04L	Y10S
2003	fh	H03K	G06F	G11C	G01R	H03M	G06F	G01R	H01L	H03K	G01B	G06F	H01L	H05K	H04L	Y10T
	sh	H03K	G01R	G06F	G11C	H01L	H03K	G06F	G11C	H03L	H01L	G06F	H01L	H05K	Y10S	Y10T
2004	fh	G06F	H03K	G01R	H01L	G11C	G06F	H03K	H01L	G01B	H03D	H01L	G06F	H05K	H04L	Y10S
	sh	H03K	G06F	G11C	H03L	G01R	H03K	G06F	G01R	H01L	H03L	G06F	H01L	H05K	Y10T	Y10S
2005	fh	G06F	H03K	G01R	G11C	H01L	H03M	G06F	H03K	G01R	H01L	H04L	H01L	G06F	Y10T	H04L
	sh	H03K	H01L	H04L	G06F	H03L	G06F	H03K	G01R	H04L	H01L	G06F	H01L	Y10S	H04L	B82Y
2006	fh	H03K	G06F	H03L	H04L	H01L	H03K	G06F	G01R	G11C	H01L	G06F	H01L	H04L	H05K	Y10T
	sh	H03K	G06F	G11C	H03L	H04L	H03K	G06F	G01R	H04L	G11C	G06F	H01L	H04L	H05K	Y02B
2007	fh	G11C	H03K	G06F	H03L	H04L	G06F	H03K	H04L	G01R	G11C	G06F	H01L	H04L	H05K	Y02B
	sh	H03K	G06F	H04L	H01L	H04J	G11C	H03K	G06F	H01L	H04L	G06F	H01L	H04L	H05K	B82Y
2008	fh	H03K	G11C	G06F	H04L	H03M	G06F	H03K	G01R	H04L	G11C	G06F	H01L	H04L	H05K	Y10T
	sh	H03K	G06F	G11C	H04L	H01L	G06F	H03K	H04L	G01R	G11C	G06F	H04L	H01L	Y02B	H04W
2009	fh	H03K	G06F	G01R	G11C	H01L	H03L	G06F	H03K	G01R	H04L	G01R	G06F	H01L	H04L	Y10T
	sh	H03K	G06F	G11C	H03L	H04L	H03K	G11C	G06F	G01R	H01L	G06F	H01L	H04L	H04W	H05K
2010	fh	H03K	G06F	H04L	H03L	G11C	G06F	H03K	H04L	H01L	G11C	G06F	H01L	H04L	H05K	Y02B
	sh	G06F	H03K	G11C	H04L	H03L	G06F	H03K	G06K	G01R	H04L	G06F	H01L	H04L	Y02B	H04W
2011	fh	H03K	G06F	G11C	H04L	H03L	G06F	H03K	G01R	G11C	G06K	G06F	H04L	H01L	H04W	Y02B
	sh	H03K	G06F	G11C	G01R	H03L	G06F	H01L	H03K	G01R	G11C	G06F	H04L	H01L	H04W	Y02B
2012	fh	G06F	H03K	H01L	H04L	G11C	G06F	H03K	H01L	H04L	H03M	G06F	H04L	H04W	Y02B	H01L
	sh	G06F	H03K	G11C	H03L	H01L	G06F	H01L	H03K	H04L	G11C	G06F	H04L	H04W	Y02B	H01L
2013	fh	H03K	G06F	H04L	H03M	H03L	G06F	H04L	H01L	H03K	H03L	G06F	H04L	H04W	Y02B	Y02B
	sh	G06F	H03K	G11C	H04L	H03L	G06F	H03K	H01L	H04L	G11C	G06F	H04L	H04W	Y02B	H04B
2014	fh	G06F	H03K	H04L	G11C	H01L	G06F	H03K	H01L	H04L	Y02B	G06F	H04L	H04W	H04B	Y02B
	sh	G06F	H03K	H04L	H01L	H03L	G06F	H01L	H04L	H03M	H03K	G06F	H04L	H04B	H04W	Y02B
2015	fh	G06F	H03K	H04L	G11C	H03M	G06F	H04L	H03K	H01L	H04B	G06F	H04L	H04W	Y02B	H04B
	sh	G06F	H03K	H04L	G01R	H01L	G06F	H03K	H04L	G11C	H01L	G06F	H04L	H04B	H04W	Y02B
2016	fh	G06F	H04L	H03K	G11C	H03M	G06F	G11C	H03K	H01L	H04L	G06F	H04L	H04B	H04W	Y02B
	sh	G06F	H03K	H04L	H01L	G11C	G06F	H03K	H03M	H04B	H04L	G06F	H04L	H04B	H04W	Y02B

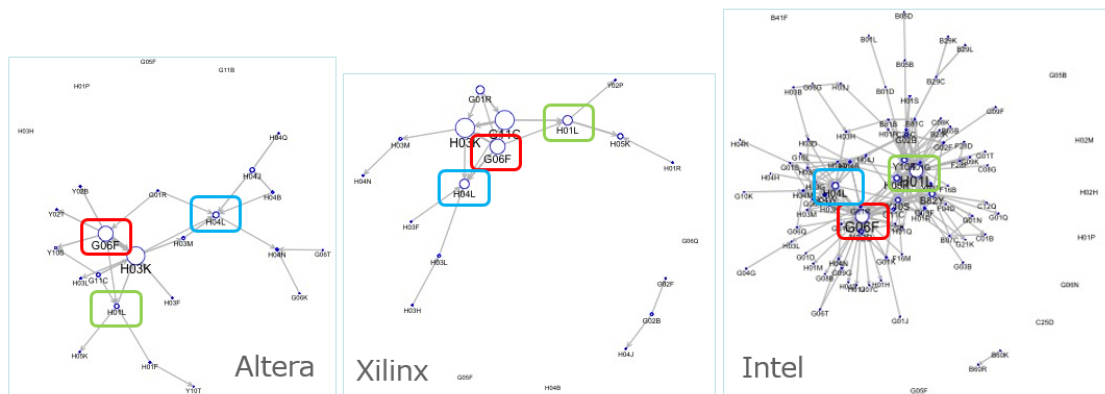


Figure 3 Technology structure.

Intel purchased FPGA-maker, Altera, in 2015. When we observe from high degree CPC list in Table 1, before Intel purchased Altera, the degree of H05K is high in the first half of the period which is focusing on technology development for chipset boards. During the latter half, the degree of H04B and H04W becomes high. It shows that the direction of development shifts to wireless transmission and data transmission. Comparing with Altera, the degree of H03K and G11C is high throughout the period. It shows that the fields of electric circuitry and memory are important and core business of this company. It means, that when Intel shifts their business to wireless transmission and data transmission, Intel plans to purchase Altera that are good in electric circuitry and memory. All of wireless transmission and these technologies are using FPGA that can be reprogrammed after it was made. Intel predicts FPGAs opportunity everywhere and purchased Altera because of Intel and Microsoft Azure project that required FPGA from Altera.

In term with Xilinx, the CPCs appeared are mostly common like Altera. Xilinx business focuses on electric circuitry and memory. At different points, Altera has a high degree of H03L (automation control circuit) throughout the period and Xilinx has a long period of high degree of G01R (measuring electric variables). In addition, the degree of H04B (wireless transmission) has been increased at the end of the period.

Therefore, we collect Altera, Xilinx and Intel-CPCs to analyze the reason behind and to see where these giant FPGA suppliers shift their business model. In addition, this patent analysis with link mining method can help the top management semiconductor companies compete in competitive advantages and targets in which segment of market they need to focus based on these suppliers trend.

5. CONCLUSIONS

This paper proposes an efficient method for semiconductor management for analysing the semiconductor business model trend with machine learning. We gathered the US patent data filed by FPGA suppliers. We employed the patent classifier to make the technology structure graph. With the proposed method, we succeeded in extracting corporate focusing business and technology area. In addition, this method can help high management to make a right decision making by proposed the worth segment they should focus on.

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Macroeconomic Environments and the Demand for Retail Space in the Shopping Centres in Malaysia

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Abstract

The performance of retail industry in a country, which simultaneously illustrates the demand for retail space, is significantly influenced by the general economic environment of said country. Previous studies have identified several macroeconomic factors that could affect the demand for retail space. However, in the case of Malaysia, studies regarding this issue are limited. This study aims to identify the macro determinants of the demand for retail space in shopping centres in Malaysia through the study of six variables: per capita income, private expenditure, inflation rate, interest rate, total population, and number of tourist arrival. The nexus between these variables and the demand for retail space in shopping centres was tested using cointegration and causality tests in the form of bivariate VAR model using annual data from year 1992 to year 2016. The results from cointegration tests found that all macro variables studied have long run relationships with the demand for retail space in shopping centres in Malaysia. Moreover, the findings suggest policy makers to consider all these variables in their long-term planning development for shopping centres industry in Malaysia. Meanwhile, the Granger causality tests show that inflation and interest rate cause short run movements in the demand for shopping centres retail space in Malaysia. The findings suggest that in order to support the growth and the development of retail industry, it is important for the government to create a macroeconomic environment with stable inflation together with low cost of borrowing. This study concludes that macroeconomic environments as well as demographic factors could influence the demand for retail space in Malaysia's shopping centres in the long run. On the other hand, only inflation rates and interest rate could affect the movements of the demand for retail space in the short run.

Keywords: retail space, shopping centre, cointegration, causality, Malaysia

1 Introduction

The wholesale and retail industry accounts for a significant share of a nation's economy. However, the performance of this industry is closely related with the macroeconomic environments of its country. A robust economy, which increases consumers' disposable income, would allow retailers to sell more goods. On the other hand, a sluggish economy that lowers consumer confidence could cause people to spend less, thus leading to decline in sales.

Retail property is a business that provides space for retailers to conduct business with customers. The demand for retail space is derived from the demand for retail goods and services. To study the demand for retail space, focus should be given on the demand for retail goods and services as highlighted by economist Tsolacos (1995), whom argued that the demand for retail space is determined by the demand for retail sales and in turn relate positively to economic trends.

The demand for retail space is influenced by the general economic situation of the country (Boykin & Ring, 1993). Therefore, it is vital to understand the macro-determinants of the retail industry, and subsequently the demand for retail space. However, most of the studies in this area concentrated on the consumer shopping behaviour and their preference (Ibrahim & McGoldrick, 2003), while others focused on varieties such as the selection of the ideal retail tenant mix (Gerbich, 1998), the determinants of shopping centre rents (Sirmans & Guidry, 1993), the impact of anchor tenants (Konishi & Sandfort, 2003), and on retail location and market competition (DiPasquale & Wheaton, 1996). For that matter, research that investigates the demand of retail space in relation to macro economy is very limited.

In Malaysia, the wholesale and retail industry continues to account a significant share of its economy by contributing about 12.7% to the country's GDP. As of 2014Q4, the industry registered an annual growth of 8.8% (PEMANDU, 2014). In line with this development, shopping centres in Malaysia also grew rapidly in the past two decades in term of number and total space. According to National

Property Information Centre (NAPIC), the total space of shopping centres in Malaysia increased to 14,638,030 square metres in 2016 from 2,624,569 square metres in 1996.

As of 2015Q2, there are 465 shopping centres in Malaysia; 59 out of this are in Kuala Lumpur (NAPIC). Furthermore, it was also reported that a total of 27 new malls are expected to be ready in greater Kuala Lumpur by 2021. Many industry players argued that there is an oversupply of shopping centres in Malaysia, especially in greater Kuala Lumpur, which is supported by the data on occupancy rate of shopping centres reported by NAPIC. The average occupancy rate of shopping centres in Malaysia for the period between 2010 and 2016 is only 80.7% (Figure 1). Meanwhile, Figure 2 clearly shows that the gap between total supply of shopping centres space in Malaysia and total space occupied enlarge over times.

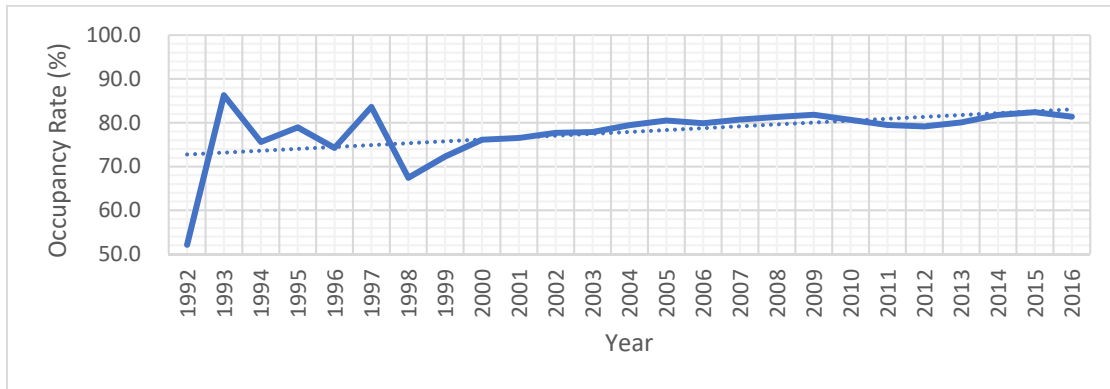


Figure 1 Malaysia Shopping Centres Occupancy Rate (1992 -2016)

Source: NAPIC

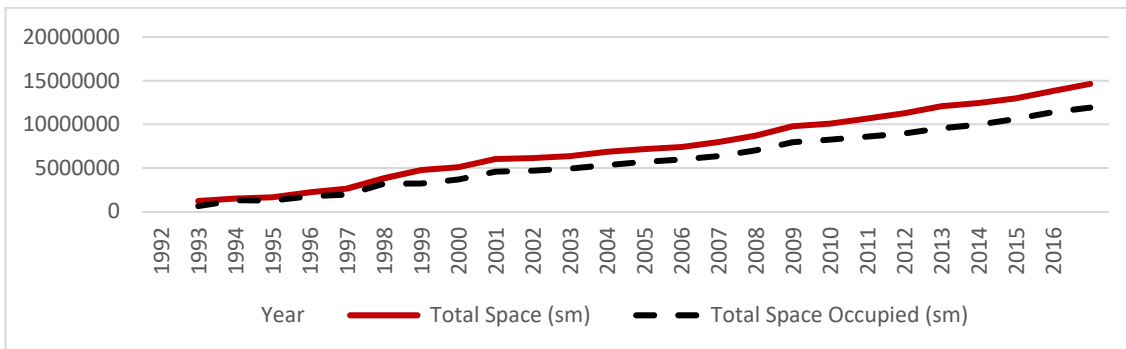


Figure 2 Malaysia Shopping Centres (1992-2016) – Total Space and Total Occupied Space (Square Meter)

Source: NAPIC

The facts presented in Figure 1 and Figure 2 indicate that despite the impressive growth of shopping centres industry in Malaysia, the industry is facing severe challenges. The shopping centres industry in Malaysia is becoming an increasingly competitive market, which can be observed through the trend in the demand and supply for retail space in the country. However, very little research has been conducted to identify the macroeconomic determinants that influence the long run demand for retail space in Malaysia. Therefore, the objective of this paper is to investigate the determinants for the demand for retail space in shopping centres in Malaysia.

Specifically, this paper intends to examine the existence of long-run relationships between macroeconomic, demographic variables, and the demand for retail space of Malaysian shopping centres by using cointegration approach. The macroeconomic variables involved in this study are per capita income, private expenditure, inflation, and interest rates. Meanwhile, the demographic factors taken into consideration for this study are total population, and number of tourist arrival.

2 Literature Review

Previous studies have identified several macroeconomic factors that could affect the demand for retail space. Benjamin et al. (1998) found that rental rates, retail sales, population growth and aggregate disposable income of the local population influence the demand for retail space. Jones (1995) concluded that rental growth is linked to the profitability of business and inflation. D'Arcy et al. (1997) established a macroeconomic model that relates the changes in retail rents to changes in a demand-side factor, which included consumer expenditure, GDP, disposable income, unemployment and interest rates.

Most of the studies on this issue, however, focused on the relationship between retail rents and macroeconomic variables. Liow (2000) argued that there is a close relationship between retail rental changes and economic fluctuations. A reduction in consumer spending during economic downturn leads to lower demand for retail goods and services, thus cause retailers to become less inclined to invest in additional space and consequently cause the demand for retail space to drop.

Tsolacos (1995) stated that retail rents are sensitive to broad economic forces in both regional and national contexts. He further suggested that the demand for retail space is derived from the demand for retail products. Ibanez and Pennington-Cross (2013) and Hendershott et al. (2002) also suggested that the rental rates of shopping centres are influenced by market conditions such as economic development, rate of local employment, size of disposable income, occupancy rate, supply and demand.

Some studies argued that the determination of retail space rental is subjected to the joint forces of both demand and supply. Tsolacos (1995) and Chaplin (2000) have included both demand-side and supply-side factors in their models. However, some researchers argue that supply-side factors have insignificant impact on retail rent determination (Hetherington, 1988) due to inelastic the supply of retail space in the short run. Fraser (1993), Key et al. (1994) and D'Arcy et al. (1997) asserted that the supply of different types of property tends to be inelastic. Therefore, retail space is primarily demand-determined.

Besides economic and demographic variables, some researchers have also investigated the impact of technology on retail sales. Baen (1999) argued that e-commerce is causing a leakage in traditional retail sales and this has profound impact on rent and retail space values. Similarly, Borsuk (1997) dealt with the implications of information technology (IT) on retail real estate and claimed that IT requires developers and investors to examine any property – owned or considered for purchase – for its adaptive use potential.

Finally, laws, regulations and other government policies can also positively or negatively affect the retail industry. Government assistance such as government-backed loans and subsidies, can help fledgling retailers grow. On the other hand, government policies can also hinder businesses by imposing regulations that increase costs, such as requiring the development and integration of new systems or establishing a minimum wage that small retailers may not be able to afford. The retail industry also relies heavily on government-supported road, rail and water transport infrastructure to move goods and bring customers to retail locations.

3 Data and Methodology

In this study, the annual data from 1992 to 2016 will be used. The main sources of data are from Department of Statistics Malaysia, Bank Negara Malaysia, National Properties Information Centre (NAPIC) Malaysia, Tourism Malaysia and World Bank Development Indicators database. The econometric tests applied in the analysis include a unit root tests, a co-integration test and Granger causality tests.

In the Augmented Dickey-Fuller (ADF) tests, the null hypothesis is the series that contains a unit root, therefore non-stationary. If the t-statistic of the estimated coefficient is greater than the critical values, the null hypothesis of a unit root is rejected, thus in favour of stationarity. In the test, the optimal lag length is chosen using the Akaike Information Criteria (AIC). This paper also uses the unit root test suggested by Phillips and Perron (1988).

In this paper, the existence of long-run relationship between the variables is determined using a Johansen cointegration test. The method suggested by Johansen (1988) could determine the number of cointegration relations that exist between the variables. Specifically, the Johansen trace tests is testing the nulls that there are less than or equal to h cointegrating relations ($r \leq h$) against the alternative hypothesis that there are more than h cointegrating relations ($r > h$).

In the final analysis, the Granger (1969) causality test will be performed. In this method, the variable y_1 is said to cause y_2 in the Granger sense if the forecast for y_2 improves when lagged variables

y1 are considered in the equation. Four findings are possible in a Granger causality test: (i) neither variable Granger causes each other; (ii) unidirectional causality from y2 to y1; (iii), unidirectional causality from y1 to y2., and (iv), bidirectional causality between two variables, which means y1 and y2 Granger cause each other.

Past studies that investigated the interaction between macroeconomic variables and the demand for retail space normally use traditional demand function with an additional measure for demographic and technology variables. In general, the relationship can be expressed in the following functional form.

$$RS_t = f(V_{it-n}) \quad ; t = 1,2,3, \dots \quad (1)$$

Where, RS_t is a total occupied retail space in shopping centres at time t (used to measure the demand for retail space), V_{it} is a set of macroeconomic variables at time t. There are four macroeconomic variables considered in this study; per capita income (GDP), private expenditure (PC), inflation rates (INF), and interest rates (proxied by Based Lending Rates, BLR). In addition, the study also included two demographic factors; total population (POP), and the number of tourist arrival (TA). However, this paper will only study the bi-variate relationship between these variables and the demand for shopping centres retail space.

4 Results

The unit root tests were conducted at level as well as at first difference of the series. The results from ADF and PP tests are presented in Table 1. The ADF test results at level show all series are not stationary at level except GDP per capita. All series, however, were found stationary at first difference except POP. Unlike ADF, the results from PP tests at level found four out of seven series are stationary at level. The series which not stationary at level are PC, BLR and TA. The results of PP tests on the first difference are consistent with the results from ADF accepts for POP. Based on the PP tests, this study concluded that all series are stationary at first difference, hence $I(1)$.

Table 1 Results from Unit Root Tests

Series	ADF		PP	
	Level	1 st Diff.	Level	1 st Diff.
RS	-0.2426	-4.4068*	-6.9820*	-6.1346*
GDP	-7.5798*	-40.4725*	-5.6810*	-120.3145*
PC	-0.4496	-4.7168*	-0.7087	-8.6030*
INF	-4.2998	-5.6201*	-4.2998*	-17.6926*
BLR	-0.7964	-4.4862*	-0.7964	-4.1705*
POP	-5.1804	-2.5043	-5.1804*	-7.2042*
TA	-1.0632	-4.5263*	-1.0580	-4.5266*

* Significant at 5% level. All data are in the form of logarithm. The optimum lag length is determined by AIC.

Next, the Johansen cointegration test was conducted to investigate the existence of long run relationship between the demand for shopping centres space in Malaysia and the variables studied. The cointegration test was performed on the bivariate VAR model consist of total occupied space (RS) of shopping centres with each of the macroeconomic and demographic variables studied, separately. The results from the test are presented in Table 2.

The trace statistics show that the variables studied are cointegrated with the demand for retail space in the shopping centres. This study found that all variables studied have at least two cointegration equations with RS. The findings indicate the existence of long run relationship between the demand for retail space (RS) in Malaysian shopping centres and per capita income (GDP), private consumption (PC), inflation rate (INF), and interest rate (BLR). On top of that, this study also found the long run relationship between the demand for retail space in shopping centre (RS) and the two demographic variables; population (POP) and number of tourist arrival (TA).

Table 2 Cointegration Rank Test (Trace) between RS and the Variables Studied

Variable	Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical value (5%)	Conclusion
GDP	None*	0.547	26.559	15.494	2 cointegrating equations
	At most 1*	0.375	9.898	3.841	
PC	None*	0.707	23.721	15.494	2 cointegrating equations
	At most 1*	0.314	7.925	3.841	

INF	None*	0.644	36.835	15.494	2 cointegrating equations
	At most 1*	0.512	15.092	3.841	
BLR	None*	0.549	25.654	15.494	2 cointegrating equations
	At most 1*	0.346	8.928	3.841	
POP	None*	0.441	16.516	15.494	2 cointegrating equations
	At most 1*	0.185	4.296	3.841	
TA	None*	0.589	27.824	15.494	2 cointegrating equations
	At most 1*	0.352	9.136	3.841	

*Denotes rejection of the hypothesis at 0.05 level. Data are in first Diff and log. Intercept (no trend) in CE and test VAR

The next analysis is to investigate the causal relationship between the demand for retail space and all variables studied. The Granger causality test was performed on the bivariate VAR model that consists of RS and variable studied individually. The results from the test are as presented in Table 3. The results show that out of six variables studied, three do not have a causality relationship with RS. The variables are GDP, POP and TA. Only in the case between BLR and RS, the bidirectional causality relationship was found. The results indicate that BLR can cause RS, and vice versa. Meanwhile, the unidirectional causality relationship was found in the case PC and INF. For PC, the direction of causality is running from RS to PC, while in case of INF, the causality is from INF to RS.

Table 3 Results of Pairwise Granger Causality Tests between RS and Variables Studied

Null Hypothesis	F-Statistic	Probability	Conclusion
GDP does not Granger cause RS	0.556	0.699	No causality relationship
RS does not Granger cause GDP	1.297	0.334	
PC does not Granger cause RS	0.746	0.582	Unidirectional from RS → PC
RS does not Granger cause PC	4.670	0.021*	
INF does not Granger cause RS	5.966	0.010*	Unidirectional from INF → RS
RS does not Granger cause INF	0.130	0.968	
BLR does not Granger cause RS	2.888	0.079**	Bidirectional causality relationship RS<=>BLR
RS does not Granger cause BLR	4.439	0.025*	
POP does not Granger cause RS	0.709	0.603	No causality relationship
RS does not Granger cause POP	0.293	0.875	
TA does not Granger cause RS	0.504	0.733	No causality relationship
RS does not Granger cause TA	0.749	0.580	

* Significant at 5 percent level. **Significant at 10 percent level. Data are in first diff and log. Max lag=4.

5 Conclusion

The demand for retail space in shopping centres is significantly determined by the macroeconomic and demographic variables of the country. However, there are not many studies that focus on this issue in the case of Malaysia. The lack of knowledge on this issue may affect future growth and development of Malaysia's shopping centres industry, and ultimately impact the retail sector as well, which is one of the main contributors to the Malaysian economy. Therefore, the objective of this study is to investigate the existence of long run relationship between the demand of retail space in shopping centres in Malaysia and selected macroeconomic and demographic variables. In addition, this study also examines the direction of causality relationship that may exist between the demand for retail space in shopping centres and variables studied.

There are six variables involved in this study; per capita income, private expenditure, inflation rate, interest rate, total population, and number of tourist arrival. The existence of long run relationship was tested using Johansen cointegration tests, while the Granger causality tests was used to examine the direction of causality relationship. Both tests were conducted in the form of bivariate VAR model consist of demand for retail space in shopping centres and variables studied, separately.

This study found per capita GDP, private consumption, inflation rate, interest rate, total number of populations, and the number of tourist arrival have long run relationships with the demand for retail space in shopping centres in Malaysia. Therefore, policy makers should consider all these variables in their long-term planning of the development of shopping centres industry in Malaysia. In contrast, the test on the short run nexus found that only inflation and interest rate could cause the short run movements of the demand for retail space in Malaysian shopping centres. Theoretically, higher inflation will reduce consumers purchasing power, hence the demand for goods and subsequently impact the demand for retail

space by retailers. While, higher interest rates increase the retailer's operation and borrowing cost as well as credit purchases by costumers. The findings suggest that in order to support the growth and the development of shopping centres industry, it is important for the Malaysian government to create an economic environment with low and stable inflation together with low cost of borrowing.

Interestingly, the causality tests also found the direction of causality between the demand of retail space in shopping centres in Malaysia and interest rate is bidirectional, which indicates that the demand for retail space could also causes the interest rate variable. In addition, this study also found that unidirectional causality runs from the demand for retail space to private expenditure in Malaysia. The findings may indicate that not only do macroeconomic variables influence the demand for retail space in the shopping centres, but the demand for retail space could also affect the macroeconomic variables, particularly the interest rate and private expenditure. However, the causality tests found no support on the causality relationship between the demand of retail space with the Malaysia per capita income. Similarly, two demographic variables, total population and number of tourist's arrival, both were found to have no causality relationship with the demand of the retail space in shopping centre.

In conclusion, macroeconomic environments as well as demographic factors have influence on the long run demand for retail space in the shopping centres in Malaysia. However, in the short run, as expected, only selected macroeconomics variables such as inflation rates and interest rate could affect the movements of the demand for retail space. In the short run, the demand for retail space could cause private expenditure and interest rates.

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Room B

Session – 6

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Empirical Analyses of Knowledge Convergence over the Second and Third AI Booms

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Abstract: AI has been through several booms and we have currently reached the 3rd AI boom which started around 2013 and AI is beginning to affect corporate management and operations. AI have been evolving over six decades. Recently AI is being adopted in many fields, not only in the manufacturing industries but also the service industries. Various technologies and scientific disciplines have been converging in AI, at the same time AI has been converging with other scientific disciplines and technologies to open up new opportunities.

In this paper, we attempt to elucidate the evolutionary path of development of AI and the structural patterns of knowledge convergence in the current and previous booms.

For this purpose we have set 2 main objectives

- 1) To characterize the first (1B), second (2B) and the current, third (3B) AI boom
- 2) To analyze the structure of knowledge convergence around AI

An innovative method has been used to identify the characteristics of AI and the evolutionary path of knowledge convergence over the booms.

Keywords: Artificial Intelligence, bibliometric, knowledge convergence, network analysis.

1. INTRODUCTION

According to McCarthy, from Stanford University who coined the term Artificial Intelligence in 1956 at a conference in Dartmouth AI is the science and engineering of making intelligent machines (McCarthy 2007).

AI is said to have reached its 3rd boom. The first boom (1B) which continued up until 1969 was based on search and deductive reasoning. AI programs were able to solve only simple problems. In the 2nd boom (2B) which took place in the 1980s, AI was mainly related to expert systems. The knowledge of the experts were used to build the knowledge bases which enabled expert systems to be constructed. AI in the 2B was highly specialized in specific domains leading to limit in generalization of applications.

Since 2013, AI has entered a new phase of the 3rd boom (3B), characterized by machine learning and deep learning. At present, there are definite signs of AI adoption in a broad range of applications, affecting society.

AI is based on a range of scientific disciplines and technologies which are interrelated. In this paper, we attempt to elucidate the underlying structure of the evolutionary pattern of development of AI over the previous and current booms, especially focusing on knowledge convergence. The various technologies and scientific disciplines have been converging in AI, at the same time AI has been converging with other scientific disciplines and technologies to open up new opportunities.

To achieve this goal we have set two objectives

- 1) To characterize the first, second and the current, third AI boom
- 2) To analyze the structure of knowledge convergence around AI

2. TECHNOLOGICAL CONVERGENCE

The concept of technological convergence has been helpful to study the dynamics of technological change, e.g., how technological change affects the organization of industries and how new entrants and incumbents can benefit from the process of technological change. The concept of technological convergence was reported by Rosenberg N in (Rosenberg 1963), who pointed out how industries which seemed different, were implementing the same technologies to solve common problems in their production lines. Furthermore, technological convergence has been used to study technological strategies. Studying the technological convergence between telecommunications and internet technologies, Miyazaki K and Giraldo E in (Miyazaki and Giraldo 2015) analyzed the technological competence building strategies of NTT while adapting to the convergence of these technologies.

In the context of the creation of new industries, Hacklin F in (Hacklin 2008) proposed the evolutionary process of industrial convergence. In the evolutionary process of industrial convergence, industries are created by the interaction of four stages, knowledge, technology, application, and industrial convergence. The framework of the four stages of convergence provides an analytical tool which can be helpful to analyze each of the four stages and their relationships. It is possible to analyze from the convergence of knowledge how likely new technologies will converge and from the converging technologies which applications might emerge. The framework has been implemented to study the dynamics of industries emerging from the convergence driven by ICT technologies (Hacklin et al. 2009). The process of knowledge convergence was explored in the food and pharmaceutical companies in the context of the functional foods industry using patent's quantitative indicators (Lalithorasate and Miyazaki 2016).

The evolution of the methods and techniques to study the evolutionary process of convergence have evolved from descriptive and qualitative approaches to quantitative and predictive. The improvement of procedures to detect early stages of convergence requires the extensive use of knowledge and technology convergence indicators or proxies, e.g., IPC networks links, combination of keywords. Among these indicators, keywords are proposed as an ideal to detect knowledge convergence (Curran et al. 2010; Hacklin 2008). However, these have not been widely used in practice given the difficulties provided by the different vocabularies used across disciplines and industries (Curran et al. 2010).

Recent works have explored the benefit of keywords as proxies of knowledge convergence. In one case these were used to identify potential areas of application convergence for Malaysian small and medium enterprises generated from the convergence of big-data and cloud computing (Chan and Miyazaki 2015). A framework to detect knowledge convergence using keywords was proposed and tested for big-data (Ruiz-Navas and Miyazaki 2018). These two works showed that the use of keywords as a proxy of knowledge are useful as they provide detail of the units of knowledge that are converging and also allows to identify papers which contain an extensive description of these units of knowledge. However, to validate the importance of keywords as a proxy for knowledge convergence, more empirical evidence is required. This work searches to contribute to the literature about the detection of early stages of industrial convergence by providing empirical evidence of the usefulness of using keywords as a proxy of knowledge convergence by testing it on the field of AI.

3. METHODOLOGIES AND DATA SOURCES

The methodology consists of two parts. In Part 1, analyses of the characteristics of the 1B&2B and the 3B is carried out. In Part 2, analyses of the dynamic structure and the patterns of knowledge convergence in AI has been carried out.

3.1. PART 1

The methodology is based on a 3 step approach. In the first step, a bibliometric analyses of Artificial Intelligence was carried out to analyze the technological accumulation over the 2B and 3B. In the first phase, having done the desk work and interviewed several experts on AI, we divided the two AI booms into 2 periods, before and after 2013. In the second stage, a bibliometric analyses based on countries over the 2 periods was

followed by co-occurrence analyses of the author keywords in the 2 periods, before and after 2013. In the third stage, analyses of knowledge convergence in AI was carried out using a novel approach.

One of the main challenges in doing an empirical analysis of AI is that the term AI is quite broad and general so that one has to first identify the key technologies underlying AI in order to apply techniques such as bibliometric analysis. We took into account a set of application keywords related to AI made by Jiqiang Niu and others in (Niu et al. 2016)

We revised the list of keywords based on a range of information sources searched including a report published by the Japanese Patent Agency in (Japanese Patent Office 2016) and by studying the practical applications of AI in IBM where one of the authors is employed (Kumar 2017). In addition, we interviewed some experts on AI at Tokyo Institute of Technology.

Bibliometric analysis was carried out using the search terms,

("machine learning" or "neural network" or "Linear Classifiers" or "Logical Regression" or "Naive Bayes Classifier" or "Perceptron" or "Support Vector Machine" or "Quadratic Classifiers" or "K-Means Clustering" or "Boosting" or "Decision Tree" or "Random Forest" or "Bayesian Networks" or "Deep Learning" or "reasoning system" or "knowledge base" or "knowledge representation" or "fuzzy reasoning" or "fuzzy control" or "genetic algorithm" or "chaos theory") AND ("speech recognition" or "image recognition" or "facial recognition" or "character recognition" or "natural language processing" or "data pattern recognition" or "visualization" or "auralization" or "Dialogue" or "agent" or "knowledge discovery" or "information retrieval" or "data mining" or "information recommend" or "Monitoring" or "diagnosis" or "control" or "optimization" or "design" or "prediction" or "web science" or "VR")

Using Web of Science Core Collection, between the period 1990 and 2016, 210,576 papers were retrieved in January 2017. Subsequently, a national performance analysis was conducted by dividing the whole period into 2 parts, prior to the 3B (1990-2012), and during the 3B (2013-2016). In the next stage, co-occurrence analysis of the author keywords was carried out over the 2 periods and we were able to extract the application keywords which only existed prior to the 3B and also the new application keywords which appeared in the 3B.

3.2. PART 2

The second objective is achieved by implementing a simplified version of the knowledge convergence framework proposed by Ruiz-Navas S and Miyazaki K in (Ruiz-Navas and Miyazaki 2018).

The simplified version of the method consists of ten steps, the first nine steps are applied for the 1B and 2B as well as for the 3B. The last step of analysis is done by comparing the results obtained. The overview of the first nine steps of the method can be seen in Fig 1.

1. Defining the knowledge base
2. Creating the author keyword co-occurrence network
3. Identification of Keywords Proxy of Knowledge Convergence (KPKC)
4. Simplifying the KPKC and obtaining the simplified KPKC (S-KPKC)
5. Detecting the S-KPKC related to knowledge to obtain the S-KPKC related to knowledge (S-KPKC-K)
6. Obtaining the S-KPKC-K's Wikipedia categories
7. Creating the network of S-KPKC-K Wikipedia categories co-occurrence
8. Detecting the knowledge converging into AI
9. Detecting the knowledge converging into AI further convergence potential

The last step is the analysis which consists of a qualitative comparison of the Knowledge topics converging into AI detected for the 1B, 2B and 3B. The comparison analyses consists of a descriptive analysis of each network and a qualitative analysis.

- The descriptive analysis consists of identifying the number of cluster detected in each network and compare them. The objective of the cluster comparison is to detect which are the unique knowledge converging keywords present in each network (1B, 2B and 3B).
- The qualitative analysis consists of analyzing the papers linked to the most central keyword of the most Eigen Vector Central cluster of the unique keywords of the 3B.

The same lexical query shown on p.4 has been used to obtain the documents set to represent the AI knowledge base. This lexical query was executed in the Web of Science from 1990 to 2017. Only conferences papers and journal articles were selected. Under these conditions, the data set is comprised of 249.300 documents. The dataset was divided for the periods of 1990 to 2013 (1B&2B) and 1990 to 2017 (3B), to represent the knowledge convergence given in the 1B& 2B and the 3B of AI, respectively.

4. FINDINGS

4.1. PART 1

4.1.1. Trend in AI publications

The trend of AI related publications using the keyword 'artificial intelligence' led to 25,841 publications shown in Fig 1.

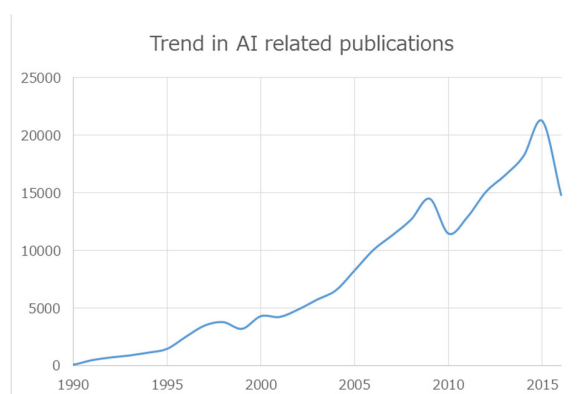


Fig. 1. Trend in publications using the search term defined by the authors

The trend in publications using the specific search terms defined by the authors resulted in 210,576 publications as shown in Fig 1. The shape of the trends in publications using the term 'artificial intelligence' is quite similar, confirming that the search terms that we defined seem to represent well the field of AI. From Fig. 2 the papers published prior to the 3B were 139,795, compared to the papers published during the 3B (2012-2016) which were 70,781, indicating that 34% of the publications have been published during the last 4 years, confirming the presence of the 3B of AI.

TABLE I. COUNTRY PERFORMANCE DURING THE 3B (2013-2016)

Rank	Country	Papers	(%)
1	PEOPLES R CHINA	20805	28.465
2	USA	11202	15.326
3	INDIA	6705	9.173
4	IRAN	4976	6.808
5	ENGLAND	3262	4.463
6	TAIWAN	2680	3.667
7	CANADA	2340	3.201
8	GERMANY	2337	3.197
9	SPAIN	2321	3.175
10	AUSTRALIA	2233	3.055
14	JAPAN	1969	2.694

Table I lists the papers published by country in the 3B. The ratio of China is above 20%, showing its strong performance. US, UK are among the top 5 nations. Japan's ranking used to be No. 4 prior to the 3B but in the 3B its ranking has dropped to the 14th position. During the 3rd AI boom, Iran has emerged among the top 5 leading nations. The Government has announced in May 2016 that it will allocate 1.68 trillion yen into AI research over 3 years. Among the top 10 institutions in AI in the 3B, 5 are Chinese. Iran's performance has also improved from the 8th to the 4th position. The Japanese government has announced that it will try to accelerate the adoption of AI in society by establishing the AI Technology Strategic Council which will promote the linkage between industry academia and government.

4.1.2. Analyses of key technologies and applications in the two periods (1B- 2B and 3B)

The occurrences of the author keywords before the 3B and during the 3B were analyzed. The keywords which existed prior to the 3B but were not retrieved in the 3B include keywords such as Fuzzy systems, Fuzzy controller, Fuzzy reasoning, Chaos, Knowledge discovery, Nonlinear systems. On the other hand the keywords which were only retrieved in the 3B include Deep learning, deep neural network as well as smart grid, big data, cloud computing, energy efficiency, indicating that in the 3B, AI is beginning to converge with other fields which are related to applications of AI.

Co-occurrences of author keywords were analyzed and mapped using R's free software called KH Coder. The lines linking the keywords indicate the co-occurrences of the author keywords in a paper. The red nodes indicate a higher degree of co-occurrences with the various keywords than the blue nodes. For example, Genetic algorithm, Neural networks and Optimization are the 3 main keywords which represent the components of AI prior to the 3B. On the other hand, Classification has co-occurrences with many different keywords such as Machine learning, Support Vector machine, Decision tree, Feature selection, data mining which represent algorithms underlying AI.

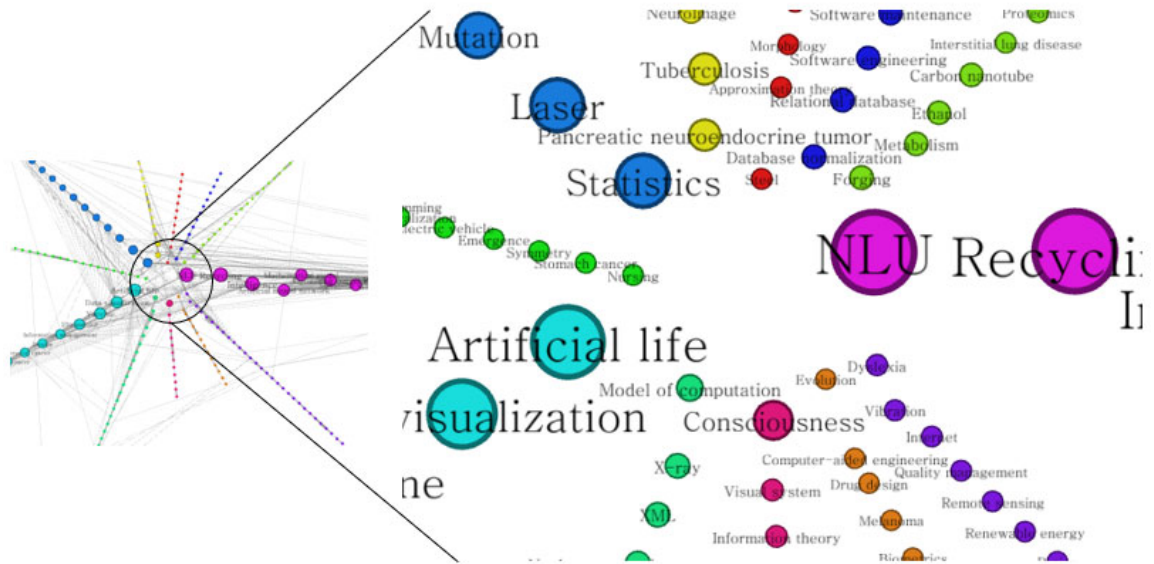


Fig. 3. A manually edited version of a radial layout of the 1B and 2B AI boom knowledge converging keywords network.

In Fig 3, the radius of the circles represents their Eigenvector Centrality, e.g., the node “Natural Language Understanding (NLU)” is the biggest node, and this means that this node is closely connected with all the other nodes of the network. The smaller nodes represent those which are highly connected to the other nodes of the network and other highly connected nodes such as the keyword “Natural Language Understanding (NLU).” Additionally, it is possible to see the knowledge convergence keywords which have the higher Eigenvector Centrality for the L2 clusters detected for the first and second boom.

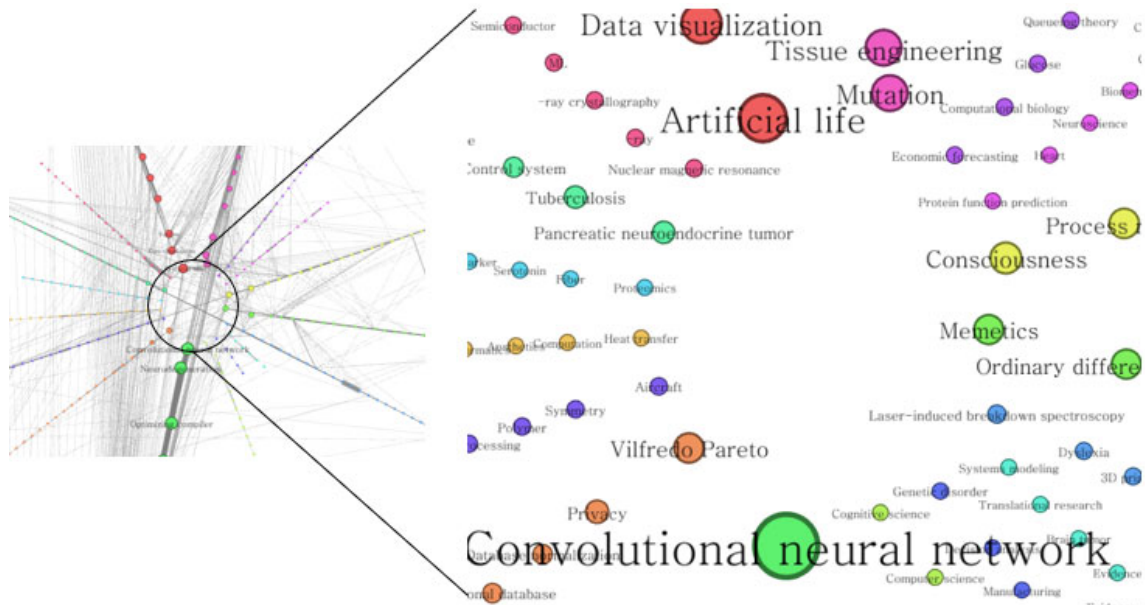


Fig. 4. A manually edited version of a radial layout of the 3B knowledge converging keywords network.

In Fig 4 as in Fig 3, the radius of the circles represents their Eigenvector Centrality. The most prominent node is “Convolutional neural network.” Additionally, it is possible to see the knowledge convergence keywords which have the higher Eigenvector Centrality for of the 17 clusters detected for the 3B.

We present in Table II; the 12 identified clusters for the 1B and 2B.

TABLE II. CHARACTERIZATION OF THE CLUSTERS OF KNOWLEDGE CONVERGENCE DETECTED FOR THE 1B AND 2B AI BOOMS.

CN	NW	L1	L2	NP	AVGEGC
1	23	Pancreatic neuroendocrine tumor Tuberculosis	Control system Network theory Prostate cancer	3204	0.03148
2	38	Model of computation	Computer network Image analysis Soft error	3178	0.02926
3	13	Consciousness	Visual system Chronic obstructive pulmonary disease Systems modeling	374	0.02730
4	14	Evolution	Object-oriented design Biometrics Clinical trial	753	0.00004
5**	44	Dyslexia	Retina Digital signal processing Combinatorial optimization	18354	0.00239
6*	35	Natural language understanding (NLU) Recycling	Privacy Vilfredo Pareto Web Ontology Language	1634	0.42593
7	34	Forging	Aircraft Atrial fibrillation Metabolism	350	0.00715
8**	13	Database normalization Relational database	Statistical model Drug discovery South Africa	29900	0.02162
9	12	Steel	Morphology Health Color	312	0.00124
10	26	Statistics	Information technology Evolutionary computation Automation	6616	0.19856
11	22	Nursing	Electric vehicle Phenotype Sound localization	1286	0.00096
12	25	Artificial life	Vaccine Design Tourism	2598	0.35439

*most prominent clusters regarding average eigenvector centrality.

**most prominent clusters regarding number of papers.

In Table II, L1 stands for label 1, which consist of the keywords with the highest local value of eigenvector centrality in the cluster. L2 stands for the three highest betweenness centrality keywords in the cluster. The column NW contains the number of keyword in each cluster. The NP column presents the number of documents from the 1B&2B dataset linked to the keywords that comprise the cluster. The column CN describes the cluster number. The column AVGEGC describes the average eigenvector centrality of all the knowledge converging keywords in the cluster.

From Table II, we can see that some clusters which encompass more articles, this is interpreted as a focus of research interest around these clusters.

- 5 (Dyslexia) and
- 8 (Database normalization | Relational database).

In terms of average eigenvector centrality the most prominent cluster is number 6 (Natural language understanding (NLU) | Recycling).

For the 3B the most central clusters were described by the following labels

- 4 (Laser-induced breakdown spectroscopy)
- 11 (Pancreatic neuroendocrine tumor | Tuberculosis) and
- 9 (Mutation | Titanium dioxide).

In 3B the most prominent cluster in terms of both number of papers and average eigenvector centrality was the number 16 (Convolutional neural network | Neurodegeneration | Optimizing compiler).

4.2.2. Comparison between unique keywords of the 1B and 2B and 3B

We calculated the unique keywords for each network, identified their clusters and their centrality values. In Table III, we present the percentage of unique keywords classified by their cluster for the 1B and 2B, the same table was done for the 3B, respectively. In Table III the column CN explain the cluster number. #UKeywords stands for the number of unique knowledge convergence keywords identified for a given cluster. % column describes the relation of the number of unique knowledge converging keywords present in each cluster concerning the total of unique knowledge converging keywords.

TABLE III. TOP TEN, CLUSTERS ORGANIZED BY THEIR PERCENTAGE OF UNIQUE KNOWLEDGE CONVERGENCE KEYWORDS FOR THE 1B AND 2B.

CN	#UKeywords	%
3▲	4	23.53%
7	3	17.65%
2	2	11.76%
10	2	11.76%
11	2	11.76%
4	1	5.88%
5**	1	5.88%
6*	1	5.88%
12	1	5.88%
1	0	0.00%

▲ Cluster with more unique keywords

*most prominent clusters regarding average eigenvector centrality.

**most prominent clusters regarding number of papers.

***most prominent clusters regarding number of papers and average eigenvector centrality.

From Table III, we can see that the cluster that possessed the higher values of unique knowledge convergent keywords for the 1B and 2B AI booms are number 3 (Consciousness) and 7 (Forging).

For the 3B, the clusters that possessed the higher values of unique knowledge convergence keywords were

- 14 (Aircraft),
- 6 (Consciousness),
- 5 (Ordinary differential equation),

- 4 (Laser-induced breakdown spectroscopy) and
- 15 (Vilfredo Pareto).

In Table IV, we present the unique knowledge converging keywords with the highest value of eigenvector centrality for the cluster which were found to be unique to each AI boom for the 1B and 2B. The column KCKW describes the highest eigenvector centrality, knowledge convergence keywords for a given cluster.

TABLE IV. UNIQUE TO THE 1B AND 2B AI BOOM, KNOWLEDGE CONVERGING KEYWORDS WITH HIGHER VALUES OF EIGENVECTOR CENTRALITY FOR EACH CLUSTER.

CN	L1	KCKW
2	Model of computation	Multi-agent system
3▲	Consciousness	Alzheimer's disease
4	Evolution	Evolution
5**	Dyslexia	Solar cell
6*	Natural language understanding Recycling	Reliability engineering
7	Forging	Carbon nanotube
10	Statistics	Wireless sensor network
11	Nursing	Nonlinear control
12	Artificial life	Forecasting

▲ Cluster with more unique keywords

*most prominent clusters regarding average eigenvector centrality.

**most prominent clusters regarding number of papers.

***most prominent clusters regarding number of papers and average eigenvector centrality.

The process to create Table IV was repeated for the 3B and as result, the cluster labeled as “aircraft” was detected to have more unique knowledge converging keywords.

4.2.3. Conclusions from the analysis

The 3B has more clusters, and this reflects the growing knowledge base of the field and the continuous development of the third boom. The diversity of fields of study of the words found in Table VI, (computer science, omics, genetics, neuroscience, engineering among others) reinforces the results obtained in the first part of this paper.

Concerning the process of knowledge convergence, it was expected that the most central cluster from the 1B and 2B, cluster 6, was going to benefit from knowledge convergence into AI, which would lead to its be further development. In the 3B, we could confirm this expectation. The keywords “Natural language understanding | Recycling” representative of the cluster 6 of the 1B and 2B, was found to have been encompassed by the 3B cluster 16 (Convolutional neural network | Neurodegeneration | Optimizing compiler) which in turn, was the most central and a center of interest regarding the number of papers.

Cluster 8, “database normalization”, from the first and second boom, became encompassed by cluster 15 in the 3B, which is not central and also covers less papers than its previous version, indicating that this concept which used to capture a lot of attention in the 1B and 2B, lost attraction to other concepts in the 3B.

4.2.4. Comparison of unique keywords

In the 3B there is a significant number of unique keywords, again reflecting the findings from the first part, regarding an increased application of AI in different fields.

As an additional analysis, we revised the papers belonging to the top unique cluster from the third boom.

The most central keyword of the unique cluster 14 of the 3B was “metabolic engineering.” We looked into the papers linked to this keyword and found applications such as optimization of bacteria’s metabolic pathways to improve a defined function. An unexpected issue with this keyword was that it was linked to unrelated documents. The reason for the connection to these unrelated documents was the lexical query keywords “boosting” and “knowledge base.” Taking into account this issue we then analyzed the second most central keyword, which was “sound.” All the papers related to sound were relevant. Among the applications related to sound, we report:

- Optimizing the design of structures to reduce sound by vibration
- Detection of gas leaks using sound under different sound environments.
- Monitoring tool wear using different variables among sound from the tool.
- Computer-aided orchestration sound samples.
- Generating sound summaries of environments to be used in architecture modeling (simulating sound on a theater or stadium)
- Gear system fault detection, using the sound of the system.
- Modeling gas emissions using diverse sources of data, among them traffic sounds.

Cluster 14 has 25 unique keywords, which link with other applications, indicating many other 3B only applications of AI. The objective of the previous example showed a sample of the broader type of applications and problems which are being solved by implementing AI related techniques.

5. DISCUSSION

The goal of this paper was to elucidate the evolutionary path of development of AI and the structural patterns of knowledge convergence in the current and previous booms.

In the 3B, through a bibliometric analysis and co-occurrence analysis, we were able to detect the important key technologies of Machine learning and deep learning. The main focus of the research has been shifting towards AI applications in the 3B, such as Energy efficiency, and Scheduling. AI can be used in many applications depending on the purpose. AI has been used in optimizing, in the 1B, expert systems in the 2B and in the current 3B, AI has evolved to the stage of using machine learning and deep learning creating capabilities in sensing, learning, identifying, tracking, forecasting by combining with other technologies such as big data and cloud. It will continue to evolve, having a significant impact on our society.

The analysis has shown some keywords which were only retrieved in the 3B. Among them were big data and cloud computing. Compared to the previous AI booms, the current AI boom is beginning to have a real impact on companies and society. AI is a technology (or a group of technologies) which could be adopted in a variety of sectors and applications.

The method proposed in the second part showed us a structural view of the knowledge convergence around AI, and to explore it in detail by using keywords as indexes to the documents related to each keyword.

The average eigenvector centrality of a cluster reflected a cluster’s potential to continue further development, i.e., the cluster with higher average eigenvector centrality in 1B and 2B, was present and more developed in the 3B.

The second part confirmed the results obtained in the first one, showing how in the third boom a relative high of unique knowledge converging keywords were present. Further research can go in detail about how AI can drive innovation in different sectors or which technological trajectories are emerging in the third boom which can be leveraged by industrial sectors or countries and even evaluate how ready are current policies or national systems of innovation to get value from this transversal potential that AI will have in our society.

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A Study of Predicting Customer Preference from Customer Transaction Data

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Abstract This paper handles the customer preferences extraction from the reward card generated data. The transaction data recorded from these reward cards will be used by each retailer to design their next promotional program by doing customer analysis. However, the retail industry in Japan currently has not been using their transactional data effectively and efficiently. Reward cards are an essential part of the retail industry in Japan. These cards are mostly functioned as marketing strategies made by each retailer to gain more customers. The data is useful for many things including forecasting future occurrences. Nowadays with the advancement of technology, we can make use of the recorded transaction data to identify patterns of customer shopping behaviors at a supermarket. By understanding the customer preferences and behavior, Japanese supermarket can apply the final discoveries to their future business strategies and marketing promotions thus, increase sales. Many Artificial Intelligence and data mining techniques can be used to conduct the customer analysis. However, in this paper, the machine learning clustering analysis method is employed. Therefore, from the result of the proposed method, we are able to help Japanese supermarket analyze customer preferences and behavior from the customer transaction data using a machine learning method.

Keywords Customer Preferences, Supermarket, Reward card, Point of Sales, Data Analysis, Machine Learning, Retail

1. INTRODUCTION

Reward cards are commonly found in many retailers and act as a competitive strategy in attracting customers. These cards have proven very useful for retailers because it offers a function that will increase the customer's purchasing experience and eventually, the retailer's sales number. The purpose of reward cards for each retailer differs, but mostly it acts as a promotion to boost sales. Among vast competition in retailers, reward card promotions that are offered may provide the customer with price discounts, coupons, free goods, free samples and more.

Moreover than it is beneficial for the customers, it is beneficial for the retailer itself because through rewards cards, the retailer may generate customer transaction data with the information such as; Who, When, Where, Which and How much did the customer has spent. This data can be used to do plannings for future strategies. However, the retail industry in Japan currently has not been using their transactional data's effectively and efficiently. Recorded data can reach up to roughly more or less 200.000 items per week. However, if this amount is analyzed using traditional data analysis, it may not make any satisfactory result. Satisfactory in this context meaning the results will only be limited to assumptions based on heuristical human knowledge. Also, the amount of data would be too significant to be processed in a short time.

The transaction data recorded from the use of these reward cards are called the ID-POS (Identification Point of Sales) in a supermarket. Since most of the POS data does not include the card number, the ID-POS does, which means each transaction in the supermarket that uses ID-POS includes customer's card number along with its identification. From the transaction data, the retailer is can know the detail information of the customer attributes and preferences, from the visit time, purchased items, amount of payment and so on. But this data is still raw, and it is important to transform or make an overview of the data to be able to start the customer analysis.

Since the above issues for detecting the customer preferences among the severe market competition presently exists, the optimal capturing method for the customer preference is required in the target industry.

Therefore, this paper propose an efficient method to capture the customer preference by using machine learning method.

The rest of the paper is organized as follows; Section 2 discusses the literature review and related work regarding the research; Section 3 briefly summarizes the gathered data and methods used; Section 4 describes the expected research results; and Section 5 are the concluding remarks as well as future work.

2. RELATED WORK

This chapter describes any related work on the case of analyzing customer behavior. After making an analysis, retailers then must think of a plan. If the data is small, complex methods like data mining would not be needed. But for large amount of data, the traditional data analysis will be very inefficient. Nowadays, with the advancement of technology, we can use data analysis, data mining and machine learning to identify patterns and behaviors of the customer from the transaction data. By understanding the customer behavior and analyzing the data, Japanese supermarket can apply the final discoveries to their future business strategies.

This paper begins by expressing the general problem of retailers who would like to know who are their customers in order to design their next promotional program to increase overall sales. With a comprehensive study, this paper aims to define the customer's preference and behavior by their purchase objectives while combining it with the ID-POS data. This paper will be using the transaction data from a supermarket in Japan. The data analysis will be carried out using the machine learning method to make a classification of customers or clustering method. By using the supermarket's transaction data, we can conduct a comprehensive analysis of their characteristics.

Many data analysis within the retail industry has been made as of today. POS (Point of Sales) data analysis and market basket analysis is the few out of many common practices to define customer's shopping behavior in the retail industry. Rajagopal [1] analyzes the role of POS promotions in stimulating arousal and satisfaction among customer. Although his study is for a different purpose, but we may be able to make use of his methodology structure and take note of his idea that there could be a connection between POS and customer behavior. Furthermore, market basket analysis is one of the common data mining applications in retail as well. Market basket analysis is one of the data mining methods concentrating on realizing purchasing patterns by extracting co-occurrences from a store's transactional data [2-4]. Annie M.C. et al. [5] made a market basket analysis to find patterns from databases and divide the customers into different clusters. Similar related work regarding customer's behavior has been studied using other methods, such as the decision tree method, by Yoshihiro Ohata et al. [6] where his study revolves around customer's migratory behavior in the supermarket which eventually results on the customer's purchase amount using RFID technology data. Yada et al. [7] applied graph mining technique to the transaction data from supermarkets in an attempt to extract characteristics of consumer behavior in salad oil market of Japan. Igor V. Cadez et al. [8] made a study to investigate customer behavior from the transaction data by making profiling, visualization, and prediction modeling techniques.

Clustering methods are one of the common techniques used to identify behavioral issues [9-10]. Cluster models group several customers together into one segment (this will be the behavior) and then consider all customers in the segment similar customers (or have the same behavior). Carlson et al. [11] used clustering analysis to group customers by the retail source of their food and to describe their everyday shopping eating behaviors. The analysis uses the 'k-means' method of clustering because k-means is a technique available for clustering large data sets where the goal is to divide respondents into controllable and comprehensible groups to describe behavior.

Next, Machine learning and clustering methods are not limited to the application in the retail industry, [12] Shibata et al. analyzed patent classification codes using the link mining method. This method has successfully clustered patents into various technology fields.

Sales number and customer's purchase history can be found by reading the overview of transaction data extracted from rewards cards. But, we can also know the customers behavior from the same data but how to do so is the challenge for this study. From the current existing research, I would like to develop a study to predict customer behavior from the transaction data using a machine learning clustering method.

3. EXPERIMENTAL CONFIGURATION

This chapter describes the configuration of this study. Data mining is the process of secondary analysis of large databases aimed at finding unsuspected relationships which are of interest or value to the database owners unlike statistics, which are data sets that are small and clean and very specific to answer a numeric problem. The purpose of data mining is to find and describe structural patterns in sparse and skewed data, as a tool to understand the data and thus make use of it for predictions and business strategies [13]

In today's service-oriented, competitive, customer-centered economy, data is the substantial information that contributes to the growth of a business. Raw data is extracted, and the only thing to be done is choosing the right method to be able to find and describe the structural patterns in the data. There are four different styles of learning in data mining applications. First is the classification learning. The classification learning structure is the set of classified examples from which it is expected to learn a way of classifying hidden examples. It means that the outcome has already been provided. In association learning, any association or similarity among features is looked for. However, it only involves nonnumeric attributes. In clustering, groups of examples that belong together or have similar patterns or structure are pursued. In numeric prediction, the result to be predicted is not a distinct class but a numeric measure [14].

In this paper, the data mining method that will be used is the clustering method because it is typically used when there are no specific identified groups in the data. By using the clustering method, we can group items that have similar characteristics with each other, thus identify the distinctiveness between one group and another. The outcome that is expected from using this method is to identify clusters and their characteristics. The steps in conducting this study are as follows:

1. Conduct a literature review on data mining clustering methods for customer behavior prediction in the retail industry.
2. Extract the raw transaction data from a Japanese supermarket.
3. Make a systematic overview of the raw data.
4. Using machine learning clustering method, find the customer cluster groups and identify each cluster's characteristics.

The steps to do data analysis are extracting raw data, transform the raw data to become more easier to read, analyze the data and then think of a plan. Due to the large data, a complex method like data mining is needed. Raw data does not give us useful data. They only appear with customer information such as name, date, time, amount, etc. That is why transforming data is important. Transforming the raw data is making common assumptions based on heuristic knowledge. Customers will be grouped into designated ranks based on the previous track records; such as the total amount of purchases. In this case, there will be three ranks; A, B, and C where group A are customers with a total amount of purchases over 20.000 yen, group B are customers with a total amount of purchases over 10.000 yen and group C are customers with a total amount of purchases less than 10.000 yen, respectively.

On the other hand, the general groupings are; Card ID, age, sex, purchased items, the day of purchase, time of purchase, and etc. However, these ranks and groupings do not describe the behavior of the customers, only their identification. Table 1 shows the overview of a transaction data with the comparison of age and day from a supermarket in Japan. Table 2 shows the same data but the comparison is time against age. This overview is using a simple analysis comparing a one-week range data of the current year and last year sales. There are 201,000 item records in this transaction. The dark red depicts a decrease in number from last year sales and dark blue depicts a good increase in number from last year sales.

Table 1 Overview of Age and Day.

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	月曜	火曜	水曜	木曜	金曜	土曜	日曜
All	89.8%	118.7%	99.3%	127.1%	83.4%	110.4%	104.1%
	-664176	1059806	-40556	1817979	-1113829	945515	235599
Member	86.8%	120.1%	97.5%	134.0%	83.8%	109.4%	102.7%
	-693756	902155	-107129	1817766	-842617	688350	118110
Nonmember	102.4%	113.3%	105.4%	100.0%	81.9%	114.8%	108.3%
	29580	157651	66573	213	-271212	257165	117489
20代	81.7%	91.8%	115.4%	97.1%	109.2%	82.7%	101.6%
	-24391	-8961	15679	-2996	8835	-32337	1902
30代	83.8%	127.7%	80.8%	101.5%	87.3%	118.7%	91.0%
	-63557	94099	-67953	6598	-55646	114556	-31210
40代	92.7%	117.5%	99.6%	124.3%	86.5%	120.3%	101.9%
	-53586	122207	-2461	206289	-94871	218596	15104
50代	90.3%	114.4%	100.1%	124.7%	81.1%	111.3%	103.5%
	-84183	120224	730	224633	-178944	152842	30655
60代	92.1%	117.8%	90.8%	142.0%	78.0%	111.1%	106.1%
	-110984	208258	-111165	632394	-307406	206623	65726
70代	80.3%	137.8%	103.6%	164.1%	90.0%	106.0%	110.1%
	-246737	322329	32766	680333	-110120	83482	66616
80代	81.7%	103.0%	113.5%	124.6%	87.0%	93.9%	97.6%
	-67818	11083	41216	95055	-52298	-39830	-9001
90代以上	61.6%	130.4%	87.4%	68.4%	46.1%	93.6%	86.1%
	-38575	30659	-11555	-30508	-56278	-11167	-16984

Table 2 Overview of Time and Age.

Time	9時～	10時～	11時～	12時～	13時～	14時～	15時～	16時～	17時～	18時～	19時～	20時～	21時～	22時～	23時～
All	110.9%	108.4%	116.5%	103.5%	105.6%	97.9%	105.6%	108.6%	97.1%	92.2%	105.3%	93.5%	113.8%	114.8%	142.4%
	251295	387531	862683	159283	210265	-82483	231530	354526	-121048	-311052	123166	-89996	120532	68033	76484
Member	112.6%	109.2%	118.4%	105.2%	105.6%	95.2%	102.5%	109.8%	96.3%	89.5%	108.0%	96.3%	118.4%	107.9%	167.5%
	254469	370666	834158	194958	172786	-158304	84624	324490	-114227	-309964	113521	-27558	77800	17524	48347
Nonmember	98.9%	103.1%	104.1%	95.6%	105.4%	112.9%	121.0%	103.6%	99.4%	99.9%	101.1%	90.2%	109.5%	121.3%	125.8%
	-3174	16865	28525	-35675	37479	75821	146906	30036	-6821	-1088	9645	-62438	42732	50509	28137
20代	270.9%	203.2%	199.1%	81.7%	55.4%	113.0%	107.4%	128.7%	73.5%	71.4%	100.2%	41.0%	90.3%	70.6%	146.6%
	12918	30877	31509	-12202	-23559	5925	4469	22557	-25239	-36755	224	-41962	-4700	-8728	2301
30代	90.3%	92.6%	128.9%	130.3%	101.7%	80.9%	81.3%	95.1%	75.8%	112.6%	119.9%	120.5%	114.2%	105.7%	297.7%
	-14261	-18795	71804	67885	3339	-44571	-57092	-13781	-98905	38985	30397	15010	5573	1572	9727
40代	102.6%	97.4%	104.8%	119.0%	103.6%	98.4%	111.3%	110.7%	103.4%	101.2%	118.2%	107.1%	142.5%	125.9%	317.9%
	6947	-10360	19416	92733	15521	-8595	51776	59626	22711	7757	55257	13858	40949	13785	29897
50代	100.1%	108.1%	119.2%	102.0%	114.0%	122.6%	85.9%	105.5%	103.5%	97.6%	106.0%	86.0%	96.3%	96.9%	105.3%
	265	37618	112408	12757	76599	100344	-99684	33603	23318	-17754	23690	-31355	-4909	-2129	1693
60代	122.8%	109.7%	123.8%	97.7%	114.1%	83.6%	104.8%	118.8%	100.4%	71.0%	97.9%	108.2%	121.5%	135.4%	139.9%
	136490	112335	318303	-23355	123354	-149747	48176	170815	2661	-188559	-5537	9264	14447	9594	5205
70代	117.0%	117.1%	121.5%	122.4%	109.5%	94.1%	119.7%	112.5%	89.0%	67.1%	112.2%	119.3%	188.4%	118.4%	0.0%
	84080	197076	274052	179855	54217	-40458	118636	72409	-50397	-114893	18026	10736	25151	2744	-2565
80代	111.6%	110.4%	95.3%	74.3%	77.4%	98.3%	132.5%	103.3%	133.2%	132.2%	53.3%	103.5%	17.3%	-	572.6%
	25811	49366	-26258	-93759	-70471	-4191	66737	6737	33733	21765	-28161	418	-7759	2350	2089

The purpose of data analysis in retailers is to find patterns from the customer’s transaction information. Retailers want to know who are their loyal customers, thus find out how they can provide what these loyal customers need and what other necessities that may attract other customers.

This paper aims to make a new cluster that is constructed on these ranks and groupings, which are the “customer behavior” clusters. Behavioral patterns of the customers can be analyzed by looking at the combination of these ranks. We may distinguish which customer are loyal and which ones are only buying due to the existing promotions. Once we know these clusters of customers, we can forecast customers who might switch to competitors. Identifying these clusters can help retailers make specific programs to attract more customers. For such an analysis, we have gathered the ID-POS data from a supermarket in Japan.

$$J = \sum_{j=1}^k \sum_{i=1}^n \|x_i^{(j)} - c_j\|^2$$

Figure 1 K-Means Algorithm.

Where J is the objective function, k is the number of clusters, n is the number of cases, x case i , c is centroid for cluster j and $\|x_i^{(j)} - c_j\|^2$ is the distance function. There is no definite targeted number of clusters for the final results. Therefore, assumptions will be made. The number of clusters is based on the CH standard or the VRC (Variance Ratio Criterion).

This paper will employ a hierarchically data clustering and ward method called k-means method [15-16]. Fig. 1. Shows the algorithm of k-means clustering. How k-means works is that it selects the centers of the original clusters from the first observations in the data set and then allocates the other observations to the closest cluster. When an observation is added to the cluster, k-means recalculates the mean of the cluster variables, and this mean becomes the new center of the cluster. If this recalculated cluster-center changes another cluster that is closest to an observation already in the cluster, then k-means moves that observation to the closest cluster and recalculates the center of its new cluster. The process happens continuously until the number of changes is very small [6].

4. EXPERIMENTAL RESULTS

This chapter describes the expected results of the clustering method data analysis. From Table 1 we can see that during Saturday and Sunday the number of young people visiting this supermarket declines. Customer aged 20's doesn't come on Saturdays, and customer aged 30's doesn't come on Sundays. From this, we can only assume and guess based on heuristic knowledge. Nowadays on weekends young people tend to go travelling or go out with friends which is why the number decreases. The number of nonmembers is blue, meaning there's a probability that customers from competitor supermarkets are somewhat starting to come to this store. Overall, Monday and Friday numbers are decreasing for members as well as nonmembers and all age ranges. Does this mean the supermarket needs to make special discounts for these two days? The answer cannot be decided since a more thorough analysis still needs to be done.

Table 2 we can see that overall this store is in good growth. Loyal customers come to this supermarket in the morning, and in the evening, especially among 30s and 40s aged people. Among customers age 30s during the time range of 2PM until 6PM also has a declining number. This suggests that 30s and 40s people are working housewives and they come to the supermarket to buy ready cooked dishes because they don't have time to cook at home after work. From this data we can say that the housewives segment has potential in contributing to the supermarket's sales. The question for this supermarket is, would it be better to increase promotions in the mornings where we know customer mostly visit or increase products of cooked dishes in the evening for potential customers? Or maybe even both? Again, the answer cannot be decided easily. Using a simple data analysis, we can suggest certain behaviour but not quite accurately and precisely.

Table 1 and 2 analysis are barely revealing the surface of the data. For a more sophisticated answer to detect the behaviour of customers, a more thorough data analysis must be done. Therefore, we will conduct a machine learning technique, k-means clustering method, using the transaction data to know more about the customers. After conducting the data analysis based on the transaction data, finally we can know customer behaviour by their clusters, each with their characteristics thus may show us why customers come to the store. Because the customers are divided into different clusters, finally the supermarket will make layouts and promotion programs based on the identified clusters.

5. CONCLUDING REMARKS

This paper proposes an efficient method for supermarkets in Japan to analyse their customer behaviour using data mining. We gathered transactional data in Japan and employed a k-means clustering method. With the proposed method, we will generate new clusters of customers based on their visiting objectives. Using this method, we can help Japanese supermarkets understand their loyal customers as well as potential customers by using historical transaction data and make a business strategy based on the results of the data.

Our future work includes improving the clustering method by making more accurate assumptions and enhancing graphs to portray the analysed data.

Data mining is just a tool in the entire practice. People are the ones who uses the result, combine it with their knowledge and understanding, and then choose what actions to take on. Should the supermarket place the pasta and tomato together so it would be easier for customers to buy? Or would it be better to place the two items far from each other to make it less convenient for customers so that they can maximize their time in the supermarket which will hopefully make them purchase more items? These actions and solutions will depend on each supermarket.

This research was made conjunction with the Green Stamp, Co., Ltd. Transaction data and the grocery heuristic knowledge were also provided from them. We wish to express our gratitude of the cooperation to our analyses.

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Analyzing the Relationship Between the Characteristics of Company Executives and Their Companies: Observation Through Facial Expressions

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Abstract Company executives play an important role in corporate activities. In this research, we focus on the characteristics of company executives in Japan, who make the important decisions. We attempt to measure the facial expression score of these executives from the photographs published on their firm's annual report. In addition, we create a narcissism index from the number of times these executives appear on their reports. Finally, we analyze how these emotional scores or narcissism indices relate to their company's performance and behavior.

Key words: Corporate governance, Finance, Artificial intelligence, Executive, Annual report, Emotional analysis, Narcissism

1 Introduction

Company executives¹ play an important role in corporate activities. However, due to successive scandals in recent years, Japanese executives are being questioned about how they make decisions. In Japan it is said that company executives are not likely to suffer market pressure because of the presence of many stable shareholders. They tend to avoid risky investments and M&A's, making the organization frustrated, and causing stagnation (N. Ikeda et al., 2018).

Meanwhile, from a global viewpoint, it is reported that executives who are optimistic and not risk-averse tend to actively conduct M&A's (Malmendier and Tate, 2008). Can executives with such a character working in Japan maintain or improve company performance?

In previous papers, the characteristics of some executives have been regarded as narcissistic, and there are a number of empirical analyses of the influence that such narcissistic behavior has had on the company's performance (Ham et al., 2017; Chatterjee et al., 2007; Seybert, 2013). In Japan, very few researchers have studied the characteristics of executives and the relationship with companies, amongst which those that mention narcissism are limited. There is a paper (e.g., Ito and Takahashi, 2015) that studied such contents using an annual report. However, since this paper only focuses on a single year and industry (information and communication), so the sample size is insufficient. In this research, we analyzed 225 Nikkei companies based on data acquired from 5 years' worth of annual reports.

2 Analysis approach and usage data

For the analysis, we used annual panel data for 5 years from 2013, and sample subjects are companies listed on the Nikkei 225. The estimation model is as follows.

$$Y_{it} = \sum_k \alpha_k E_{it}^k + \sum_l \beta_l X_{it}^l + \varepsilon_{it} \quad (1)$$

The variable representing the performance and behavior of company i in year t is denoted by Y_{it} , the

¹ In this paper, we define company executive as the company president. It does not include the chairman or other chief officers.

variable representing the company executive's characteristics is denoted by E_{it}^k , and the control variable by X_{it}^l . ε_{it} is an error term. Also, α_k and β_l represent the parameters of each variable, and the interest in this analysis is indicated by the coefficient of α_k . The variables used and their definitions are as shown in Table 1.

Table 1 Variable Definitions

Explained variables (Y at Model 1~7)	
Capex	Capital expenditures/ Sales
R&D	R&D expenses/ Sales
SGAex	Selling, general and administrative expenses/ Sales
Debt	Debt/ Total assets
M&Asize	Size of Acquisition of subsidiaries and affiliates
M&Anum	Number of Acquisition of subsidiaries and affiliates
ROA	Net income/ Total assets
Narcissism indicators	
FirstExec	Number of pages where the executive first appears
PeopleNum	Number of people appearing on the page where the executive appears
ExecNum	Number of times the executive appears
PicSize	The executive's picture area / Area of the entire page
SigSize	The executive's signature area / Area of the entire page
Emotion variables	
Anger	
Sadness	Emotion numbers detected from executive's face photo
Happiness	
Control variables	
LnEmployee	Natural log of number of employees
Industry_d	One if it is the current industry, zero otherwise
Year_d	One if it is the current fiscal year, zero otherwise

Y_{it} is roughly divided into two indicators: corporate behavior and corporate performance. First, we use "ratio of capital investment to sales (Capex)", "ratio of research and development expenses to sales (R&D)", "selling, general and administrative expenses ratio (SGAex)", "debt ratio (Debt)", "size of acquisition of subsidiaries and affiliates (M&Asize)" and "number of acquisition of subsidiaries and affiliates (M&Anum)" as indicators of corporate behavior. The second, "total asset profit ratio (ROA)" is used as an index representing corporate performance. All of this financial data was obtained and calculated from "Nikkei NEEDS" (Nihon Keizai Shimbun).

Furthermore, two types of indicators are used for E_{it}^k , which shows the characteristics of management. First of all, the narcissism indicator includes "the page number on which the company executive first appears in the annual report (FirstExec)", "the number of people in the photograph of the company executive (PeopleNum)", "the number of times the company executive appears on the annual report (ExecNum)", "the ratio of the company executive's photo to the page size (PicSize)", and "the ratio of the company executive's signature to the page size (SigSize)". The second, "emotion scores other than narcissism (Anger, Sadness and Happiness)" measured from the picture of the company executive appearing on the annual report are added as variables. Research which focuses not only on narcissism but also on emotions such as anger and sadness of executive management (e.g., M. Madera and D. Smith., 2009) exists, and in this paper emotions other than narcissism are hypothesized to have an influence on corporate performance and behavior. For the reason they were added as variables. This data was collected from the annual report of 225 Nikkei companies from 2013 to 2017 and Microsoft Emotion API² was used for measuring emotion scores. Table 2 shows the descriptive

² The Emotion API detects eight kinds of emotions (anger, contempt, disgust, fear, happiness, neutral, sadness, surprise)

statistics of the variables used for estimation.

Table 2 Descriptive Statistics

Explained variables (Y at Model 1~7)	N	Mean	S.D.	Min	Max
Capex	1,000	0.065	0.067	0	0.923
R&D	1,000	0.030	0.042	0	0.292
SGAex	1,040	0.203	0.139	0	0.766
Debt	1,100	0.581	0.193	0.072	0.963
M&Asize	527	41981.180	174404.200	1	3254104
M&Anum	1129	1.271	2.552	0	28
ROA	1,100	0.030	0.038	-0.519	0.240
Narcissism indicators	N	Mean	S.D.	Min	Max
FirstExec	1006	6.409	5.141	0	32
PeopleNum	1,011	1.323	1.044	0	13
ExecNum	1,012	3.378	1.969	0	15
PicSize	908	0.188	0.170	0.002	1.000
SigSize	723	0.007	0.005	0.001	0.034
Emotion variables	N	Mean	S.D.	Min	Max
Anger	513	0.001	0.004	2.0E-13	0.075
Sadness	513	0.012	0.056	2.3E-13	0.819
Happiness	513	0.575	0.383	1.4E-05	1.000
Control variables	N	Mean	S.D.	Min	Max
LnEmployee	1100	9.888	1.173	6.148	12.806

3 Results

3.1 Analyses of narcissism indices

Tables 3 and 4 illustrate the results in the case where the narcissism indices are added to dependent variables. The upper row of the table shows dependent variables and the left column shows independent variables. The values in parentheses are z values. ***, **, * are significance levels at 1%, 5%, and 10%, respectively. Table 3 is for companies belonging to manufacturing industries and Table 4 is for companies outside manufacturing industries.

First, as shown in Table 3, in Model 1, PeopleNum is negatively significant. Namely, as the number of people photographed with the company executive increases (= if the degree of narcissism of the company executive decreases), it becomes more difficult to make capital investments. Also, in Model 4, ExecNum is positively significant. This indicates that the debt ratio increases as the number of times the company executive appears increases (= if the the company executive's narcissism increases). These results are also consistent with the results of previous studies, where these studies focused on limited industries or data (Ham et al., 2017; Chatterjee et al., 2007; Seybert, 2013; Ito and Takahashi, 2015).³

Next, as shown in Table 4, FirstExec is negatively significant in Model 1. This result indicates that it becomes more difficult to make capital investments as the page where the company executive appears for the first time on the annual report comes later (= if the company executive's narcissism decreases). Also, in Model 4, FirstExec and PeopleNum are negatively significant. In other words, as the number of people who appear in the report with management appears later, or as the number of people photographed with management increases (= if the company executive's narcissism decreases), there is a tendency for the debt ratio to be in decline. These results are also consistent with the results of previous studies, where these studies focused on

from the expression of a person in the image.

³ Some results inconsistent with the previous studies are also confirmed, as in Sigsize negatively significant in Model 4 and FirstExec in Model 6 being positively significant.

limited industries or data (Ham et al., 2017; Chatterjee et al., 2007; Seybert, 2013; Ito and Takahashi, 2015).⁴

Table 3 Regression Results (Narcissism / Manufacturing Industries)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
	Capex	R&D	SGAex	Debt	M&ASize	M&Anum	ROA
FirstExec	0.00	0.00	0.00	0.00	1679.83	0.03**	0.00
	[-1.34]	[-1.03]	[-1.08]	[1.44]	[1.4]	[2.04]	[-0.55]
PeopleNum	-0.00*	0.00	0.00	0.00	2537.56	0.02	0.00
	[-1.9]	[-1.64]	[-0.59]	[0.29]	[0.51]	[0.37]	[0.58]
ExecNum	0.00	0.00	0.00	0.00**	1747.96	0.01	0.00
	[0.03]	[-1.27]	[0.49]	[2.63]	[0.62]	[0.27]	[-0.4]
PicSize	0.00	0.00	0.01	-0.03	-22687.41	0.17	0.00
	[0.24]	[-0.42]	[0.71]	[-1.54]	[-0.58]	[0.34]	[0.31]
SigSize	0.40	-0.15	-0.43	-1.71***	-377652.20	-14.34	-0.64
	[0.95]	[-0.66]	[-0.84]	[-2.57]	[-0.39]	[-0.92]	[-1.59]
LnEmployee	0.00	0.00	0.01	0.03**	11513.01**	0.42***	0.00
	[1.22]	[0.01]	[0.65]	[2.03]	[2.31]	[4.78]	[1.16]
Year_d	yes	yes	yes	yes	yes	yes	yes
Intercept	0.03	0.05	0.17	0.29**	-108191.10**	-3.33***	0.00
	[1.06]	[1.42]	[1.61]	[2.33]	[-2.15]	[-3.76]	[0.18]
Adjusted R-square	0.02	0.01	0.00	0.01	0.10	0.14	0.05
N	400	400	400	400	199	400	400

Note: The upper row of the table shows dependent variables. The left column shows independent variables. The values in parentheses are z values. ***, **, * are significance levels at 1%, 5%, and 10%, respectively.

Table 4 Regression Results (Narcissism / Non-manufacturing Industries)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
	Capex	R&D	SGAex	Debt	M&ASize	M&Anum	ROA
FirstExec	-0.00**	0.00	0.00	-0.00*	-340.29	-0.02	0.00
	[-2.12]	[-0.52]	[-1.59]	[-1.92]	[-0.07]	[-0.62]	[1.34]
PeopleNum	0.00	0.00	0.00	-0.00**	-28818.59	0.06	0.00
	[0.88]	[0.38]	[1.25]	[-2.18]	[-0.67]	[0.49]	[0.54]
ExecNum	0.00	0.00	0.00	0.00	38348.52***	-0.02	0.00
	[0.69]	[0.1]	[0.53]	[-0.85]	[2.95]	[-0.22]	[0.19]
PicSize	-0.01	0.00	0.00	0.01	-267490.70*	-0.40	0.00
	[-0.62]	[-0.68]	[-0.18]	[1.03]	[-1.81]	[-0.52]	[-0.03]
SigSize	-0.43	-0.04	-2.90***	-0.12	-407130.70	14.11	-0.17
	[-0.36]	[-0.33]	[-2.99]	[-0.16]	[-0.05]	[0.33]	[-0.36]
LnEmployee	-0.01**	0.00	-0.05***	0.06***	56177.91**	0.50	-0.01*
	[-2.03]	[0.85]	[-4.24]	[5.14]	[2.16]	[1.42]	[-1.67]
Industry_d	yes	yes	yes	yes	yes	yes	yes
Year_d	yes	yes	yes	yes	yes	yes	yes
Intercept	0.26***	-0.01	0.62***	0.18	-611059.90**	-3.51	0.06*
	[4.65]	[-0.72]	[4.4]	[1.34]	[-2.13]	[-0.93]	[1.91]
Adjusted R-square	0.81	0.17	0.19	0.51	0.15	0.27	0.06
N	224	224	249	302	151	303	302

Note: The upper row of the table shows dependent variables. The left column shows independent variables. The values in parentheses are z values. ***, **, * are significance levels at 1%, 5%, and 10%, respectively.

⁴ Some results inconsistent with previous studies are also confirmed, as SGAex is negatively significant in Model 3, and M&ASize in Model 5 being negatively significant.

3.2 Analyses of emotion indices

Table 5 shows the results of analyzes conducted with emotion indices as dependent variables. As shown in Table 5, in Model 7, Anger is positively significant, which indicates that corporate executives are likely to have a positive influence on business performance when expressing feelings of anger. Next, focusing on Sadness, it is negatively significant in Model 2, while it is positively significant in Model 3. In other words, it was shown that when the company executive expressed sadness, the relevant company spent less on research and development, yet tended to invest more in SG & A. Focusing on Happiness, statistically significant results were not obtained for all models. In the Spanish banking industry, the negative emotional characteristics of managers affect more compatible strategies and more typical performance, whereas positive emotional characteristics will promote deviations from the industry's central tendency (Juan Bautista Delgado-García and Juan Manuel De La Fuente-Sabaté, 2010). In this analysis, it is partly shown that management's negative emotions, such as sadness and anger, have a positive influence on corporate behavior and business performance, which is concordant with the results of previous studies (e.g., Juan Bautista Delgado-García and Juan Manuel De La Fuente-Sabaté, 2010).

Table 5 Regression Results (Emotion Indices)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
	Capex	R&D	SGAex	Debt	M&Asize	M&Anum	ROA
Anger	-0.17 [-0.47]	0.05 [0.24]	0.05 [0.13]	-0.35 [-0.93]	60502.70 [0.02]	17.09 [0.93]	0.52* [1.91]
Sadness	-0.04 [-1.55]	-0.09*** [-5.60]	0.06* [1.82]	0.03 [0.98]	31839.31 [0.14]	-0.39 [-0.26]	0.00 [0.15]
Happiness	0.00 [-0.34]	0.00 [-1.57]	0.00 [0.21]	0.00 [-0.33]	24981.15 [1.23]	-0.21 [-0.87]	0.01 [1.56]
LnEmployee	0.00 [-0.59]	-0.00** [-2.13]	0.00 [0.50]	0.05*** [5.03]	28901.30*** [4.01]	0.50** [2.08]	0.00 [-0.83]
Industry_d	yes	yes	yes	yes	yes	yes	yes
Year_d	yes	yes	yes	yes	yes	yes	yes
Intercept	0.17*** [4.81]	0.08* [1.86]	0.06 [0.53]	0.31** [2.56]	-300810.70*** [-3.69]	-3.49 [-1.31]	0.03 [1.20]
Adjusted R-square	0.77	0.23	0.25	0.23	0.14	0.27	0.10
N	495	495	495	503	270	504	503

Note: The upper row of the table shows dependent variables. The left column shows independent variables. The values in parentheses are z values. ***, **, * are significance levels at 1%, 5%, and 10%, respectively.

4 Conclusion

In this paper, 225 Japanese companies were analyzed to find the relationship between company executive characteristics and corporate behavior and performance. As a characteristic of the company executive, we used the narcissism indices created from such factors as the number of times the corporate executives appeared in the annual report, and the emotion scores measured from the company executive's photo in the same annual report.

As the results of empirical analysis, this study confirms the relationship between the company executive's narcissism and corporate behavior. In addition, this study also suggests a certain correlation with the emotion indices.

Further research is needed. This research would benefit from a bigger sample size in some variables. Also, appropriate control variables need to be added.

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Halal Market Development in Japan: Are We Ready?

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Abstract: Halal market in Japan has been developing rapidly since the past decade despite the low Muslim population in Japan. In the current practice, Japanese people are not identified by their beliefs. While religious belief and everyday life practices do not mix in Japan, in some occasions Japanese people treat various religious practices in their important life events such as weddings and funerals. On the contrary, for Muslims, Islam is a way of life. The concept of halal, for example, plays a crucial role in determining what is permissible and vice-versa in everyday life. Until around two decades ago, the concept of halal was almost unknown to Japanese people. Insignificant population of Muslims in Japan and their demography were amongst the reason why halal market was almost not considered in doing business in Japan. However, the growing interest in knowing Islam due to several global incidences had changed the demography of Muslim converts, thus empowering Muslim's dire needs on domestic halal market. This is also supported by changes in Japanese population, globalisation of business and culture and the significant increase of inbound tourism to Japan within the past two decades. Since then, Japan has observed business interests in establishing and developing a solid halal market to cater the increasing Muslim population and inbound Muslim tourists to the country. This article attempts to understand the current status of halal market development in Japan and make recommendations on how the halal market development in Japan can perpetuate effectively. Data are gained using qualitative approach such as observation and document analysis. The current status of Japan's halal market development is analysed using SWOT analysis. From this analysis, we can understand that the strength of halal markets in Japan relies on the government's policies while the weakness centralises around business strategies. On the other hand, the opportunities of halal market development in Japan are huge and effective in expansion to global market. However, Japan has to be careful on the threats as halal market is sensitive – misunderstanding and misappropriation of halal certifications may affect the perception on halal products/services of Japan. As a conclusion, this paper provides some recommendations for Japan's strategy in developing its halal market successfully.

Keywords: halal, Muslim-friendly, halal tourism, market strategy

1 Introduction

Japan, religiously dominated by Shintoists and Buddhists, counts about 120,000 Muslims who have difficulty finding halal food at home. The halal concept so far has been little known to the society, and there is still a big lack of knowledge about the religion itself. However, in the past few years the Muslim population in Japan has been increasing, as well as the number of Muslim expatriates, thus the demand for halal food has increased in parallel.

In the recent years, Japan has been observing a rapid increase in the arrival of tourists. According to Japan National Tourism Board (2016), the total arrival of inbound tourists to Japan has increased 3 folds since 2011. While it is difficult to determine the number of inbound Muslim tourists as they are not being identified by religion, the number of two countries which population are dominantly Muslims, Indonesia and Malaysia, has increased 5 folds since 2011. It is expected that inbound Muslim tourist arrival will reach one million by 2020 (Crescentrating, 2016a)

Compared to a decade ago, Japan was one of the countries that were not Muslim-friendly despite its excellent offerings to residents and tourists in general. Muslim tourists have especially complained about the availability of halal food, places to pray and the lack of signage in English (Sazanami, 2013). Japanese society are also sceptical about Islam and Muslims residing in Japan (Nakhleh & Penn, 2008). However, within a short period of time, Japan has been able to gain confidence from Muslim tourists to visit Japan and ranked in the top ten of non-Muslim countries chosen as a holiday destination by Muslim tourists in 2015 (Crescentrating, 2016b).

2 Changes in Japanese economic environment and tourism policy

Japan's economic environment has changed tremendously in the recent years mainly due to two factors; the super-aging society and globalization trend (Bloom, Canning, & Fink, 2011; Muramatsu & Akiyama, 2011). Being the top country that has 60 years old and above population in the world, Japan can no longer rely

upon its heavily shrinking domestic market, as it has been in the past. The globalization of business which translates in to stiff competition between economies in the world also forces Japan to review their policies at hand.

2.1 The establishment of LCC

The Ministry of Land, Infrastructure, Transportation and Tourism of Japan has strategically pursued the Open Sky Policy in 2010. This new policy included metropolitan airports to respond to changes in the competitive climate resulting from global trends towards air services liberalization while accommodating vigorous economic leaps in Asian and other overseas nations (Ministry of Land, Infrastructure, Transportation and Tourism of Japan, 2015). Open Sky Policy is an agreement on mutually removing bilateral constraints on the number of operators, that of routes and that of flights in international air transportation to enhance the quality of services, such as cutting airfares by encouraging the entry of new airlines, increasing the number of flights and stimulating competition between airlines. The agreement involving a total of 27 nations and regions were realized by March 2015, while discussions with ASEAN started in October 2014 with a view to concluding an air services agreement between Japan and ASEAN.

As of September 2017, Japan has open skies agreements with 33 countries or regions, which cover 96 per cent of the international passengers flying into and out of Japan. Open sky has encouraged the establishment of LCC services to Japan, namely AirAsia X, Scoot Airlines, Peach Airlines and many others. As a result, the Japanese aviation market is experiencing continuous growth, especially in the number of international passengers. According to the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), during the 2016 financial year (April 2016–March 2017), Japanese airports handled 83.95 million international passengers, 212.42 million domestic passengers (counted twice, upon departure and arrival), 3,786,625 tons of international cargo and 1,768,923 tons of domestic cargo (counted twice, upon departure and arrival) (Kamimura, Kamiya, & Boggs, 2018)

2.2 Tourism policy

For the first time, Japan has achieved the target of 10 million foreign visitors to the country, compared to only 5.21 million in 2003. In June 2013, the Ministerial Council on the Promotion of Japan as a Tourism Oriented Country, together with all cabinet members have decided on the country's new tourism strategy – Action Program toward the Realization of Japan as a Tourism-oriented Country. Among key policy actions in tourism are services promotion to foreign visitors including visa facilitation, Muslim-friendly environment and services, multi-lingual signage and tax-free shopping apart from upgrading airport access and increasing free wireless hot spots, even on moving trains (Kida, 2014; Kodera, 2014).

Prior to July 1st, 2013, travellers from almost all ASEAN countries were required to apply for a visa to enter Japan. Visa exemption for visitors from Thailand and Malaysia led to a great increase of number of visitors. The number of visitors' arrival from Thailand increased 96 percent to 250,000 while Malaysia 53percent to 110,000 compared to the total visitors' arrival of the first half of 2013 (prior to visa relaxation). Taking full advantage of Asia's economic growth, visa relaxation for short-term visitors have proven to attract visitors from the growing middle class in these countries (Smith, 2016b).

2.3 Tokyo Olympics 2020

The Tokyo Olympics, scheduled to be held in 2020, can be expected to have positive effects on the Japanese economy. Such effects will come mainly through the following two demand channel - an increase in foreign tourism, and an increase in construction investment associated with this event. The number of foreign visitors to Japan has been growing steadily, mainly due to the easing of visa requirements and the depreciation of the yen. The government's target of reaching 40 million foreign visitors by 2020 will likely be achieved. It is expected that there will be 920,000 spectators visiting Tokyo per day.

Nevertheless, taking other countries as a yardstick, there is still ample room for an increase in the number of foreign visitors, and it is certainly possible to further promote tourism in Japan, for example by reinforcing measures to attract foreign tourists in the run-up to the Tokyo Olympics (Osada, Ojima, Kurachi, Miura, & Kawamoto, 2016). The authors also suggested that to achieve a lasting increase in tourism is by promoting touristic resources nationwide. For Japan, this means, for example, establishing routes that allow tourists coming to Japan for the Olympic Games to make excursions to regional areas in addition to visiting the Tokyo metropolitan area.

3 Muslim-friendly facilities

With the government initiatives in place, tourism-related industries have begun positioning themselves to benefit from the increase. After complaints from inbound tourists about the lack of free wireless hot spots in Japan, NTT Docomo Inc launched a wireless internet service specifically targeting foreign visitors. Convenience

stores such as 7 Eleven and Family Mart also provides free Wi-Fi spot. Pocket Wi-Fi services are also available at airports and online for travellers to book and use, with a convenient way of returning it on the day of departure home. For Muslims, free Wi-Fi is especially important to check the halal status of ingredients, finding ways to halal restaurants and mosques and also finding out the prayer times that are changing by seasons in Japan.

The number of mosques in Japan has tripled in 2014 (90 mosques) compared to 2006 (30 mosques) (Hamanaka, 2014). This is an indicator that the Muslim community in Japan is steadily growing. In fact, it also shows that Muslim community in Japan are economically and socially empowered to raise funds and get various approvals, including from the neighbourhood to purchase lands or acquire buildings to convert it into a mosque. The cost of building a mosque is shown in the list of currently proposed mosque projects in Japan in Table 1. It is apparent that the nearer the mosque to the city center and tourist attractions, the more expensive the cost would be, as shown by Kyoto, Shizuoka and Shibuya Masjid project cost compared to others which are located in the outskirts or in residential area. Shizuoka Masjid, however, is a special project because it includes the construction of an Islamic school, a library, rooms for accommodation and shop lots in the mosque area. Therefore, not all mosques are located in tourist areas as the cost of building or acquiring one is very expensive.

Figure 1 The Map of Mosques (Masjids) Across Japan



Table 1 List of Proposed Mosques Construction Cost Derived from Their Donation Drive Leaflets

Proposed Mosque (Masjid)	Location	Cost (USD)
Kyoto Masjid	Kyoto	3,550,000
Shizuoka Masjid	Shizuoka	3,000,000
Shibuya Masjid	Shibuya, Tokyo	2,041,000
Tsukuba Masjid	Tsukuba	616,120
Tokai Masjid	Tokai	310,621

To attract more Muslim tourists/customers, halal or Muslim-friendly restaurants, hotels, airports, train stations, tourist information centers and shopping malls have started to provide prayer rooms as small as for 1 person praying at a time. This makes travelling very convenient for Muslim tourists as they can save time fulfilling their obligations of finding halal food and performing prayers. Some examples of famous supermarket/shopping mall/convenient stores that have introduced halal corners at their places are AEON (selected stores in Tokyo, Kanagawa, Chiba, Saitama, Ibaraki, Gunma and Tochigi), Gyomu Super, Lawson (Okachimachi store) and Nissin World Delicatessen(Tokyo). The fact that many Muslim tourists prefer cooking than eating out due to reasons such as to ensure halalness of their food or to save money when travelling with a large group, the setting up of halal corners in these retailers can attract such market segment by responding to their needs.

4 Changes and Issues in Japan's Developing Halal Market

4.1 Entrepreneurs' dilemma

In a survey conducted in 2005, two factors have been identified as the delaying factor for halal business entrance; first, the lack of knowledge about Islam and halal, and secondly the "chicken-and-egg" dilemma as to whether the entrepreneurs should take the risk and enter the halal market thus motivate the Muslim tourists to come or wait until the number arrivals significantly increase (Shazlinda, 2008). Adhering to halal requirement would mean higher setting up and operating costs. This is because apart from halal ingredients, utensils should be separately used if a central kitchen is not established. Same applies to operation lines. Bottom line, cross-contamination with non-halal elements must be avoided. This requires a huge investment (Sazanami, 2013).

Another dilemma that is experienced by entrepreneurs considering halal market is the difference in adherence towards halal among Muslim communities. Some communities have different practice than others. For example, some Muslims eat other meat except for pork, while some other Muslims consume only halal-processed meat (such as chicken, beef and mutton) while avoiding pork. The level of "strictness" is also reflected on the differences in halal standards of countries that issues certifications. This confusion was a drawback in striving for halal compliance of food and products.

There is also seems to be a misunderstanding among businesses who view halal as a guarantee for profitability. There have been cases where businesses have to shut down because of no proper planning in selecting location, services provided and poor marketing execution. Both Islamic regulation and Japanese culture in doing business need to be considered when involving in halal business.

4.2 Diversification of Halal Food

In a survey conducted a decade ago, Japanese people were not only unaware the meaning of halal, but those who did, relate halal closely to "ethnic foods" (Yusof & Shutto, 2014). In a narrow sense, ethnic foods are defined as foods originating from a heritage and culture of an ethnic group who use their knowledge of local ingredients of plants and/or animal sources. Thus, in a broader sense, ethnic food can be defined as an ethnic group's or a country's cuisine that is culturally and socially accepted by consumers outside of the respective ethnic group (Kwon, 2015). For example, ethnic foods that are well received in Japan are kebab (Middle East), tomyam-kun (Thailand) and nasi goreng (Indonesia/Malaysia). As much as ethnic foods are considered foreign to Japanese, so does the term halal. As such, when speaking on halal, Japanese food was scarcely in the picture.

However, the globalization of food has introduced Japanese food in countries where Muslims are the main population. Local halal Japanese food is more accessible to the market in Malaysia and Indonesia, although some are widely adjusted to the local tastes. Therefore, Muslim tourists who go to Japan expect to taste the local cuisine rather than ethnic foods. This has motivated many establishments to offer halal/Muslim-friendly Japanese food such as ramen, yakiniku, syabu-syabu, teppanyaki, Japanese curry, sweets and desserts. To gain the trust of Muslim customers, many of these restaurants apply halal certifications.

4.3 Halal Certification Bodies in Japan

While Japanese producers strive to tap the growing local and international halal food sector, there is a concern that the proliferation of certification bodies is a potential problem. According to Keigo Nakagawa, a researcher and consultant for the Tokyo-based Japan Halal Business Association (JHBA), with 152 member companies, there are 22 halal certifying entities in Japan. However, there are numerous halal certification bodies globally that certifies halal products in Japan but many are vague in their authorities.

The Malaysian government department of Islamic development (JAKIM), for instance, cites only two "recognised foreign halal certification bodies and authorities" in Japan: the Japan Muslim Association (JMA) in Tokyo, established in 1953 as the first Japanese Muslim organisation; and the Japan Halal Association (JHA), a non-profit organisation (NPO) in Osaka. For both citations, Jakim includes an image of the halal logo stamp the agencies use. The Japan government does not oversee halal certification and this exacerbates the problem for companies – and individuals – who want to be certain their certification will stand up to scrutiny. Japan halal food market was estimated to be worth about US\$200 million to US\$250million in 2015 and most of the portion is imported from Malaysia (Smith, 2016a).

4.4 Innovations to cater halal market

The 'omotenashi' culture in Japan motivates the creation of innovations to solve problems faced by Muslim visitors. A major problem faced by non-Japanese speakers Muslim tourists is their inability to identify whether a product is halal/consumable or not because they could not read the ingredients. As halal marks are not proliferated in the daily products, Muslims need a tool to be able to make judgement. Those who do not want to take risks would usually hire Japanese speaking tour guide but backpackers with low travel budget need a cheaper option to solve this problem.

Many mobile applications have been developed to assist Muslim tourists in getting them to halal/Muslim restaurants and prayer spaces. For example, MuslimPro and HalalNavi navigate users to the nearest halal/Muslim-friendly restaurants or prayer spaces. Meanwhile Halal Gourmet Japan app allow users to identify whether the food product is consumable or not just by taking photos of it.

For Muslim visitors, halal bento (foodpack) delivery service is also fulfilling the gap in this segment. Large group tours can benefit from this service because not many halal restaurants can fit in a large number of people. Halal bento also saves time for Muslim travellers as they do not need to walk around to find halal restaurants. Another usage of halal bento is when they enter tourist attractions such as Disneyland and Universal Studios Japan that have little choice on halal food. Some halal bento service providers uses bento box that can be heated just by pulling a string. This is very convenient for Muslim travellers especially during colder season.

Another innovation that has been developed to fulfil Muslim needs is the mobile mosque. It is a truck renovated by expanding the container on both sides. The air-conditioned prayer room can fit 50 worshippers at a time and has a compass that points to the Qibla in Makkah. These mobile mosques are specifically built to cater both sportsmen and spectators of the Tokyo Olympics2020. The mobile mosques were tested by Muslim students of Yamaguchi University to get advice. More innovations are expected to be created as the number of Muslim tourists to Japan rises.

5 SWOT Analysis and Recommendations

Based on these observations from the current situation of halal market development in Japan, we have concluded the strengths, weaknesses, opportunities and threats that Japan faces in promoting halal market in the country.

Strengths	Weaknesses
<p>Japanese government’s willingness to ease certain regulations/policy such as visa requirement and Open Air Sky policies</p> <p>The facilities and infrastructure (such as free Wi-fi hotspots) help Muslim tourists to find halal food and prayer space during their visit</p> <p>Diversification of halal food market allows Muslim consumers to explore and enjoy Japanese authentic taste.</p>	<p>Business strategy with the belief that getting halal certified can ensure profitability</p> <p>No government control in halal certification by Japan’s halal certification body which can cause confusion and rejection</p>
Opportunities	Threats
<p>Increasing domestic market for halal products</p> <p>Ready global market for halal product</p> <p>Innovation of new technology to solve problems faced by Muslim tourists</p>	<p>Unreliable halal certification system can expose halal products in Japan to scrutiny and the loss of trust from Muslim consumers</p>

5.1 Recommendations

Back in 2003, a mere 5 million foreign tourists visited Japan and the nation’s inbound travel industry looked at destinations such as Hong Kong, Singapore and Thailand with thinly disguised envy. That same year, the government launched the Visit Japan campaign with the aim of doubling foreign arrivals. That campaign can be considered a roaring success as the number of foreign arrivals soared past 20 million last year, is on course to surpass that figure in 2017 and is expected to reach 40 million in 2020, the year Tokyo hosts the Olympic Games. The government – which plans for tourism income to offset declines in other sectors of the Japanese economy – has established a new target of 60 million arrivals by 2030.

The outcome of the total arrivals of foreign tourists, including Muslims have been promising so far. Japanese government should continue to be sensitive on policies related to Muslim tourists’ needs while in Japan. This includes the monitoring of halal certification bodies to ensure the authenticity of halal certification. Japanese government can seek advice and expertise from renowned certification body such as JAKIM to execute the monitoring.

While halal is a lucrative business, it is also important for businesses to understand that it is only another ‘tool’ in marketing their products. The belief that ‘halal business is profitable’ should be corrected as it does not guarantee success unless careful, strategic planning and execution are carried out. Businesses should also understand the risks of doing halal business as it is a sensitive issue if the standard is not protected.

Another concern is about the sustainability of halal market development after Tokyo Olympics 2020. With the current pace of arrival rate, Japan’s popular tourist spots such as Kyoto and Osaka are already

overcrowded it may create 'tourism pollution'. As facilities for Muslims such as mosques are also available in other cities across Japan, promotion on these places as new tourist destinations should also be carried out to disperse tourists and to provide income to the locals.

It is also recommended for the authorities to conduct halal awareness campaign, not only to business owners but also to the surrounding community and schools. This is because by such understanding tourism products can be more diversified, such as homestay, exchange and cultural activities with Muslim tourists. Muslims residing in Japan, especially Japanese Muslims whose population has reached 40,000 people in 2017 can participate in executing such campaigns as they understand both sides, language and culture of Japanese and Islam.

6 Conclusions

It requires an effort of a nation to encourage the development of halal market in Japan. Japan has already have the know-how and expertise in producing quality products, and it is possible to add its value by applying halal standards as its branding. Not only will halal Japanese quality products fulfill the needs of increasing Muslim tourists and population in Japan, but also to be exported to countries with Muslim population around the world.

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Room B

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REVERSE INNOVATION: A NEW-OLD CONCEPT

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Abstract Reverse innovation refers to the case where an innovation initially launched in a developing country before trickling up to the advanced country. While the central idea of reverse innovation is intuitively clear, it is conceptually vague. This literature review study provides an improved the espoused definition of the concept of Reverse Innovation. Base on the literature, a research agenda can enrich and extend mainstream theories in the typology of Innovation for and from developing countries, the five gap that MNCs struggle to pursue the Innovation Process in Emerging market, and the relationship between Reverse Innovation. The implications for management are concerned with the research agenda. Most significantly, while greater recognition and power of innovation in formerly subordinate organizational units is inconvenient to some, the ability to leverage the potential of reverse innovation makes a firm more likely to succeed in global innovation overall.

Keywords: Reverse Innovation, Emerging Markets, MNCs gaps, Global Innovation

1. INTRODUCTION

Emerging markets recently receive the central attention in both academic and managerial discussions in term of Research and Development and Innovation activities due to their growing demands, broad markets and exceptional R&D talented source. Countries like China and India, initially playing secondary roles, have now become the global innovation hubs. Emerging markets no longer just borrow innovations from developed countries; from time to time they also contribute innovations to the rest of the world, including developed countries. Less developed countries, emerging market set up the game and spread innovation all around the world. The term reverse innovation in our paper context refers to innovation as originating from developing and has been used to represent the target of developing country by foreign multinational that have been considerate of the advanced product localization.

RI has made tremendous gains in popularity. As Vijay Govindarajan predicted, reverse innovation is a promising research field for both scholars and managers in international business and strategy because of the enriched mainstream theories in various of areas. The main conceptual goal of this article is to proposal the systematically review the concept of Reverse Innovation in the existing literature. We first provide an overview of Reverse Innovation concept that bring some historic literature backgrounds about Reverse Innovation in order to answer the following review question: how is reverse innovation positioned in the existing literature? Essentially, from the theory point of view, the state of the art in Reverse Innovation is not completely new in the context of various definitions provided in the literature. In terms of theory, we have demonstrated that the idea behind the concept is not entirely new, analyzing RI in the context of the various definitions provided in the literature. In addition, a research agenda is proposed base of the literature that investigate the nature of innovation in Emerging market, the typology of Innovation for and from developing countries, the five gap that MNCs struggle to pursue the Innovation Process in Emerging market, and the relationship between Reverse Innovation. In each of these areas, the article offers illustrative literature and questions for further research. However, these are only tentative ideas based on assumptions and arguments that need to be evaluated and tested rigorously. Following the literature, a significant managerial implications related to Reverse Innovation are presented to help Managers obstacle and grasp their organization strategies' implications.

2. REVERSE INNOVATION: A NEW-OLD CONCEPT

The rise of developing countries as emerging markets receives the huge attraction from Management scholars to investigate their position in Research and Development and in Innovation as well. In the mainstream international business literature, industrially advanced countries have been the center and origin of global diffusion of innovation that means Innovation is assumed to originate in the developed countries where the world's leading multinational corporations (MNCs) are located [1]. According to the traditional flow, advanced countries are the place that new products and technology first developed and then launched before spreading and commercializing in less developed countries. From market point of view, innovation is thus from advanced to developing countries. Well-known examples of recent innovations in emerging markets first introduced in developing countries and only later in advanced countries have challenged the mainstream innovation concept. In 2012, MNCs invested more in emerging markets than in the core economies of the United States, Europe and Japan [2]. Chinese market is the target market of Nokia before spreading and marketing them in Europe. Tata introduced the Tata Nano for the price conscious consumer in India in 2009 and launched Tata Nano in Europe and U.S. subsequently [3]. According to the discussions from both academic and managerial, the term "Reverse Innovation" is describe Innovation as originating from Emerging market and has even been used to represented less developed country-targeted innovation by MCN that else ways have been analyzed a form of advanced product localization [4]. In other words, Reverse Innovation concept was born when products and technology when satisfied the local needs in connect with cost, infrastructure, and regulatory system before flowing back to wealthy countries.

The Reverse innovation evolution is experienced through fourth consistent phase. MNCs investigated innovation in emerging market to meet the local customer's need and then offer the same products and technologies in developed countries. The Reverse Innovation approach where R&D activities are not only concentrate for consuming product but also the new market where innovated products and technologies are generated. In term of tremendous demand for good and economical products, Emerging markets are eager to offer many possibilities for technology innovation, which is crucial for the entrepreneurship development [5]. In the nutshell, many multinational corporations consider entering the market of emerging economies not only as goods and services exporters but also as beneficiaries of innovation developed on that market. [6]. Differences in the approach to traditional innovation and in the reverse innovation phase are presented in Figure 1.

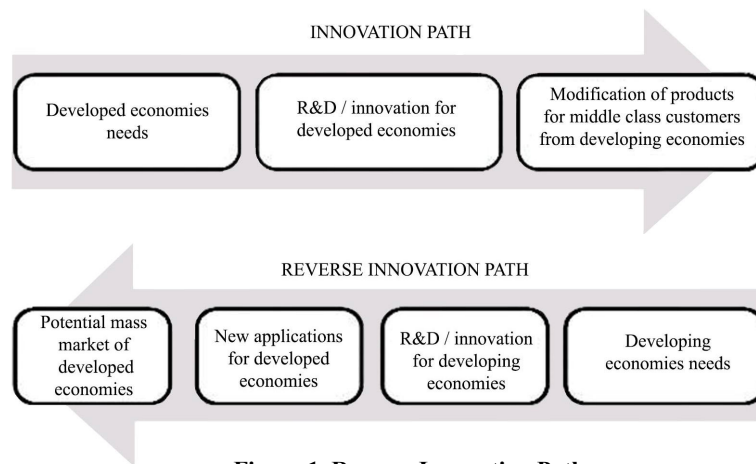


Figure 1. Reverse Innovation Path

However, the idea that innovation originates in other than advanced countries is not a brand new concept. For instance, Hart and Christense used the term "disruptive innovation" to describe new products and technologies coming from Emerging market [7] while Brown and Hagel (2005) applied "blowback innovation" for the innovation resolutions that generated and launched in less developed markets [8]. Nonetheless, in the theoretical view point, Reverse Innovation is still a new concept because it suggests that innovations coming from emerging markets can flow unbound to high-income countries which has never been formulated before. Moreover, the role of Foreign subsidiaries of MNCs and the backward contribution to the parent companies is the main stream innovation research that received the vast attention from scholars and managers in term of developed countries investment. Recently, many merging market

MNCs join the global games and pursue indigenous innovation and transformation of global technology that leads the attention from academic research and managerial practice [9, 10].

Although Reverse Innovation is intuitively clear and a unique concept, it seems to cross conceptually to a few well-known concepts. It is difficult to distinguish reverse innovation from other notions of innovation such as cost innovation, frugal innovation, good enough innovation and frugal innovation. In the section 3, a terminology reverse innovation in developing countries and the classification of characteristic are presented to prove the plentitude of innovation concepts in Emerging market.

3. REVERSE INNOVATION TERMINOLOGY IN DEVELOPING COUNTRIES

In recent times, the concentration of the corporate management and tremendous scholars are aimed at innovativeness in Emerging Markets. It is important to present different innovation approaches to comprehensively understand the essence of Reverse Innovation. The central the central idea of reverse innovation is intuitively clear, however, it is conceptually overlap. It is difficult to distinguish reverse innovation from other notions of innovation, such as cost innovation, good enough innovation, frugal innovation and disruptive innovation in Figure1. Researchers and practitioners often use these terms interchangeably, the important strategic implications of the differences among these contexts is vague. A reference framework for reverse innovation is still missing, especially one that differ from each other with respect to their technology and market novelty. This section aims to give the comprehensive the distinction between types of innovation for the purposes of defining and distinguishing is based on synthesized documents

Table 1. Frequently Used Concepts of Innovation for and from Developing Economies

Innovation concept in/for Developing Countries	Definition	Reference
Frugal Innovation	Innovation that has a large cost advantage, and in some cases inferior performance, compared to existing solutions, and developed in a resource-constrained context	Zeschky, Widenmayer, and Gassmann (2011) [11]
Good Enough Innovation	Innovation associated with functionality and features designed in a way that they meet specific needs of customers with limited environment resources	Govindarajan, Ramamurti (2011) [12]
Cost Innovation	Leveraging developing economies' cost advantage to develop innovation at dramatically lower costs	Zeng and Williamson (2007) [13]
Disruptive Innovation	Processes of replacing older technologies with technologies that change the course of development	Christensen, Hart (2002) [7]
Reverse Innovation	Innovations adopted first in poor (developing) countries before being adopted in advanced economies	Govindarajan, Ramamurti (2011) [12], Immelt et al. (2009) [4]

Burger-Helmchen defined frugal innovation as sharing many similar features with Reverse Innovation, except that frugal innovations do not necessarily have to spread to high-income countries [14]. In another concept, Reverse Innovation is presented as a Frugal Innovation that is transferred from the emerging-market environment to the developed market [15]. Frugal innovation originally developed for very specific applications in resource-constrained environments and its tendency to disrupt, for example, a frugal innovation reach the new customer group when accidentally making a portable product. A case in point is Logiq Book, an ultrasound machine served for China rural customer's [12]. This notebook computer is designed to simplify the features than traditional one that make it much smaller and lighter for the rural target markets. The benefit from its portability rural customers receiving are the convenience in diagnosis and treatment [4]

In general, Frugal innovations are novel from both the technology and market perspectives. Although existing technologies are employed in most cases, frugal innovations are built on new product architectures that capture the new applications with affordable price than the current products.

Good-enough innovation is innovation focused not only on low price, but also on greater functionalities and features designed to meet a range of resource constraints beyond capital constraints [15]. good-enough innovation allows low price points by taking advantage of local cost advantages combined with better local sourcing conditions. The challenge of good-enough innovation is in customizing value: adding function,

eliminating unnecessary segment while decreasing cost for the target customer. The product is often created as a result of focusing on basic features, is more durable, easy to use, but has no automated processing [16]. A prominent example of frugal innovation is Mettler Toledo, a Swiss laboratory equipment manufacturer and its weight scale for the Chinese market [15]. Mettler's Western strategies is to reduce both low-cost manufacturing and materials. This weight scale now became a suitable product for customer who would like to own a basic functionality at a low cost in many market [11].

Overall, Good-enough innovation is innovation focused not only on low price, but also on greater functionality of offered products. Traditionally, good-enough innovations have been the domain of emerging-market firms that address price-sensitive customers.

Cost innovation is not a novel concept. There are tremendous cases which low-cost products shift the expensive products into a reasonable good by declining the cost. Enterprises introducing cost innovation based on the "affordability zone" for resource-constrained consumers. In term of capitals, cost innovation taps the potential customers who are looking for cheap good and makes them the first-time customer despite of the limited resources and low technical [17]. However, the appeal of cost innovations is not the only strength in building competitive advantage. According to William, enterprise can attract affluent customers seeking a bargain or expand the market for what had once been a niche or specialty product [18]. In Cost Innovation case, a representative example is Huawei-Chinese firm. and its top-notch smart phones. Huawei quantities occur 20 percent of the cost of Western competitors. By offering the same functionality and quality of Ericsson at a lower cost, Huawei beats the Swedish company on its home turf in a tender for a 4G mobile network deal [15].

Finally, Disruptive innovation is defined as "an innovation that results in worse product performance in mainstream markets" or as a "typically cheaper, simpler, smaller and frequently more convenient to use" version of an existing product [19]. The concept of disruptive innovation was started from developed economies, however, it changes the competition conditions, taps new customers, and finally disruptive the current market or open the new market [5]. Disruptive innovation in the Reverse Innovation literature is still ambiguous. According to Hart and Christensen, Asian firm succeeded in applying disruptive innovation that maps the concept of disruptive innovation in emerging countries in which seems then reasonable to think that some Reverse Innovation could be disruptive [7]. Offset printing is the proper instance for Disruptive Innovation. Offset printing has a high overhead cost but very low unit cost to compare to computer printers. But as printers, especially laser printers, have improved in speed and quality, they have become increasingly useful for creating documents in limited issues.

The above description of given types of innovation allows to identify differences between them, which are particularly clear in such areas as: technology and market novelty and therefore significantly affect how firms approach, develop, and position solutions. **Appendix** presents the differences for the concepts discussed above, as well as examples of enterprises and products related to specific types of innovation.

In sum, a consensus on the definition of Reverse Innovation has not been completed yet. Scholars and managers have used other variants of the definition in the literature that may have blurred the original definition. Based on the collected literature, we believe that authors should be more cautious when using the term reverse innovation. A more balanced definition of RI could be proposed.

4. EME AND CHALLENGES IN REVERSE INNOVATION

In fact, the needs and opportunities in the developing world are so different from those in the rich world that the very first requirements for reverse innovation success are humility and curiosity. Govindarajan and Trimble [12] defined five gaps that separate the reality of emerging countries from that of developed countries: price-performance, infrastructure, sustainability, regulatory and preference. Table 2. summarizes the five gaps separate the reality of emerging countries from that of developed countries.

- *The Performance Gap*

Product enhancement, new features and improved performance are the result of any innovation process. Customer in Emerging Market neither demand nor afford the same products performance level to the wealthy customers are enjoying. [14]. This does not mean customers in developing countries don't need innovation or innovative products. It means they need products with innovative features tailored to their needs. Indeed, what customer in this segment need is radically reinvented design that tailored to their needs at an ultra-low price. Consistently, to achieve the lowest possible price, MNCs utilize the "good-better-best" rich-world product line MNCs scheme is to export to the developing world, the tendency is to focus just on the "good" offering. For instance, Nokia managed to capture 60% market share in India by reimagining the

cell phone and created an offering to satisfy customers at reasonable prices while NOKIA manufactured the basic modeled and customize the software likes pudding Hindu-language feature text message.

Table 2. Environmental Challenges of EMEs in Reverse Innovation

Factor	Challenges
The price-performance	Developing or emerging market consumers have less purchasing power, consumers in these markets still have needs, which are generally different from the needs of consumers in rich countries. To conquer these markets, cheaper products with new functionalities have to be developed.
The infrastructure gap	The infrastructure gap refers to the potential lack of infrastructure in developing or emerging countries, such as unreliable electric power This reality sometimes imposes particular features on products or even different product solutions.
The sustainability gap	Merging countries have more severe environmental concerns than high-income countries
The regulatory	The regulatory gap refers to the differences in regulations between developing or emerging countries and developed countries. This gap can be problematic if innovations in developing or emerging countries do not follow the basic regulatory standards in place in industrialized countries and therefore could put some people at risk
The preference gaps	The preference gap refers to diversity of tastes, habits and rituals influencing innovations, succinctly.

- *The Infrastructure Gap*

According to Dakshinamoorthy and Gordon, while developed countries have privilege the extensive infrastructure such as road, telecommunications networks, modern transportation, communication, and energy systems, schools, hospitals, banks, and more, the developing world does not. Naturally, utilizing a powerful asset and infrastructure is an convenience for product development [20]. In spite the fact that lacking of modern infrastructure, developing world can trickle-up up the innovation like its advantage. Difficult constraints can inspire creative workarounds that sometimes lead in unexpected directions. As a result, developing nations become the destination where rich nations concentrate, repair and replace market. This was the case for GE Healthcare in India, GE first designed an ultra-low-cost portable EKG machine for rural India, one of the top considerations was long battery life and after that quickly found a market in the developing world and is now sold in more than 60 countries, both rich and poor.

- *The sustainability Gap*

The sustainability gap suggests that less developed countries have more serious environmental problems than the wealthy nations [21] The intensity of sustainability issues are highest in the developing world due to the conflict between the economic continuity and environmental sustainability. There is some cases prove the positive relationship between Reverse Innovation and sustainability management. For example, China is currently eager to produce electric car to cut down the extreme pollution problems.

- *Regulatory Gap*

Appropriate regulation functions eliminate odds business behavior with societal good and keep the market healthily. Developed countries regulatory systems tend to be completed as a result of decades' development while those in the less developing countries still occurs shortcoming. In particular circumstance, the distinguishable regulations make the developing world a more favorable environment. Fewer regulations may result in less friction and faster progress toward innovation. [22]. Diagnostics for all is a typical business instance in term of utilizing the regulation gap. Diagnostics for all decides to commercialize the paper-based diagnostic test with embedded chemicals which react with blood, urine, saliva, or sweat in the developing world so as to sidestep the painstaking FDA approval process despite the hunger from the developed market.

- *The preference gap*

Base on Corsi et al, preference gap refers to diversity of tastes, habits and rituals influencing innovations [23]. PepsiCo, for example, is developing new snack foods, starting with a new lentils base ingredient in

India market due to the ubiquitous of lentils in this market. MNCs need to look for the gap before investigating the reverse innovation in emerging market

In sum, five of enormous needs gaps shed light on the MNC strategies to win the emerging economies by making light adaption of successful rich world offerings is inadequate. Other identified RI challenges include different market conditions, intellectual property risks, resource could be fertile ground for RI.

5. RESEARCH AGENDA

5.1. Clarify the Reverse Innovation Scope

A consensus on the definition of Reverse Innovation has not been completed yet. Scholars and managers have used other variants of the definition in the literature that may have blurred the original definition. Reverse Innovation is motivated by and depends on constraints that characterize current emerging markets. Therefore, Reverse Innovation is considered the temporary phenomenon because the convergence between developing countries have been weaken the concept of Reverse Innovation as commonly defined that are already demonstrated by many economists. [24] [25] Based on our findings, we believe that authors should be more cautious when using the term reverse innovation. A more balanced definition of RI could be proposed.

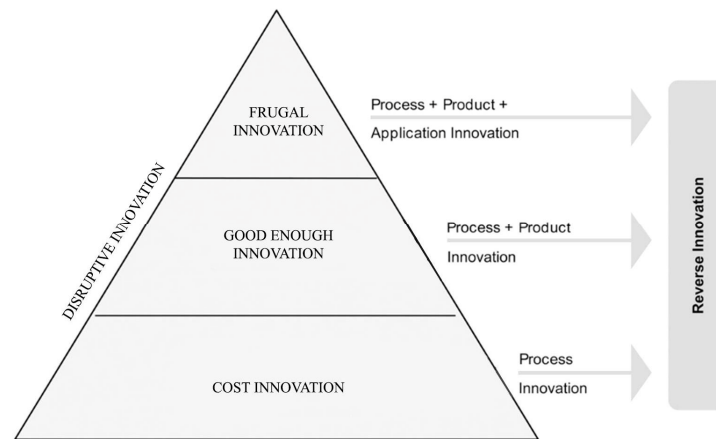


Figure 3. Market position and hierarchy of innovation

Moreover, there are some misconceptions around the different innovation types in this domain that may limit managers' ability to derive informed implications for strategy and operations. During the literature in the Reverse Innovation typology, it became clear that reverse innovation was not congruent with the other types of resource-constrained innovation. Reverse innovation cut across the other categories—reverse innovations were always built on cost, good-enough, or frugal innovations. The frugal innovation, cost innovation and good enough innovation become reverse innovation when it ultimately transferred to from developing market to developed market. We propose the Matrix in **Figure 3** that clarify the various types of innovation in plays as well as their strategies to help MNCs managers especially in Emerging Market to get a panoramic view of the Innovation picture, which helps them decide the right strategy when entering a new market.

In sum, Innovation for resource-constrained consumers in emerging markets has received increasing attention, but the discussion thus far has lacked a common understanding with regard to the definition of the various types of resource- constrained innovation. Future research should investigate in the clarification of Reverse Innovation; a standard definition could be proposed that contribute to identify the Innovation field. Besides that, sub- reserve innovation types should be studied seriously to avoid confusion between types while simultaneously suggesting different strategies having different types of innovation.

5.2. Research in Local Institutional Relates

The literature framework in Section 3 highlights the fact that different environmental factors can foster or restrain Reverse Innovation. The innovation context cannot be ignored, and managers should verify the presence of gaps between developing or emerging market and developed markets as well as growing cost awareness in developed countries in terms of the targeted innovation, in order to facilitate its reversal.

Although there is great potential in some emerging markets, companies should not be blind to local institutional realities for example, political or regulatory.

Emerging markets constitute a double-edge sword for multinationals,” as they offer opportunities caused by institutional voids or a lack of formal rules, but also have major challenges to overcome. Understanding the importance and influence of local government, differences in ways of doing business in these markets, as well as the importance of local leadership is crucial. Multinational companies conducting RI therefore face the challenge of managing the gaps between emerging and developed markets and need to ensure that the political placed on the multinational companies in emerging markets do not interfere with or impede their ability to reverse innovations. For instance, inbound foreign direct investment is often supported because local spillover effects are expected. But what if foreign R&D centers engage in reverse innovation? Why should local policymakers subsidize foreign R&D in their country if MNCs aim to use host-country innovations for the benefit of far-away markets? Another noteworthy example is Essilor’s lens coating innovation developed in China [22]. The world leader in optics developed a much less expensive, higher performing, more resistant lens coating in China, thanks to collaboration with local partners and regulatory flexibility in China. Although the product’s return to developed markets would highly benefit consumers, it would be blocked by European Union regulations.

So far, the future research in policy support and local regulation is a promising field for scholars and practitioner that We would expect local policy to support local R&D going into local products first. In the same vein, policies in the home country of MNCs focus on keeping jobs at home, and hence policies in those countries will likely discourage shifting innovation capability offshore and thus weaken a firm’s ability for reverse innovation overall.

6. CONCLUSION

Reverse Innovation for resource-constrained consumers in emerging markets has received increasing attention, but the discussion thus far has lacked a common understanding with regard to the definition of the various types of resource-constrained innovation. To tackle this limitation, we started broadly and then focused on specific databases and research terms. We also wanted to contribute to the literature and hope that further research on this important innovation concept will refine and clarify our results. Moreover, from theoretical standpoint, reverse innovation exposes numerous future research for mainstream model of innovation, MNCs in emerging market challenges to trick up the RI, internationalization, Reverse Spillover and Management Implication as well. A feasible research agenda on research innovation is presented in this article that could be the promising research area for global strategy scholars and managers to revisit these model and develop argument and theories systematically.

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7. APPENDIX

APPENDIX. Main characteristic of Innovation Concepts in EMEs

Category		Frugal innovation (FI)	Good-enough innovation (GI)	Cost innovation (CI)	Disruptive (DI)	Reverse innovation (RI)
Description		Application-engineered emerging market solution	Value-engineered emerging market solution	Cost-engineered emerging market solution	Technology-engineered emerging market solution	Cost-, value-, application-, or technology- engineered global market solution
Technology Aspects	Technical novelty	Medium-high Technical novelty	Low-Medium Technical novelty	Low technical novelty	Medium-high Technical novelty	Low-Medium Technical novelty
	Specificity	-Cost-effective raw materials - Local Sourcing - Local Production - Smaller components - New applications -Customized for poor markets	- Local sourcing - Local production - Standard components, - Less automation - High robustness - High ease of use	-Cost-effective raw materials - Local sourcing - Local production - Standard components - Smaller product sizes	-Cost-effective raw materials - Standard components -Customized for poor markets - Standard components -Commercialization of emerging of marginal markets	Cost, good- enough, frugal or disruptive innovation characteristics
Market Aspects	Target customer	Efficiency-seeking high-income customer	Efficiency seeking high-income customer	Efficiency-seeking high-income customer	Efficiency-seeking high-income customer	Resource-constrained or efficiency-seeking customer
	Strategy	Cost cutting, feature optimization and application innovation	Cost cutting and tailored feature optimization	Cost cutting	Technologies and new products created for new markets	Application of CI, GI, FI + DI strategy for emerging markets

Example	GE - Logiq Book Safaricom - M-Pesa	MT - weighing scale Logitech - M215	Huawei - phones and infrastructure Nokia - cell phones Godrej - soap	Offset printer digital photography	GE - Logiq Book MT - weighing scale MT - weighing scale Logitech - M215
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The Effect of Strategic Orientations on Organizational Performance of SMEs: Empirical Evidence from Pakistan

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Abstract: Strategic orientations like Market orientation (MO) and Learning orientation (LO) play critical role in improving the performance of both large and small scale businesses. This paper investigate the relationship between LO and organizational performance with MO as moderator. The current study reports the findings of two hundred and seven owners or managers of Small and Medium Sized Enterprises (SMEs) in Pakistan. The findings of the study indicate a positive relationship between LO and organizational performance. Mo was found to have moderated the direct relationship between LO and organizational performance. This study is among the few attempts made to systematically examine the interplay among MO, LO and organizational performance in SMEs operating in Pakistan.

Key Words: Market orientation, learning orientation, SMEs, performance, Pakistan

1 Introduction

Enhancing the productivity and competitiveness of the organizations has been an issue for both small and large organizations around the globe. In this context, organizations needs to deliver products with superior value in order to meet the changing needs and expectations of the customers (Beneke, Blampied, Dewar, Soriano, & Deacon, 2016). Prior studies in the strategy literature have suggested that business organizations must adopt those strategies that help them to effectively respond to the changing market demands (Hilman & Kaliappen, 2014), and compete successfully in the dynamic business environment (Altinay, Madanoglu, De Vita, Arasli, & Ekinci, 2016; Jogaratnam, 2017). Research scholars have highlighted that both small and large organizations need to deploy strategic orientations like market orientation (MO) and learning orientation (LO) in order to survive and grow in the competitive business environment (Jabeen & Mahmood, 2015).

Prior studies focusing on strategic orientation have suggested that the adoption and implementation of two strategic orientations namely MO and LO help both small and large organizations to enhance their core competitiveness, satisfy the current and latent needs of the customers and achieve improved organizational performance (Choi, 2014; Lin, Peng, & Kao, 2008; Mokoena & Dhurup, 2016). MO reflects the organizational behavior to understand the changing buying pattern of present and potential customer as well as keeping vigilant eye on the competitors' move in the marketplace to deliver superior value to customers (Narver & Slater, 1990). LO on the other hand reflects an organization ability to generate and share the market related information across the organization and facilitates the superior value creation (Sinkula, Baker, & Noordewier, 1997). Review of the extant literature in the subject area has highlighted that the complimentary effects of both MO and LO enable the organizations to respond effectively to changing market demands, gain competitive advantage and enhance the organizational performance (Slater & Narver, 1995).

Notably, the strategy literature has highlighted that most of the prior researches have attempted to associate organizational performance with a single orientation, like LO and MO (Frank, Kessler, Mitterer, & Weismeier-Sammer, 2012; Hilman & Kaliappen, 2014). However, recently researches argue that the adoption and implementation of a single orientation may prove less effective to achieve improved organizational performance (Baker & Sinkula, 2009; Hakala, 2011), and suggested that organizations need to build their strategies based on multiple orientations together in order to survive and grow in today's challenging business environment (Laukkanen, Nagy, Hirvonen, Reijonen, & Pasanen, 2013). Prior researches argued that organizations that deploy multiple strategic orientations are in better position to respond effectively to the changes posed by business environment and exploit the business opportunities (Choi, 2014; Deutscher, Zapkau, Schwens, Baum, & Kabst, 2016; Farrell &

Oczkowski, 2002). In the light of the aforementioned arguments, the present study takes an integrated approach and investigates that how MO and LO together influence that organizational performance of SMEs.

Nevertheless, majority of the studies on strategic orientations have been conducted in developed economies and in large organizational settings. However, prior studies argue the researchers should not assume the interplay between strategic orientation and performance as homogenous in all contexts due to low sampling variance and suggested the inclusion of moderator in the relationship according to the context of the study (Rauch, Wiklund, Lumpkin, & Frese, 2009). The researchers more recently called for further attention to investigate the interplay between LO and MO in developing countries like Pakistan (Hussain, Rahman, & Shah, 2016), the research area which has been paid less attention by the research scholars.

The present study fills the gap in the literature by taking a configuration approach to examine that whether MO moderates the LO-organizational Performance link in the context of SMEs operating in Pakistan. We suggest that firms can achieve improved organizational performance by deploying effectively their strategic orientations like LO and MO simultaneously.

2. Literature Review

2.1 Learning Orientation

LO of an organization demonstrate its ability to develop a mechanism where market related knowledge is created and shared among the members across the organization for attaining the competitive advantage and superior performance (Calisir, Gumussoy, & Guzelsoy, 2013). This mechanism include observing changes in the market, intelligence generation and sharing regarding preferences and taste of the customers, keeping a vigilant eye on competitors actions and developing/ and adopting new technologies to exploit the business opportunities in those markets where the competitors have not yet reached (Sikora, Nybakk, & Panwar, 2016). A learning oriented organization is capable to generate and utilize market related information by exhibiting strong commitment to learn with in and out the organization, open mindedness in questionaing and challenging its current ways of doing things and developing new ways to learn about its customers and competitors to deliver superior customer value (Kaya & Patton, 2011; Sinkula, et al., 1997). Shared vision demonstrates the value an organization gives to the learning process (Calantone, Cavusgil, & Zhao, 2002), to transform the organizational learning acquired into action by its members (Calisir, et al., 2013; Sinkula, et al., 1997). Concentrating on these dimensions of LO enable organizations to be sensitive to market changes, generate market related information and respond to the changing market demands effectively that ultimately results in gaining competitive advantage and greater performance.

2.2 Market orientation

MO reflects the ability of a firm to create superior customer value by displaying its strong commitment towards delivering superior customer value, satisfying its customer, maintaining long term customer relationships, sharing and responding to competitors related information and exploiting the business opportunities based on market related information (Attia, 2013; Slater & Narver, 2000). Narver and Slater (1990) conceptualised MO as a three dimensions construct explaining the machanism under which a firm understand its target customers (customer orientation), observe movement of its competitors and discussing their strategies (competitor orientation) and sharing these information across the organization (interfunctional coordination) getting input from them, devising strategies and delivering superior value to its customers. Market oriented organizations are in better position to identify needs and wants of the customers and get closer to them to fulfill them which ultimately results in creating and deleivering better customer value enabling organizations to be on more competitive position (Baker & Sinkula, 2009; Hilman & Kaliappen, 2014).

2.3 Learning orientation and Organizational Performance

Review of the previous literature on strategic orientation has highlighted that LO facilitates and enables both large and small businesses to acquire and develop knowledge by understanding the changing needs of the market and thereby fulfilling the needs of the customers (Hakala, 2013; Maes & Sels, 2014). Prior studies have reported the significant influence of LO on organizational performance. For example, a study conducted by Calantone et al. (2002) reported a significant and positive impact on organizational performance. These researchers further reported that LO has indirect influence on organizational performance through competitive advantage. A recent study conducted by Rhee, Park & Lee (2010) in small technology innovative firms in South Korea opined

that an organization that simultaneously deploys both strategic orientations (MO & LO) would be in a better position to improve its overall performance. They further added that focusing LO strategy more compare to MO can enable an organization to bring innovation and will results in greater competitive advantage. A more recent study conducted by Maes and Sels (2014) support the notion that the implementation of LO strategy with other strategies can facilitate the organization in attainment of its predetermined goals. More recently, Kharabsheh, Ensour, & Bogolybov (2017) conducted their study on 190 senior managers working in manufacturing organizations in Jordan and concluded that LO helps organizations in improving their organizational performance. Hence, on the basis of the extant literature, the following is predicted.

H1: Learning orientation is positively associated with the organizational performance of SMEs in Pakistan.

2.4 Moderation by Market Orientation

Prior studies in strategic management have reported that MO facilitates nurturing of LO in organizations because of its responsiveness to the external environment in terms of learning from outside the organization (Slater and Narver, 1995; Fang et al., 2014). The same view is supported by Matsuno, Mentzer, & Ozsomer (2002) that high market orientation of an organization leads to its high LO. Moreover, Dickson (1996) argues that LO provides a fertile environment to all other strategic orientations in an organization for the reason that of its ability to constantly enhance the market information generation process. Other studies suggested that an organization must deploy MO and LO together for improved organizational performance (Baker & Sinkula, 2002; Dada & Fogg, 2016). In the same line, a more recent study by Deutscher et al. (2016) argue that implementation of both high level of LO and MO together results in greater organizational performance.

Notably, the few existing studies that consider both MO and LO simultaneously investigated 1) the direct effects of these orientations on performance (Baker & Sinkula, 1999; Santos-Vijande, Sanzo-Perez, Alvarez-Gonzalez, & Vazquez-Casielles, 2005), 2) investigated the mediating role of LO (Keskin, 2006; Yeni, Hastini, & Hasti, 2017), or moderating effect of LO (Beneke, et al., 2016; Fang, Chang, Ou, & Chou, 2014) on the relationship of MO and performance. Moreover, majority of these studies have been conducted in large organization settings in developed countries. Nevertheless, scholars argue that the results obtained from large organization may not be applicable to small organization because SMEs use small portion of marketing research and encounter greater financial pressure (Lonial & Carter, 2015). Moreover, SMEs in developing countries operate in poor state of infrastructure, having limited access to finance and underdeveloped institutional environment as compared to large organizations (Roxas, Ashill, & Chadee, 2016; Zayed & Alawad, 2017). Therefore, this study attempts to address the gaps in the strategy literature and investigate the possible moderating effects of MO on LO and organizational performance relationship in the context of SMEs operating in a developing country like Pakistan. Hence, we hypothesized the following.

H2: Market orientation moderates the association between learning orientation and organizational performance of SMEs in Pakistan.

3 Research Methods

3.1 Study Context and Sample

The context of the current study is Pakistan. SMEs play a critical role in promoting the economic growth, raising standard of living and improving the industrial development of both the developed and developing countries (Dar, Ahmed, & Raziq, 2017). In developing economies SMEs contribute positively to the creation of employment opportunities, reduction in poverty, development of entrepreneurship (Hosseini & Ramezani, 2016). SME sector in Pakistan contributes 30% to Gross Domestic Products (GDP), though this sector constitutes 93% of the overall businesses in Pakistan (Mirani & Shah, 2012). The challenges these SMEs face include; lack of education and training, difficulty in access to finance and modern technology and, entrepreneurial skills which may have somehow negative impacts on health of these SMEs (Hussain, Abbas, & Khan, 2017; Jaffari et al., 2011). Though, the respective share of this sector into national economy is low compared to the large organizations, however, the importance of this sector cannot be ignored in the economic and social development process of the country. It is argued that the development of this sector is one of the prerequisites for ensuring economic and social development in any country (Dobrovic, Lambovska, Gallo, & Timkova, 2018). Keeping in view the increasing importance of this sector, the current study highlights the important role these strategic orientations can play in development of this sector and making it more competitive, since this sector has the potential to promote social and economic development.

The data were collected from owners or managers of SMEs registered with either SMEDA or chamber of commerce, with less than 250 employees as per the criteria of Small and Medium Enterprises Authority (SMEDA) Pakistan for definition of SMEs. This study concentrated on two big cities of Pakistan namely Islamabad and Peshawar for data collection. For this purpose, 400 questionnaires were randomly distributed among the respondents, of which 225 were received back, of which some were discarded due to missing information. The usable responses were calculated to be 207, resulted in a response rate of 52%.

3.2 Measurement

This study used quantitative research methodology to collect the primary data. MO was measured through 15-items scale, adapted from Narver & Slater (1990). LO was measured through 15-items scale adapted from Sinkula et al. (1997) and validated by Nasution et al. (2011). MO and LO were measured on five-point Likert scales, ranging from 1 = “strongly disagree” to 5 = “strongly agree”. The organisational performance as dependent variable was subjectively measured through 3- items namely market share, sales growth and overall performance on a five-point Likert scale ranging from 1 = “poor” to 5 = “excellent”. The respondents were asked to assess the results of their companies against the competitors over the past three years.

3.3 Data Analysis

To ascertain the reliability, pilot testing of the developed instrument was performed. The Cronbach alpha reliability statistics were used to measure the reliability of the variables of the study. The alpha reliability for MO and LO and organizational performance was checked and found to be 0.68 and 0.68 respectively. The alpha reliability results for the dimensions of MO and LO are as follows; competitor orientation (0.67), customer orientation (0.70), inter-functional coordination (0.66), commitment to learning (0.80), shared vision (0.79) and open mindedness (0.77). The alpha values of the main variable and their sub-dimensions were found to be above 0.60 (Hair, Babin, Money, & Samouel, 2003), and thus indicated that the instrument is reliable. Descriptive statistics i.e. skewness and kurtosis were used as indicators of the deviation which have been suggested by Meyer, Becker, & Van Dick (2006) to confirm that whether the data is normal. The values derived for both skewness and kurtosis were within acceptable range indicating the data was normal. Inferential statistics were used to test the hypotheses of the study. Pearson correlation was used to confirm the correlation among the variables of the study. Linear regression analysis was conducted to check the significant influences of LO on organizational performance. The moderating effect of MO on LO-organizational performance link was also checked using Baron and Kenny (1986) approach. Other assumptions like homoscedasticity, multicollinearity were satisfied before the regression analysis was performed.

4 Findings

The results of linear regression analysis derived from testing *H1* are given in Table 1. The results indicated that LO has a significant ($F=155.006$, $p=0.000$) and positive impact on organizational performance (standardized $\beta = .656$). Therefore, *H1* of the study is supported.

Table 1 Coefficients for *H1*

Hypothesis	Mean	Standardized beta	F	Sig
<i>H1</i>	Learning Orientation	0.656	155.066	0.000

Note: Dependent variable: organizational performance

The results of moderating effects of MO on LO and OP relationship using three steps Baron and Kenny (1986) method of moderation are reported in Table 2. The results of linear regression has already been reported in Table 1, where LO has significant and positive impact on organizational performance (Step 1). In step 2 of the Table 2, MO was added as moderator with LO. The results indicated that the addition of MO showed the increase of 02 per cent indicating R-square i.e. $0.433-0.431=0.355$ (change of F-value= 81.198, $p < 0.05$). In the next step (step 3), after adding the interaction term of LO*MO with step 2, the explanation power of the model ($R^2 = 0.771$; $p < 0.001$) raises to 77.1 percent. The results reported that interaction term resulted in significant increase of 33.8 percent (change in F-value = 227.713, $p < 0.001$) in explaining the variance in organizational performance. The results reveal that the adoption and implementation of high level of MO practices in SMEs strengthen the relationship between LO and OP. Thus, hypothesis *H2* is supported.

Table 2 Model Coefficients and Summary for *H2*

Step		Standardized beta	R	R ²	F Change	Sig. F Change
1	LO	0.656	0.656	0.431	155.066	0.000
2	LO	0.617	0.666	0.433	81.198	0.000
	MO	0.119				
3	LO	-.594	0.878	0.771	227.713	0.000
	MO	-.118				
	IT	1.424				

* LO (Learning orientation), MO (Market orientation), IT (Interaction Term).
Note: Dependent variable: Organizational Performance

5 Discussion

The objective of the present study was to investigate the role of LO and MO for improving organizational performance of SMEs in Pakistan. The current study also examined the moderating effect of MO on organizational performance. To examine how LO strategy is critical for improving the organizational performance; we tested our first hypothesis (*H1*) to check the effects of LO on organizational performance. The results demonstrated that there is positive and significant influence of LO on organizational performance and support the previous studies indicating that LO positively influence firm performance (Keskin, 2006; Wang, 2008). To examine the moderating effect of MO on the LO-organizational performance relationship, we tested our second hypothesis (*H2*), the results of which revealed that MO moderates the link between LO and organizational performance. The results support the work of Baker and Sinkula (1999) that both MO and LO enable organizations to deliver superior customer value and leverage the market opportunities by serving with innovative products. Voola, Casimir, Carlson, & Anushree (2012) also support the notion that organizations deploying multiple orientation simultaneously are better able to serve the customers and compete in the dynamic market successfully.

6 Limitations and Future Research

This research has several limitations. Subjective performance measures were used in light of the previous studies of Narver and Slater (1990) and Roxas et al. (2016). However, objective performance measures such as financial data would be valuable to be employed and the results should be compared with the current study for more in-depth insights on the subject matter. Moreover, this study relied on data collection in two cities namely Peshawar and Islamabad. Future studies should consider other industrial cities of the country. This study provided an integrated approach and investigated the relationship between MO, LO and organizational performance, it is proposed that future research may take the sub dimensions of these orientations and their relationships with organizational performance may be examined. This study was conducted in SMEs operating in two cities of Pakistan; future studies concentrating on other industrial hubs of the country are proposed to be conducted for gaining more insights on the behaviour of these orientations.

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Comparative Study on the differences between the NPD process in China and Developed Countries

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Abstract Through comparing and analyzing advantages, disadvantages, challenges existing in markets in China and developed nations, the article can prove to provide more possibilities for NPD, and bring clear developing direction for domestic companies and multinational companies. Based on relevant data and analyses in the five phases of NPD, the article combines information about NPD during the process of comparison between China and developed nations to provide business strategies for companies in China, which is different from other articles. And this article lets companies in China know that they should focus on keeping innovative and expanding market to face changes in the process of NPD.

Key words: definition, new product development, business activities, emerging market, innovation, R&D, advantages, disadvantages, challenges, technological issues

1 Introduction

New product development (NPD), a term used in business and engineering, refers to the complete process of bringing a new product to market and enabling customers to purchase it. In business and engineering, new product development means the complete process of bringing new products to market. The core aspects of NPD are product design and various business considerations. New product development is widely described as turning a market opportunity into a product that can be sold. Products can be tangible (physical things that can be touched) or intangible (such as services, experience or beliefs), although sometimes services and other processes are different from "products." Importantly, NPD requires relevant personnel to exactly know the needs and needs of customers, the competitive environment and the trend and changes existing in the market.

Originally, developing new product activities mainly appeared in the developed countries due to rapid economic growth and technological advance. But in the recent decades, multinational companies in developed countries have been shifting a large part of their R&D activities to emerging markets such as India and China. While the location of R&D centers in other developed countries is driven by lucrative markets or expertise from local ecosystems in these countries, R&D locations in developing countries are mainly due to low-cost access by technicians. Over time, many R&D centers in these markets have evolved to accumulate advanced technological capabilities, resulting in higher value-added jobs for their employees and seeking responsibility for complete products or technologies (Srivardhini K. Jha, Ishwardutt Parulkar, Rishiksha T. Krishnan, and Charles Dhanaraj, 2016). Pointed at current trends and situations around the world, there are some comparative studies and relevant analyses in some aspects about differences between China and some developed countries through analyzing NPD activities and conditions in these nations. Through relevant analyses and comparisons, the article can provide a clear direction for companies in China that develop new products in Chinese market, and even in the global market, and also give some business advice for companies in developed nations.

2 NPD in China

2.1 Entire Developing Situation in China

As one of most potential emerging markets around world, the speed of developing and producing products is amazing. For its entire manufacturing field, China not only surpassed the United States in 2011 to become the world's largest producer of manufactured goods, but it also used its vast manufacturing engine to improve living standards by doubling the country's per capital GDP over the past decade.

However, with economic growth slowing, costs rising and other unstable factors, the situation of NPD in China encounter challenges and difficulties. And in a more fundamental macroeconomic reality, these pressures are rising: as manufacturing becomes more affluent, the relative role of manufacturing in China is almost inevitably declining, which means slower developing trend in NPD. For example, manufacturing growth is slowing at a faster rate than overall economic growth, and there is evidence that the country has lost some of its new factories to lower-cost regions, such as Vietnam, which has sparked competitiveness for Chinese manufacturing industry. It could directly make more pressures on developing new products for corporations, especially for international companies.

2.2 Challenges in NPD

2.2.1. Rising Costs:

In recent years, rising wages and the appreciation of Chinese currency have restricted China's exports and focused global attention on the future as a low-cost manufacturing center. Most multinational companies that produce labor-intensive products, such as textiles and apparel, are actively seeking diversification outside of China to reduce costs, political and supply chain risks. And what these global companies focused on is not only a global competitive issues, but more about which participants in the value chain will create the most value. So from this point, creating new products or innovation might not be a focused center.

2.2.2. Higher consumers' demand for new products:

According to relevant researches, by 2020, more than half of the income of Chinese urban households, calculated on the basis of purchasing power parity, will enable them to enter the middle class - this category is almost non-existent in China in 2000 (Karel Eloot, Alan Huang, and Martin Lehnich, 2013). The consumers in this middle class have more and higher requirements for new products, which make many local producers' engineering and developing abilities not reach to these corresponding requirements from these customers. For instance, recently a Chinese TV manufacturer's executive recently admitted that his company could not fully meet the requirements of high-end customers.

2.2.3. Comparatively weak regulation:

Rising consumer expectations will require food and beverage companies to become more competitive in terms of freshness and regulatory compliance, while Chinese standards still lag behind Western standards. For example, In March 2005, a small amount of toxic colorant Sudan Red was found in KFC's New Orleans chicken wings and chicken burgers (Huang Shumao, 2014).

2.2.4. Increased volatility:

The uncertain global economic environment since 2008 has complicated the lives of manufacturers everywhere. For example, in the Chinese steel industry, after a decade of double-digit growth, annual demand growth in 2012 slowed to 3%. The result is a reduction in capacity utilization and fierce competition. The average profit margin of the industry fell by 56% from 2010 to 2012. Similarly, in China's huge automotive

industry, the annual growth rate has grown from 7% to 52% over the past five years. Household appliances and electrical machinery manufacturers have also experienced strong demand fluctuations and have been exacerbated by rising overseas demand.

This level of volatility makes planning for Chinese manufacturers difficult.

2.3 Advantages about NPD in China

In the recent years, companies in China are opening a new path for products and services to the world. It is targeted at accelerating innovation pace – redesigning R&D and innovation processes to make new product development faster and less expensive. The new focus is unlikely to produce an amazing technological breakthrough, but it allows Chinese competitors to reduce the time it takes to bring innovative products and services to the mainstream market.

Silicon Valley and other technology hotbeds may be able to match the pace of Chinese innovation in specific areas such as electronics and Internet services. However, the most powerful Chinese competitors are unique in that they can combine accelerated innovation with rapid expansion and low-cost high-volume production, and apply these technologies to a variety of traditional industries. We see that the Chinese industry is accelerating innovation, including pharmaceuticals, telecommunications and information technology, medical and industrial equipment, consumer electronics and e-commerce. While it may not affect companies that consistently deliver breakthrough innovation, it poses real threats and opportunities for many mainstream competitors (Peter J. Williamson and Eden Yin, 2014). Besides, there are some other main advantages for developing new products in Chinese market.

Lower developing and producing costs: Although relevant costs in China keep in a growing trend as mentioned above, there is a significant cost difference between China and developed nations. Comparatively, these developed countries' manufacturers have higher management costs, higher training costs, and higher turnover. China's affordability makes overseas manufacturing an ideal choice for a common cause (Nathan Resnick, 2018).

Cheap labor: By outsourcing to China, companies can get the cheap labor of the factory without having to train employees, provide computer access, or endure any other difficulties in employment. China's wages are significantly lower, and using these savings is as easy as establishing a relationship with the factory.

Higher production capacity: Chinese factories produce goods for the global economy. Their manufacturing capabilities far exceed people's expectations. When companies are outsourcing to China, they are working with time-tested factories that have been producing quality products in similar industries for many years and are in great supply.

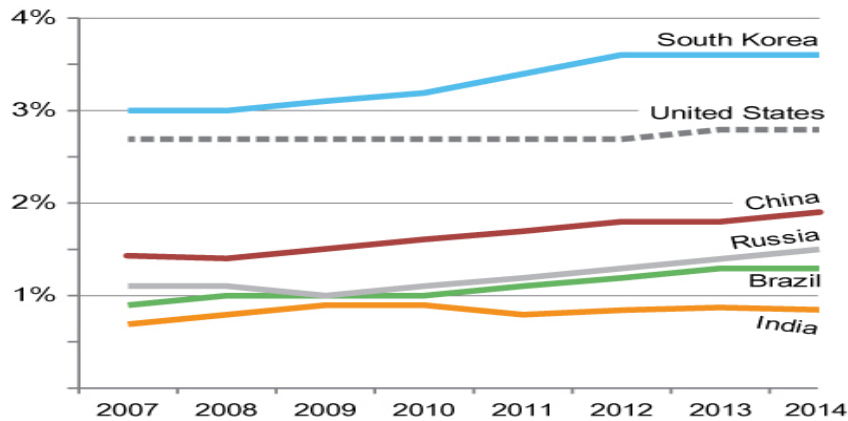
Better expansion and diversification opportunities: Choosing China as NPD market can provide more opportunities for multinational companies to expand its market. With large population base and advanced technology, there are still big potential existing in Chinese market.

Through analyzing market in China, it has showed advantages, disadvantages, opportunities and challenges for NPD in China. Next, here are some analyses and researches about NPD in developed nations compared with developing countries.

3 NPD in developed countries

Compared to these developed nations, like the United States and those in Europe, some developing nations are expected to see constant growth in their R&D investments in the recent years. The following chart can show this trend.

Table 1 Research Intensity Trends



As what the curves shows (Battelle, 2013), most Asian countries are expected to experience significant economic growth in 2014. When GDP growth is combined with the country's commitment to increase research intensity, there is often a strong R&D fund growth (as in China). From this perspective, many international companies turn to invest R&D in these emerging market. For markets in developed nations, there are highly developed capital markets, high liquidity, strong regulatory bodies, large market capitalization, and high per capital income (Emerging Money, 2012). Based on these factors, it is clear to get comparative advantages and disadvantages.

Highly developed market: The market in developed nations means more strong competitors, and they own mature plans, strategies and professional abilities to face challenges and changes in the market. This market requires high-quality products, especially for new product development, it means a bigger challenge and higher requirement.

High liquidity: This point brings more unstable factors, especially in keeping talents. Certainly, companies can catch this point to hire more professional employees.

Strong regulatory bodies: It gives more restrictions to local companies, but it also provides safe guarantee for consumers and avoid some unethical and illegal business activities by some companies during the process of pursuing profits, which efficiently supervise the corporate actions.

Large market capitalization and high per capital income: It means more profits and market shares that companies can grasp, which can provide developing fund for companies.

4 Differences in the process of NPD

Based on the five phases in the process of NPD, there are some differences about relevant aspects between China and other developed countries.

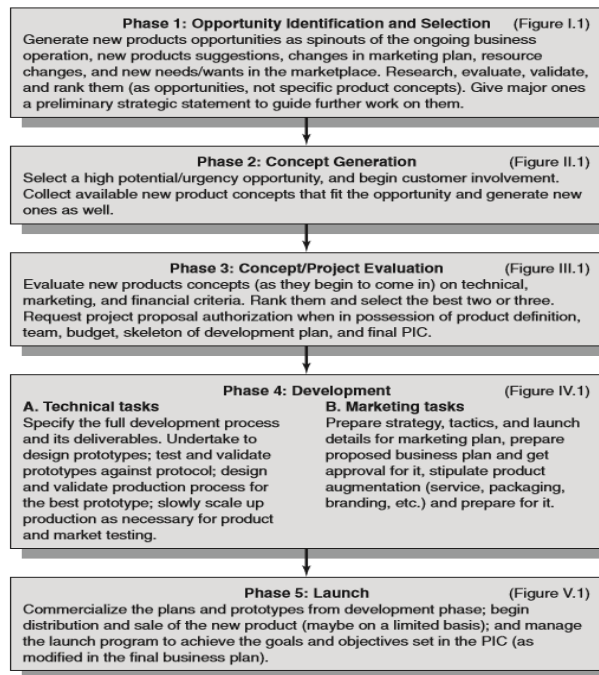


Figure1

4.1 Opportunities phase

As a result of ongoing business operations, new product recommendations, changes in marketing plans, resource changes, and new demand/demand in the market, new product opportunities are generated. Research, evaluation, verification and ranking (Merle Crawford and Anthony Di Benedetto, 2011).

For Chinese NPD, globalization means more opportunities. For example, China can utilize more advanced technology to create new products, which can increase the competition of companies in China. On the other hand, more extensive market is opened for China, it is can be seen as another opportunity. But for developed countries, it maybe means less opportunities. On the one hand, more competitors can bring more forces. On the other hand, relevant costs are increasing, such as labor costs. Certainly, these nations also can develop more advanced products through depending on their advantages in technological fields.

4.2 Concept generation and project evaluation

Choose high potential/emergency opportunities and start customer engagement. Collect new product concepts that fit the opportunity and generate new concepts.

With more opportunities appearing in the global market, generating concept is easier as innovative ideas occur with advanced technology.

Evaluate new product concepts on technology, marketing and financial standards (when they start to appear). Rank them and choose the best two or three. Request project proposal authorization when you have a product definition, team, budget, development plan skeleton and final PIC (Merle Crawford and Anthony Di Benedetto, 2011).

For project evaluation, China is still being in the developing process of NPD, and its relevant regulation system is not perfect, which maybe cause relatively inaccurate evaluation.

4.3 Development

This phase mainly includes two parts: technical tasks and marketing tasks.

For technical part, specifying the complete development process and its deliverables. Undertake the design prototype work; test and validate the prototype according to the protocol; design and verify the production process of the best prototype; slowly expand the production scale according to the needs of

product and market testing.

For marketing part, prepare the strategy, strategy and startup details of the marketing plan, prepare the proposed business plan and obtain approval, and stipulate that the product is added and prepared (Merle Crawford and Anthony Di Benedetto, 2011).

As what is analyzed above, advanced technology can bring technical improvement. Due to more technological methods in developed nations, they have a perfect method of development and production. For marketing tasks, most countries have their own clear tasks or development direction.

4.4 Launch

Commercialization plans and prototypes from the development phase; starting to distribute and sell new products; and managing start-up plans to achieve the goals and goals set in the PIC.

With development in social media, launching methods are various today. Companies in China and developed nations can utilize social media to launch new products quickly.

The Entire procedure diagram is showed below.

5 Conclusion

Pointed at current market and economy, based on the analyses above, there are three main aspects in conclusion.

5.1 Achieve excellent development

According to requirements and demands in Chinese and developed nations' market, the global market needs high qualified and innovative products, so domestic and multinational companies should work hard to bring manufacturing-excellence tools and approaches to improve efficiency.

Considering relevant costs, lower costs of developing and producing products in China compared to developed nations is still an important business factors, which attracts many companies to set R&D and manufacturing centers in China.

5.2 Keep innovative

For industries that rely on innovation, the triple blow of rising costs, complexity and competitive pressure means that the old ways of developing products in China are now likely to become liabilities. Maintaining competitiveness will require domestic companies and multinational companies to change, starting with the mindset and attitude of accumulating product development activities in China.

Product development barriers. Chinese domestic companies must go beyond the "faster, cheaper" fixed approach adopted by R&D methods in recent decades. For every Chinese innovator who is attracting attention from the world, we still see dozens of small companies working hard to develop R&D pipelines, which will help them develop from new entrants to existing ones that can achieve their global ambitions.

5.3 Target extensive market

Although there is still potential developing space existing in China and some developed countries, companies, especially for multinational companies, other developing nations, like some countries in the Asian Pacific areas, and even Africa, there are more potential markets waiting for being exploited. Leaders and managers in companies should establish proper business plans, strategies, and lead professional teams to open more markets, and can even utilize local resources to create new products and bring more possibility for NPD.

On the whole, the rise of China in recent years has been an amazing performance for the manufacturing industry. However, rising costs, more mature consumers and basic macroeconomic realities mean that yesterday's manufacturing methods are losing their relevance. For domestic companies and multinational manufacturers, the immediate priority is to increase productivity, improve product development methods, and expand more broad market around the world. Those who do this can create lasting competitive advantages and lay a solid foundation for development in the long run.

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Room B

Session – 12

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Exploring the Potential of Malaysia Research Universities in Research and Development

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Abstract

Among the Malaysian Universities, research universities are heavily depended on the government and private research grants from home Malaysia and abroad. Universities are focusing on different research areas depending on the potentials of the universities. Researchers in universities are actively conducting researches in own specialized fields. As a result, the numbers of patent publications has been increasing over the years. However, the universities are seen to be have concentrated research focus. Misallocation of research grants may result in unproductive usage of the grants because of the lack of institutional research support. Using the Derwent Innovation and Derwent Data Analyzer, this paper investigates and explores the scenarios and research strength of the research universities in Malaysia. The findings of this paper will assist and can be a reference to the grant sponsors and the industries to allocate the research grants efficiently. Potential universities can also be identified for effective University-Industry collaboration and partnership.

Keywords: Patent, Research University, patent analysis

1 Introduction

Universities in Malaysia are generally categorized into public and private universities. Private universities include locally established universities and campuses of foreign universities. Public universities in Malaysia are funded by the government and are governed as self-managed institutions and they come under the Universities and University Colleges Act 1971 [1] except for Universiti Malaya and Universiti Teknologi MARA which they come under Act of Parliament [2]. There are approximately 20 public universities in Malaysia and among them there are 5 research universities. The oldest public and research university is University Malaya. The other research universities are Universiti Teknologi Malaysia, Universiti Putra Malaysia, Universiti Kebangsaan Malaysia and Universiti Sains Malaysia.

University Malaya was established in 1905 as King Edward VII College of Medicine and change its name to Universiti Malaya when it merged with Raffles College on 1949. This university is in the World Top 100 ranking and Asia Top 50 ranking, with more than 50 research facilities and total RM 287 million grant spent until 2016, are currently focusing on nanotechnology and Industry Revolution 4.0 [3]. Universiti Teknologi Malaysia, which was upgraded into university in 1971 from Technical College that was established in 1951, has two main campuses in Johor Bahru and Kuala Lumpur. This university is the oldest public engineering and technology university in the country, specializes in technical studies and offers a comprehensive engineering division. This is reflected in the subject rankings, which in the top 100 for mechanical engineering, electrical engineering and chemical engineering [4]. Universiti Putra Malaysia is also one of the leading research university in Malaysia and was originally founded in 1931 as School of Agriculture. This legacy is reflected in its performance in the subject rankings, which of the 19 subjects in which UPM is internationally ranked, it appears within the top 100 for agriculture and forestry. Furthermore, many of the results of commercialization of UPM research and innovations (UPM products) have been sold in various types of essentials such as health food, agriculture and livestock [5]. Universiti Kebangsaan Malaysia (UKM), the national university of

Malaysia was born from the aspirations of the nationalists to uphold the Malay Language as a language of knowledge. Universiti Kebangsaan Malaysia opened on 18 May 1970 to 192 undergraduate students in Kuala Lumpur, a temporary campus housing three main faculties, the Faculties of Science, Arts and Islamic Studies. In October 1977, UKM moved to its present premises which form the main campus in Bangi. Beside main and health campuses, currently UKM operates seven research stations (RS); The Tasik Chini RS, The Marine Ecosystem RS, The Langkawi Geopark RS, The Marine RS, The Fraser's Hill RS, The Plant Biotechnology RS etc [6]. Universiti Sains Malaysia (USM) is a government funded autonomous university in Malaysia and founded on 1 June 1969 as a statutory body with its own constitution. It is among the oldest institute of higher learning (IHL) in Northern Malaysia. It has three campuses, a main, a health, and an engineering campus where main campus focusing on science and health and engineering campuses focus on their field respectively [7].

All 5 research universities are actively conducting research based on their respective focused field and patenting their invention and innovation. Figure 1 indicate the number of patent applications for each university and it shows that the number is increasing over the years [8]. However, further investigation is needed to determine the research field that each university are focusing on in order to see the strength and opportunities of research areas in Malaysian universities starting with Malaysian research universities.

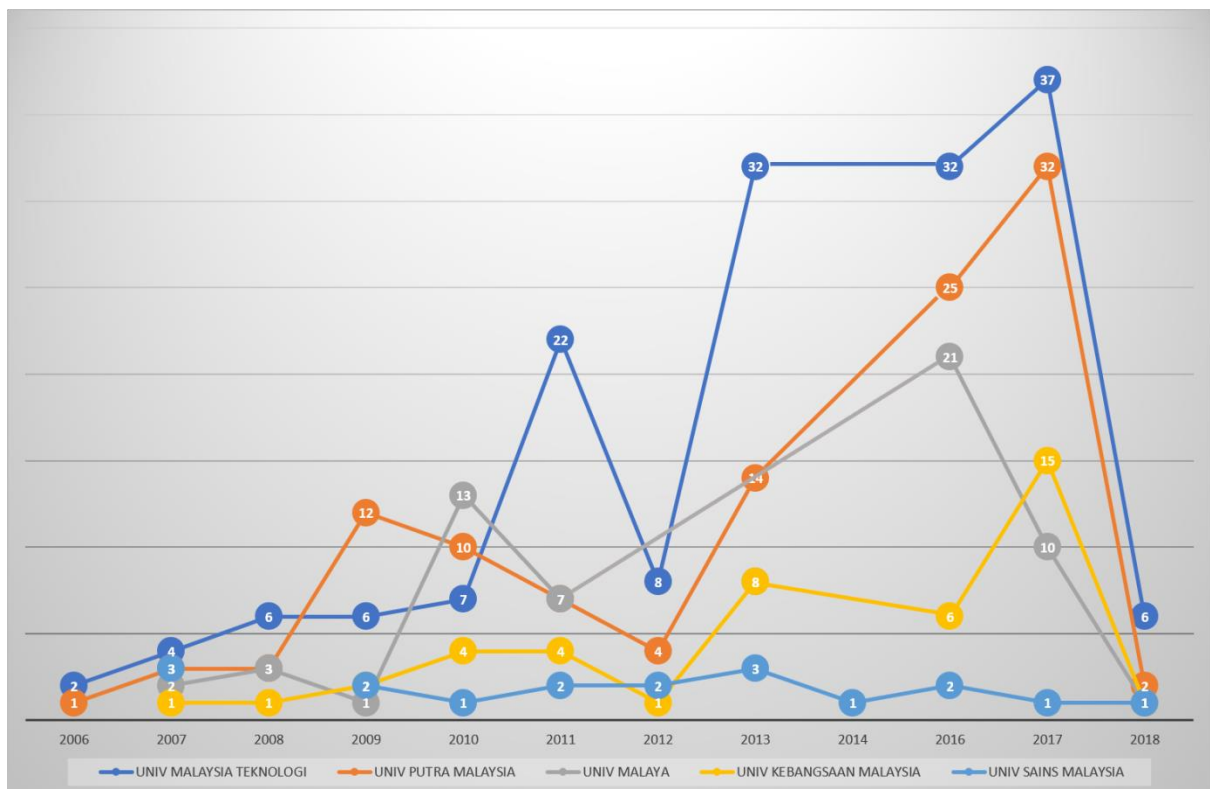


Figure 1: Patent applications by the research universities

The primary focus of this paper is to explore 5 research universities strength in respective fields. The outcome of the paper will serve a guide for the funding agencies, both national and international, to distribute the research grants optimally among the universities.

2 Methodology

2.1 Derwent Innovation

Derwent Innovation (DI) is used to search for patents applied for in Malaysia either by Malaysian or foreign companies, universities or individuals. Patent data in the latest 10 years (2008-2017) was collected. Derwent Innovation enables users to search authoritative and accurate patent data from Derwent World Patent Index (DWPI). DWPI is the world's most comprehensive database of

enhanced patent documents which prevents users from checking multiple sources, coping with foreign languages or dealing with incomplete records.

Using Derwent Innovation, two different data sets were created. The first data set is all granted patents in Malaysia from 2008-2017, however, the patents that have their basic patent registered earlier in other countries were included too. The patents that have their basic patent registered earlier in other countries show that the inventors thought of Malaysia as market for business and it is necessary to protect their inventions or innovations in Malaysia.

The second data set only consisted of all granted patents that their basic patent was patented in Malaysia from 2008-2017. This indicate that only the inventions or innovations that originated in Malaysia are in this set.

2.2 ThemeScape Map

Both of the data set were then analysed using ThemeScape Map in Derwent Innovation. ThemeScape Map is a tool that able to distinguish and cluster words in the patent documents into a contour map which locate the similar patent close together. As this map is a contour map, the similar patents are located together around the lighter colour 'peak' contour while patents that are not related to each other are in the 'sea' section. From this map we are able to see which fields that Malaysia are focusing on in these selected years. Maps from both data set were generated and compared.

2.3 Derwent Data Analyzer

Further analysis of the data was done using Derwent Data Analyzer. Derwent Data Analyzer empowers users to analyse trends, profile competitors, avoid infringement and identify strategic development opportunities in information gained from patent data.

3 Results and Discussions

3.1 ThemeScape Map

Figure 2 show the ThemeScape Map of the first data set which are the data of all granted patents in Malaysia from 2008 to 2017 including the patents that had their basic patent registered earlier in other countries. As this map is a contour map, the similar patents are located together around the lighter colour 'peak' contour while patents that are not related to each other are in the 'sea' section. From this map, we are able to see that the main field that Malaysian and foreign companies, universities and individuals thought as important business market are the upper right part of the map which could be conclude as "Disease" field. The patents regarding on disease treatment such as Arthritis and Rheumatoid are mainly registered in Malaysia in the recent years. Other fields that were located around the 'peak' are "Industrial Container" and "Palm Oil".



Figure 2: ThemeScape Map of granted patents in Malaysia from 2008-2017 including the patents with their basic patent registered earlier in other countries

Figure 3 shows the map of the second data set which are the data of all granted patents that their basic patent was patented in Malaysia first from 2008 to 2017. This means that this data set is a group of patents that the inventions or innovations are originated from Malaysia but it is not necessarily from Malaysian. From this map, we are able to see that there are seven field in the ‘peak’ sections including the “Disease” and “Palm Oil” field from Figure 4.1. Other fields on the ‘peak’ section are “Measure”, “Automatic Cable”, “Rubber”, “Biomass” and “Manufacture”. While this patent data set is believed to indicate the strength of research capability and innovations in Malaysia as the inventions or innovations are originated from this country, we selected this patent data set to analyse further.



Figure 3 ThemeScape Map of granted patents with basic patents first patented in Malaysia from 2008-2017

Based on the list of Top Assignees for the second data set which are the data of all granted patents that their basic patent was patented in Malaysia from 2008 to 2017 in Table 1 and Figure 4, Malaysia universities dominated the list of the top assignee. Other than universities are Malaysian institutions and companies such as MIMOS Berhad and SIRIM Berhad, and a few of multinational companies such as Matsushita Denki Sangyo Pte Ltd (PANASONIC). As universities are believed to be the centre of research and innovations in Malaysia, further analysis on Malaysia universities were made.

Table 1 Top 20 Assignee of Basis Patents in Malaysia in 2008-2017

Assignee/Applicant	Total Patent
Universiti Teknologi Malaysia (UTM)	151
Universiti Putra Malaysia (UPM)	104
Universiti Malaya (UM)	65
Telekom Malaysia Berhad	48
Universiti Kebangsaan Malaysia (UKM)	45
Universiti Teknologi MARA (UiTM)	43
MIMOS Berhad	34
Petroleum Nasional Berhad & Universiti Teknologi Petronas (UTP)	31
SIRIM Berhad	29
Malaysian Palm Oil Board	29
Universiti Islam Antarabangsa Malaysia (UIAM)	29
Universiti Malaysia Pahang (UMP)	24
Universiti Tun Hussein Onn Malaysia (UTHM)	23
Universiti Sains Malaysia (USM)	14
Mardi Penyelidikan dan Kemajuan Pertanian	12
Sony Ericsson Mobile Communication	11
Matsushita Denki Sangyo Pte Ltd (PANASONIC)	9

Taiwan Semoconductor Mfg Co Ltd	9
Natural Rubber Producers Research	9
Purecircle Sdn Bhd	8

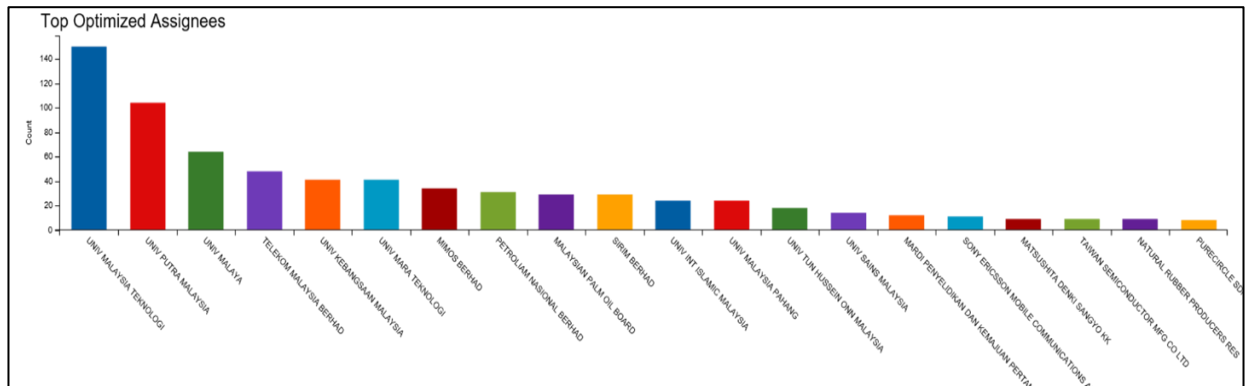


Figure 4: Top 20 Assignee of Basis Patents in Malaysia in 2008-2017



Figure 5: Universities' patents in the Themescape Map (basic patents first in Malaysia from 2008-2017)

In Figure 5, university patents are marked with the red dots in the second data set of all granted patents that their basic patent was patented in Malaysia from 2008 to 2017. We are able to see that universities are having their technology patented in all the field in the 'peak' sections such as "Disease", "Palm Oil" and "Manufacture" field. However, to determine which university focus on which technology field, further analysis need to be made.

In Figure 6, patent registration trend in last 10 years is shown. Data for patent registration trend for all granted patent in Malaysia, all basic patent in Malaysia, and patent by universities in Malaysia was plotted and compared. From this graph we are able to say that patent registration for each data set is increasing over the year.

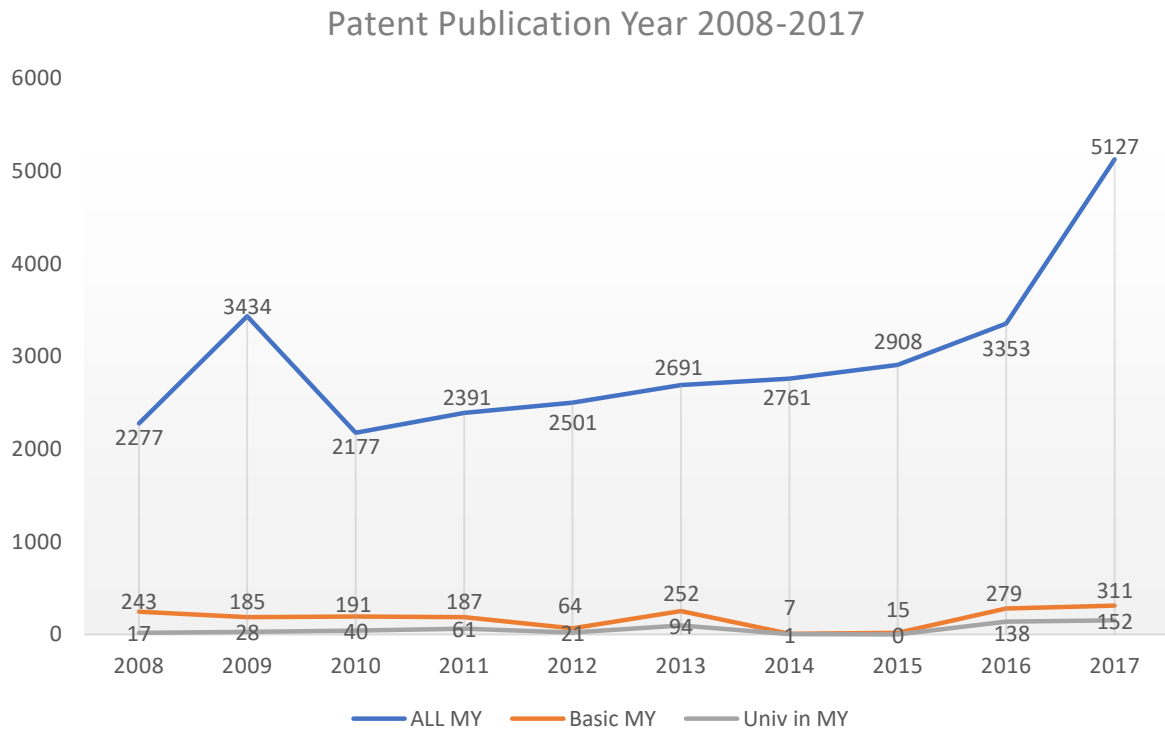


Figure 6: Patent Publication Year 2008-2017

3.2 Competencies of respective Malaysian Research Universities:

Using the data set of all granted patents that their basic patent was patented in Malaysia from 2008 to 2017, as universities are at the top in the Assignee list, we would like to see what are the strength of each universities in different research area. According to the World Intellectual Property Organization (WIPO), in each patent documents, patents are divided into 8 major technology areas with approximately 70,000 subdivisions by International Patent Classification (IPC). IPC is a system of language independent symbols for the classification of patents according to the different areas of technology. Therefore, at first, all the patent from the universities in Malaysia is divided into the eight technology field groups in order for us to be able to view each university focusing area of technology. The technology field group is shown in Table 4.2 and the results of the patent division in each university is shown in the Table 4.3 below.

Table 2 Technology Field

R1 HUMAN NECESSITIES	R5 FIXED CONSTRUCTIONS
R2 PERFORMING OPERATIONS, TRANSPORTING	R6 MECHANICAL ENGINEERING
R3 CHEMISTRY, METALLURGY	R7 PHYSICS
R4 TEXTILES, PAPER	R8 ELECTRICITY

Table 3 Technology Field for each university in Malaysia

	R1	R2	R3	R4	R5	R6	R7	R8	Total
UTM	31	22	25	-	12	5	36	21	151
UPM	31	11	35	1	3	5	12	8	104
UM	24	5	22	-	1	-	11	2	65
UKM	11	7	77	-	2	1	4	9	45
UiTM	12	8	12	4	2	2	2	1	43
UIA	12	3	8	-	-	1	4	1	29
UMP	5	4	9	-	1	1	3	1	24
UTHM	3	8	5	1	1	1	4	-	23
UTP	2	4	9	-	-	-	4	1	20
USM	2	3	6	-	-	-	3	-	14
UniMAS	1	1	2	-	-	1	-	1	6
UteM	1	2	1	-	-	-	1	-	5
UniMAP	-	1	1	-	1	-	1	-	4
UMT	2	-	-	-	-	-	-	-	2
UMS	-	-	2	-	-	-	-	-	2
								Total	591

From the table, we are able to see that Universiti Teknologi Malaysia (UTM) has the highest patent number at 151 patents followed by other research universities (RU) which are Universiti Putra Malaysia (UPM), Universiti Malaya (UM) and Universiti Kebangsaan Malaysia (UKM). However, Universiti Sains Malaysia (USM) has the lowest patent number at 14 patents for RU.

Most of the universities owned a large number of their patents in (R1: Human Necessities), (R2: Performing Operations, Transporting), (R3: Chemistry, Metallurgy), (R7: Physics) and (R8: Electricity) field. But some of the university still have few patents in unpopular field such as Universiti Teknologi MARA (UiTM) and Universiti Tun Hussein Onn (UTHM) who have patents in (R4: Textiles, Paper) field. However, as this 8 technology field grouping did not show precisely what are the technology that the universities are focusing on, we organize further analysis with Derwent Data Analyzer.

3.3 Derwent Data Analyzer

IPC Catchword is a list of short technical terms or keywords which refer to the smaller subdivisions of technology field in the IPC. From the bubble chart of the IPC Catchword vs Assignee in Figure 7, we are able to see that which university are focusing on which technology field. Universiti Teknologi Malaysia (UTM) who is the top assignee are focusing on Computers and Measuring technology field while Universiti Putra Malaysia (UPM) are focusing on Medicine and Vaccines technology field. Universiti Malaya (UM) are focusing on Medicine, Universiti Kebangsaan Malaysia (UKM) on Measuring and Transistor and Universiti Sains Malaysia (USM) are focusing on Measuring technology field. From here is we could conclude that each university had their own strength and focusing area of research.

From Matrix Viewer in Figure 8, Top 20 Patent Assignee vs Top 20 IPC Catchword is shown. From this matrix viewer we are able to understand which university are among the highest patent assignee which are Universiti Teknologi Malaysia, Universiti Putra Malaysia, Universiti Malaya and so on. We are also able to see that most popular technology field are Medicines, Measuring, Computers, Copolymers, Vaccines and so on. From here also we understand that top patent assignees among the universities focused to register their patent on popular technology fields.

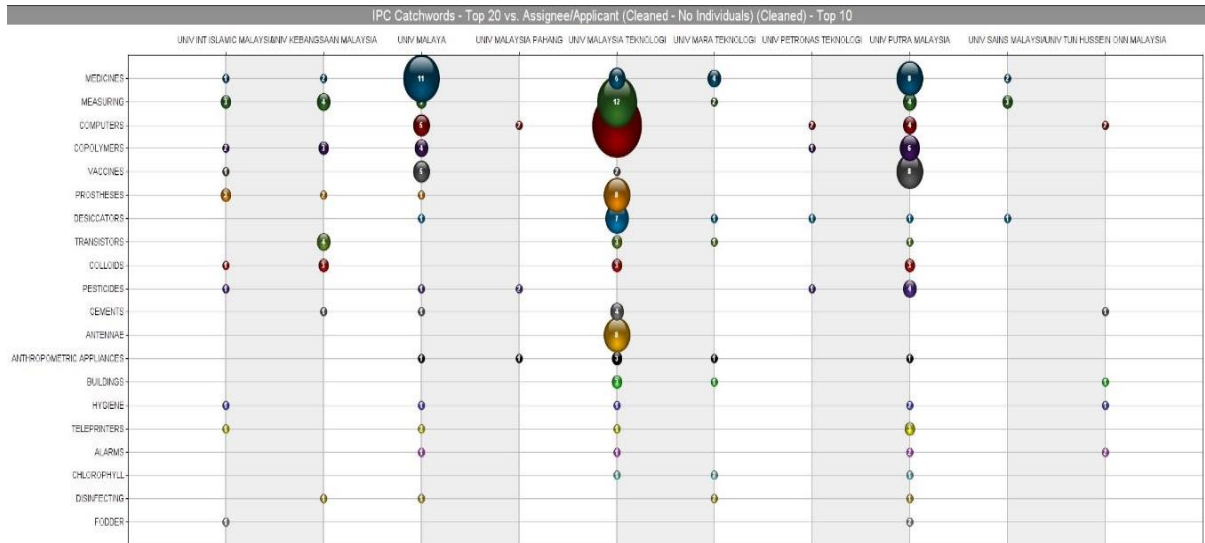


Figure 7: Bubble Chart of Top 20 IPC Catchword vs Top 10 Assignee for Universities Patent Dataset

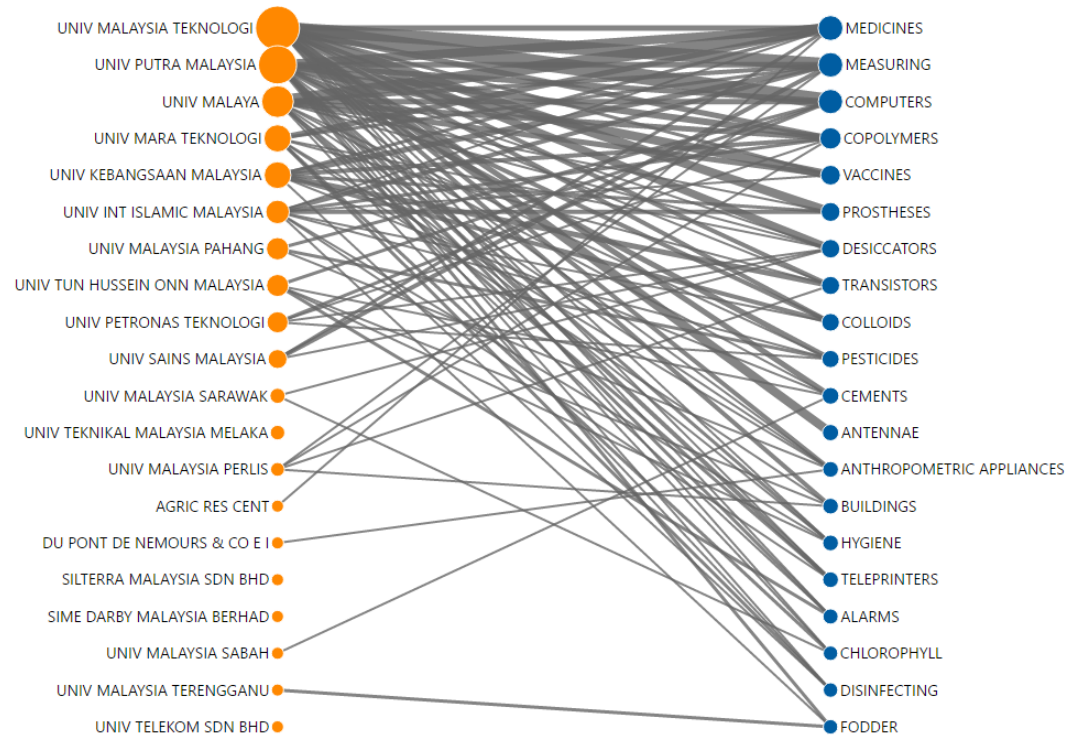


Figure 8: Matrix Viewer of Top 20 Assignee vs Top 20 IPC Catchwords for University Patent Dataset

4 Conclusion and Future Study

Figure 9 show the word cloud charts of the IPC catchword for the universities in Malaysia. In the word cloud charts, the size of the words indicated the patent publication popularity level which show technology field focused by universities in Malaysia. The popular technology fields for patenting in Malaysian universities are Medicines, Measuring, Computers, Copolymers and Vaccines.

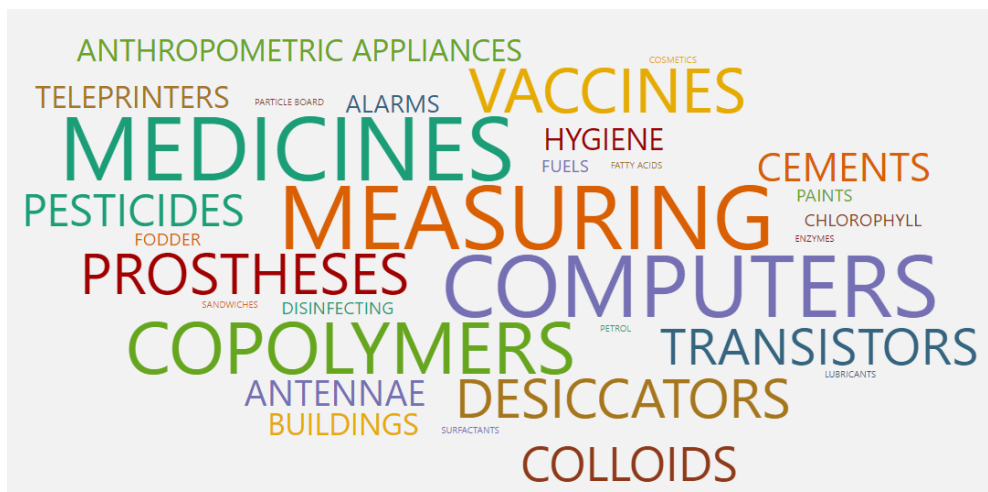


Figure 9: Word cloud chart for IPC Catchword of Patent Publication for Universities in Malaysia in 2008-2017

From above analysis we could conclude that each university had their own strength and focusing area of research. However, from this analysis, we are still unable to determine what the universities are doing with the patents after the patents were granted. Our next focus of study is to analyse the outcome of the patents in universities in Malaysia.

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How Organization Culture, Strategy, and Capability Affecting Innovative Performance

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Abstract

From 60 papers with the main theme of Organizational Culture (16 papers), Strategy (12 papers), and Capability (32 papers), the qualitative analysis done to the qualitative data interpreted into quantitative data, the main purpose is to see the correlation amongst the keywords to indicate future research on its affect to innovative performance of the organization in the market. The overall relationship show: the theme organizational culture 69% relates to strategy and 50% relates to capability/slack, the theme organizational strategy relates 67% to both culture/behavior and capability/slack, while the theme organizational capability 75% related to strategy and 53% related to culture. The relationship significantly shifted for papers published in the last 5 years, although the number of data decreased. From the perspective of research's country/area background, these articles grouped into two group of emerging market countries and developed market countries. The last decade data showing the tendency of increased research contribution from emerging market countries. Especially between culture and strategy the relationship increased become 100% from both direction. From culture to capability increased become 80%, from capability to strategy increased become 83%, but from strategy to capability decreased become 50% and from capability to culture decreased become 33%. From the perspective of research area background, emerging market portion increased from 35% become 46% in the last 10 years.

Keywords: Organization Culture, Strategy, Capability, Innovative Performance.

1. Introduction

The increased interest in culture has led to the development of different theories/models/frameworks aiming at explaining organizational culture (Hall, 1976; Hofstede, Neuijen, Daval Ohayv, & Sanders, 1990; Sagiv, Schwartz, & Arieli, 2011; Schein, 1985) and its impact on as well as relevance for organizations (Dauber, Fink, & Yolles, 2012). Organizational culture has been recognized as an essential influential factor in analyzing organizations in various contexts. Its importance to establish competitive advantages (Cameron & Quinn, 2006) or its impact on organizational performance (Gordon & DiTomaso, 1992; Ouchi & Wilkins, 1985) has engaged scholars for many years. Cameron and Quinn (2005) emphasize that the success of organizations is not only determined by specific external conditions, for example, barriers to market entry, rivalry in the industry, and supplier and buyer power.

Many authors argue that culture and strategy are two important components in an organization that are inseparable from one another. Strategies most often fail because they aren't executed well. Things that are supposed to happen don't happen. A strong culture facilitates understanding of the business's strategy by employees and motivates supportive behaviors by socializing members through mentoring, storytelling, and example. Consequently, if the success of business strategy is dependent on appropriate behavior, then it is essential for the organization to have a supportive culture in the other word culture is a source of competitive advantage when it enables the business to execute its strategy more effectively or efficiently (Slater, Olson, & Finnegan, 2011). Every firm has a unique history that defines the present situation and often provides a foundation for a competitive advantage which other firms would find impossible to imitate (Barney & Wright, 1998). Culture, when matched to business strategy, is a valuable resource as it promotes both effectiveness and efficiency. The competing values framework is an established model for representing culture (Robert E. Quinn, 1983).

Recently, some scholars have suggested that the impact of firm resources and capabilities on performance may be moderated by contextual variables such as geographical location and culture due to the different economic and technological environmental conditions they represent (Rivkin, 2001). Organization slack also allows the firm to initiate changes in strategy with respect to the external

environment. Nevertheless, given the tradeoff between the costs and benefits of slack, they generally believed that the benefits outweigh the costs, and hence, an important strategy they frequently proposed for coping with environmental uncertainty is to maintain slack (Mark P. Sharfman, Gerrit Wolf, Richard B. Chase, 1988).

2. Literature Review

2.1 Papers Collection and Screening Process

The literature review conducted through some steps. First, the author searched for articles which containing one of the keywords of culture, strategy, and capability in the context of organization or firm or corporate or company published from various journals subject category. From this step collected 60 articles and then the subject categorized based on Scientific Journal Rankings (SJR, 2018). The list of subject category Strategy and Management (27 articles) included *Asia Pacific Journal of Management*, *British Journal of Management*, *Creativity and Innovation Management*, *European Management Journal*, *International Journal of Business Science and Applied Management*, *International Journal of Hospitality Management*, *International Journal of Industrial Organization*, *Journal of Engineering and Technology Management*, *Journal of High Technology Management Research*, *Journal of International Business Studies*, *Journal of Management in Engineering*, *Journal of Organizational Behavior*, *Journal of Product Innovation Management*, *Long Range Planning*, *Omega*, and *Strategic Management Journal*. The list of subject category Marketing (10 articles) included *Industrial Marketing Management and Journal of Business Research*. The list of subject category Business and International Management (6 articles) included *Journal of Applied Business Research*, *Journal of Business Venturing*, *Journal of Management and Governance*, *Journal of World Business*, and *Marketing Letters*. The list of various subject category in Accounting, Economics, Humanities, Psychology, Sociology, and Human Resource (17 articles) included *Accounting Organizations and Society*, *European Economic Review*, *European Journal of Operational Research*, *Human Resource Development Quarterly*, *International Journal of Accounting Information Systems*, *Journal of Business Ethics*, *Journal of Operations and Supply Chain Management*, *Journal of Vocational Behavior*, *Organizational Dynamics*, *Procedia Social and Behavioral Sciences*, *Public Choice*, *Revista Latinoamericana de Psicologia*, *Technovation*, and *The Leadership Quarterly*.

From this 60 articles then cursory analysis performed through reading articles titles, journal name and subject category, abstracts, and introduction to identify the most related main theme to the keywords of culture, strategy, and capability. Based on cursory reading results, identified 16 articles with the main theme of culture, 12 articles with the main theme of strategy, and 32 articles with the main theme of capability. Each articles from the main theme of culture then cursorily analyzed its relationship both to strategy and capability as described in section 2.1.1. Same process conducted to the main theme of strategy and capability and the result described in section 2.1.2 and 2.1.3. To anticipate expanded meaning of the keywords which particularly used in the articles, author acknowledge associated words with culture and capability (example: behavior associated with culture and slack associated with capability). Next step to grouping each theme in to a table then sorted by year of publication, with information of the articles showed included title, author(s), year of publication, and keywords check list relationship. For the keywords check list relationship coded as "O" for positive relationship and coded "X" for negative relationship. The relationship result table and analysis from these 60 articles will be shown in the next section 2.2. In section 2.2 additional analysis made to identify the research country/area background supported each articles in order to see some correlation to further research interest.

2.2 Organization Culture, Strategy, and Capability Definition

2.2.1 Organizational Culture

Almost every statement in a business has a very diverse definition of organizational culture that sometimes depends on the context of the time, location, type of business, and leadership style that influence it. Organizational culture also has many definitions even though it still contains one essential element such as: values; traditions; belief; actions; etc. Organization culture can now be defined as a pattern of shared basic assumptions that was learned by a group as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems (Schein, 2004). Culture and leadership are two sides of the same coin, in that leaders first create cultures

when they create groups and organizations. Once cultures exist they determine the criteria for leadership and thus determine who will or will not be a leader. But if elements of a culture become dysfunctional, it is the unique function of leadership to be able to perceive the functional and dysfunctional elements of the existing culture and to manage cultural evolution and change in such a way that the group can survive in a changing environment. The bottom line for leaders is that if they do not become conscious of the cultures in which they are embedded, those cultures will manage them. Cultural understanding is desirable for all of us, but it is essential to leaders if they are to lead (Schein, 2004).

Culture is the display of collective behavior. It is influenced by a set of shared norms and values. Every organization exhibits a culture. The departments within the organization have a culture. Anytime people work together for an extended period of time, a culture is formed. It's the force that guides and directs how people will interact with one another and deal with those beyond their group. Since culture has such a large impact on individual actions and how people accomplish work, there is an overwhelming temptation to fiddle with cultural attributes values, norms, beliefs, symbols, philosophy, and environment. However, culture is created and shaped by a cascade of influences (Torben, 2013).

2.2.2 Strategy

While there are many definitions of organizational strategy however typically the definition will contain an implicit meaning that is closely related to culture or sub-culture within an organization. In some papers and books that the authors make reference to conclude the correlation that is inseparable between culture and strategy in an organization, calling one is part of the other or stating that it is difficult to imagine one is only seen as an important factor that only stands alone in an organization.

Strategies most often fail because they aren't executed well. Things that are supposed to happen don't happen. A strong culture facilitates understanding of the business's strategy by employees and motivates supportive behaviours by socializing members through mentoring, storytelling, and example. Consequently, if the success of business strategy is dependent on appropriate behaviour, then it is essential for the organization to have a supportive culture (Slater et al., 2011). An organization's culture should have characteristics that are not common to the cultures of its competitors, and, as an invisible asset, should be difficult for competitors to imitate (Jay Barney, Mike Wright, David J. Ketchen, 2001). Culture, when matched to business strategy, is a valuable resource as it promotes both effectiveness and efficiency. The competing values framework is an established model for representing culture (Robert E. Quinn, 1983). When an organizational strategy is influenced by its culture, there are other aspects that are not less important contribution to the strategy in its preparation and implementation, which is the leadership in that respective organization.

2.2.3 Capability

Capability can be defined as the ability and capacity of an organization expressed in terms of its: human resources (their number, quality, skills, and experience), physical and material resources (machines, land, buildings), financial resources (money and credit), information resources (pool of knowledge, databases, and), intellectual resources (copyrights, designs, patents, etc.). (Business Dictionary, 2018). In order to develop successful strategies to exploit the external opportunities or control the external threats (due to continual changes in external environment), analysis of an organisation's capabilities is important for strategy making which aims at producing a good fit between a country's resource capability and its external situation. Internal analysis will help to understand the organizational capability which influence the evolution of successful strategies. Many of the issues of strategic development are concerned with changing strategic capability better to fit a changing environment. However, looking at strategic development from a different perspective i.e. stretching and exploiting the organizations capability to create opportunities, it again becomes important to understand these capabilities. The above two perspectives together are called the Resource Based View (RBV) of strategy (Jay Barney, Mike Wright, David J. Ketchen, 2001).

In addition to the different capabilities that each organization has, there are also different strategies in preparing excess capability to anticipate flexibility space for innovation without disrupting an organization's daily activity. This excess capability that is intentional or unintentional in an organization is commonly referred to as organizational slack. The concept of organizational slack was developed to identify the difference between resources currently needed and the total resources available to an organization. When there is little environmental uncertainty or need for change, and the focus is simply on productivity; too much organizational slack represents a static inefficiency. However, when innovation

and change is needed, slack can act as a dynamic shock absorber, and allows scope for experimentation. This process tends to be self-reinforcing due to positive feedback between the environment and organization (Tidd, 2001). To be strategic, a capability must be honed to a user need (so that there are customers), unique (so that the products/services can be priced without too much regard for the competition), and difficult to replicate (so that profits will not be competed away) (Pisano, 1994). Above Tidd, Teece, and Pisano opinion supports the argument that human resource competencies believed to be one of the pillars of the organization capability.

2.3 Classification of The Relevant Literature with Culture, Strategy, and Capability

2.3.1 Literature with main theme of culture in corelation to strategy and capability

The total of 16 articles collected as the main theme of culture and consist of relatively covered decades of period from year of 1983 up to 2016, covering 12 journals (*Human Resource Development Quarterly, Journal of Business Ethics, Journal of Business Research, Journal of High Technology Management Research, Journal of Management in Engineering, Journal of Organizational Behavior, Journal of Vocational Behavior, Marketing Letters, Organizational Dynamics, Procedia Social and Behavioral Sciences, Revista Latinoamericana de Psicologia, The Leadership Quarterly*), and 9 subject categories (*Arts and Humanities, Marketing, Strategy and Management, Applied Psychology, Business and International Management, Organizational Behavior and Human Resource Management, Psychology, Social Sciences, Political, Social and Behavioral Science*). The corellation of each articles then checked to the keyword of strategy and capability or slack, and put the list based on the order of publication year in order to see relative trend by certain period of time, the summary are as in Table.1.

From the Table.1 of 16 articles in general around 69% of the articles with culture theme related to strategy and around 50% related to capability/slack. Interestingly this relationship increased if we observed the above articles that published in the last 5 years period (where the area of research/researchers of 3 articles from Asian and 2 articles from European).

2.3.2 Literature with main theme of strategy in corelation to culture/behavior and capability/slack

The total of 12 articles collected as the main theme of strategy and consist of relatively covered decades of period from year of 1996 up to 2015, covering 8 journals (*Journal of Business Venturing, Industrial Marketing Management, Journal of Business Research, European Management Journal, Journal of Engineering and Technology Management, Long Range Planning, Omega, International Journal of Business Science and Applied Management*), and 3 subject categories (*Business and International Management, Marketing, Strategy and Management*). The corellation of each articles then checked to the keyword of culture/behavior and capability or slack, and put the list based on the order of publication year in order to see relative trend by certain period of time, the summary are as in Table.2.

From these 12 articles in the Table.2 around 67% of the articles with strategy theme related to culture/behavior and around 67% related to capability/slack. This relationship to culture/behavior increased if we observed the above articles that published in the last 5 years period while to capability/slack the relationship relatively decreased (where the area of research/researchers of 3 articles from European and 1 article from United States).

Table.1 Articles with Organization Culture theme and relationship to Strategy and Capability/Slack

No		Author (s), Year	Keywords		
			Culture	Strategy	Capability/Slack
1	The Role of the Founder in Creating Organizational Culture	(Schein, 1983)	O	X	X
2	Bringing Corporate Culture To the Bottom Line	(Denison, 1984)	O	O	O
3	Measurement metrics at aggregate levels of analysis: Implications for organization culture research and the GLOBE project	(Peterson & Castro, 2006)	O	X	X
4	Knowledge Management to Learning Organization Connection	(Chinowsky & Carrillo, 2007)	O	O	O
5	The Positive Ethical Organization: Enacting a Living Code of Ethics and Ethical Organizational Identity	(Verbos, Gerard, Forshey, Harding, & Miller, 2007)	O	O	X
6	CEO values, organizational culture and firm outcomes	(Berson, 2007)	O	X	O
7	The Dimensions of Learning Organization Questionnaire (DLOQ): A Validation Study in a Korean Context	(Ji Hoon Song, Baek-Kyoo (Brian) Joo & Chermack, 2009)	O	X	O
8	The Effect of Learning Organization Culture on the Relationship Between Interpersonal Trust and Organizational Commitment	(Ji Hoon Song, Hong Min Kim, 2009)	O	O	X
9	Business strategy, marketing organization culture, and performance	(Slater et al., 2011)	O	O	X
10	Person–organization (culture) fit and employee commitment under conditions of organizational change: A longitudinal study	(Meyer, Hecht, Gill, & Toplonysky, 2010)	O	O	X
11	Exploration of a construct model linking leadership types, organization culture, employees performance and leadership performance	(Yuan & Lee, 2011)	O	X	X
12	Person–job fit, person–organization fit and innovative work behavior: The mediating role of innovation trust	(Afsar, Badir, & Khan, 2015)	O	O	X
13	The role of knowledge-oriented leadership in knowledge management practices and innovation	(Donate & Sánchez de Pablo, 2015)	O	O	O
14	Transformational leadership, innovation climate, creative self-efficacy and employee creativity: A multilevel study	(Jaiswal & Dhar, 2015)	O	O	O
15	Studying the links between organizational culture, innovation, and performance in Spanish company	(Naranjo-Valencia, Jiménez-Jiménez, & Sanz-Valle, 2016)	O	O	O
16	The mediating role of an innovative culture in the relationship between absorptive capacity and technical and non-technical innovation	(Ali & Park, 2016)	O	O	O

Note: “O” means positive relation and “X” means negative relation.

Table.2 Articles with Organization Strategy theme and relationship to Culture/Behavior and Capability/Slack

No		Author(s), Year	Keywords		
			Strategy	Culture/ Behavior	Capability/ Slack
1	Organizational Innovativeness: Exploring the Relationship Between Organizational Determinants of Innovation, Types of Innovations, and Measures of Organizational Performance	(Subramanian & Nilakanta, 1996)	O	X	O
2	Theories of organizational structure and innovation adoption: the role of environmental change	(Damanpour & Gopalakrishnan, 1998)	O	O	O
3	The relationship between organization strategy, total quality management (TQM), and organization performance—the mediating role of TQM	(Daniel I. Prajogo, 2006)	O	O	X
4	The Capital Structure Implications of Pursuing a Strategy of Innovation	(O'Brien, 2003)	O	X	O
5	The impact of a company's business strategy on its technological competence, network competence and innovation success	(Ritter & Gemünden, 2004)	O	O	X
6	Exploring the antecedents of potential absorptive capacity and its impact on innovation performance	(Fosfuri & Tribó, 2008)	O	X	O
7	Achieving synergy between strategy and innovation: The key to value creation	(Brooke Dobni, 2010)	O	O	O
8	Business Models, Business Strategy and Innovation	(Teece, 2010)	O	X	O
9	Business models for open innovation: Matching heterogeneous open innovation strategies with business model dimensions	(Saebi & Foss, 2015)	O	O	X
10	Knowledge management and innovation in knowledge-based and high-tech industrial markets: The role of openness and absorptive capacity	(Martín-de Castro, 2015)	O	O	X
11	Examining the relationship between creativity and innovation: A meta-analysis of organizational, cultural, and environmental factors	(Sarooghi, Libaers, & Burkemper, 2015)	O	O	O
12	External environment, the innovating organization, and its individuals: A multilevel model for identifying innovation barriers accounting for social uncertainties	(Hueske, Endrikat, & Guenther, 2015)	O	O	O

Note: "O" means positive relation and "X" means negative relation.

2.3.3 Literature with main theme of capability/slack in correlation to strategy and culture/behavior

The total of 32 articles collected as the main theme of capability/slack and consist of relatively covered decades of period from year of 1978 up to 2015, covering 20 journals (*Accounting Organizations and Society, Asia Pacific Journal of Management, British Journal of Management, Creativity and Innovation Management, European Economic Review, European Management Journal, International Journal of Accounting Information Systems, International Journal of Industrial Organization, Journal of Applied Business Research, Journal of Business Research, Journal of High Technology Management Research, Journal of International Business Studies, Journal of Management and Governance, Journal of Operations and Supply Chain Management, Journal of Product Innovation Management, Journal of World Business, Omega, Public Choice, Strategic Management Journal, Technovation*), and 8 subject categories (*Accounting, Business and International Management, Economics and Econometrics, Engineering, Marketing, Miscellaneous, Sociology and Political Science, Strategy and Management*).

Table.3 Articles with Organization Capability/Slack theme and relationship to Strategy and Culture/Behavior

No		Author(s), Year	Keywords		
			Capability/ Slack	Strategy	Culture/ Behavior
1	Organizational Innovation: A Model and Needed Research	(Cummings & O'Connell, 1978)	O	O	O
2	Slack in Participative Budgeting: The Joint Effect of a Truth-Inducing Pay Scheme and Risk Preferences	(Waller, 1988)	O	X	X
3	The simple analytics of slack-maximizing bureaucracy	(Wyckoff, 1990)	O	X	X
4	Organizational slack in subsidized nonprofit institutions	(Duizendstraal & Nentjes, 1994)	O	X	X
5	Organizational Innovativeness: Exploring the Relationship Between Organizational Determinants of Innovation, Types of Innovations, and Measures of Organizational Performance	(Subramanian & Nilakanta, 1996)	O	O	X
6	What is the Optimum Amount of Organizational Slack? A Study of the Relationship between Slack and Innovation in Multinational Firms	(Nohria & Gulati, 1997)	O	X	O
7	The Impact of the Multi-divisional Structure on Organizational Slack: The Contingency of Diversification Strategy	(Riahi-Belkaoui, 1998)	O	O	O
8	Organizational Slack and Corporate Greening: Broadening the Debate	(Bowen, 2002)	O	O	O
9	Curvilinear Relationship Between Organizational Slack and Firm Performance: Evidence from Chinese State Enterprises	(Tan, 2003)	O	O	O
10	In-house competition, organizational slack, and the business cycle	(Rudolf Kerschbamera, 2001)	O	O	O
11	Organizational Slack and Firm Performance during economic transitions: Two studies from an emerging economy	(Tan & Peng, 2010)	O	O	O
12	Information technology and organizational slack	(Dehning, Dow, & Stratopoulos, 2004)	O	O	O
13	Exploration and exploitation innovation processes: The role of organizational slack in R & D intensive firms	(Geiger & Makri, 2006)	O	O	O
14	Reverse logistics, stakeholders' influence, organizational slack, and managers' posture	(Álvarez-Gil, Berrone, Husillos, & Lado, 2007)	O	O	O
15	Effects of firm resources on growth in multinationality	(Tseng, Tansuhaj, Hallagan, & Mccullough, 2007)	O	O	X
16	Organizational slack and firm performance during institutional transitions	(Su, Xie, & Li, 2009)	O	O	O
17	Product market competition and organizational slack under profit-target contracts	(Piccolo, D'Amato, & Martina, 2008)	O	O	O
18	Organizational slack and firm's internationalization: A longitudinal study of high-technology firms	(Lin, Cheng, & Liu, 2009)	O	O	O

No		Author(s), Year	Keywords		
			Capability/ Slack	Strategy	Culture/ Behavior
19	Behind organizational slack and firm performance in China: The moderating roles of ownership and competitive intensity	(Ju & Zhao, 2009)	O	O	X
20	CEO duality, organizational slack, and firm performance in China	(Peng, Li, Xie, & Su, 2010)	O	O	X
21	Organizational Slack and Knowledge Creation in Product Development Projects: The Role of Project Deliverables	(Richtnér & Åhlström, 2010)	O	O	X
22	Organizational Slack And Performance: The Impact Of Outliers	(Wefald, Katz, Downey, & Rust, 2010)	O	X	X
23	Creative workforce density, organizational slack, and innovation performance	(C. J. Chen & Huang, 2010)	O	O	X
24	Innovativeness of Industry Considering Organizational Slack and Cooperation	(Faco & Csillag, 2010)	O	O	X
25	The impact of technological diversity and organizational slack on innovation	(Huang & Chen, 2010)	O	X	O
26	Managerial incentive, organizational slack, and performance: empirical analysis of Japanese firms' behavior	(Mizutani & Nakamura, 2014)	O	X	O
27	Does technological diversification matter to firm performance? The moderating role of organizational slack	(Y. M. Chen, Yang, & Lin, 2013)	O	O	X
28	"Squeezing R&D": A Study of Organizational Slack and Knowledge Creation in NPD, Using the SECI Model	(Richtnér, Åhlström, & Goffin, 2014)	O	X	X
29	How do managers decide on internationalization processes? The role of organizational slack and performance feedback	(Lin, 2014)	O	O	X
30	Organizational slack and corporate social performance: Empirical evidence from China's public firms	(Xu, Yang, Quan, & Lu, 2015)	O	O	O
31	A reexamination of the organizational slack and Innovation relationship	(Marlin & Geiger, 2015)	O	O	O
32	Unraveling the link between managerial risk-taking and innovation: The mediating role of a risk-taking climate	(García-Granero, Llopis, Fernández-Mesa, & Alegre, 2015)	O	O	X

Note: "O" means positive relation and "X" means negative relation.

The correlation of each article then checked to the keyword of culture/behavior and capability or slack, and put the list based on the order of publication year in order to see relative trend by certain period of time, the summary are as in Table.3.

From these these 32 articles with capability/slack theme in general around 75% related to strategy and around 53% related to culture/behavior. This capability/slack relationship to strategy increased for the articles that published in the last 5 years period while to culture/behavior the relationship relatively decreased (3 articles from Asian, 2 articles from European and 1 article from United States).

2.3.4 The relationship between culture, strategy, and capability

The relationship will be seen from the point of view of each of the main keyword which are as the themes of the related papers. From the total of 60 papers that became the reference, then three groupings were made: the first group collected around 16 papers with the main theme is organizational culture and then looked at the relationship to strategy and capability/slack. The second group of 12 papers with the theme is organizational strategy then seen its relationship to culture/behavior and capability/slack. The third group of 32 papers with the theme is organizational capability was then seen in relation to culture/behavior and strategy. The results of the overall relationship analysis show: the theme organizational culture 69% relates to strategy and 50% relates to capability/slack, the theme organizational strategy relates 67% to both culture/behavior and capability/slack, while the theme organizational capability 75% is related to strategy and 53% related to culture (Figure.1A). Interestingly, the relationship between culture, strategy, and capability significantly shifted for papers published in the last 5 years (Figure.1B).

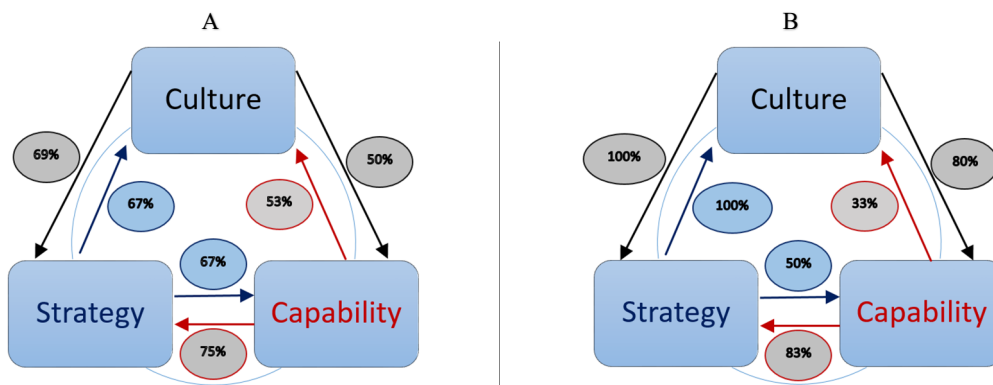


Figure 1. Relationship diagram of organizational culture, strategy, and capability. Figure 1.A applied from all papers and Figure 1.B applied from papers of the last 5 years. Arrow direction guide the relationship from main theme word to the respective words and percentage number in the circle indicates relationship.

From the perspective of research's country/area background, these articles grouped in to two group of emerging market countries (EMC, included some countries in Africa, most countries in Eastern Europe, some countries of Latin America, some countries in the Middle East, Russia and some countries in Asia) and representative of developed market countries included USA, Canada (CAN), Australia (AUS), and European Countries (EUR) (Vercueil, 2012).

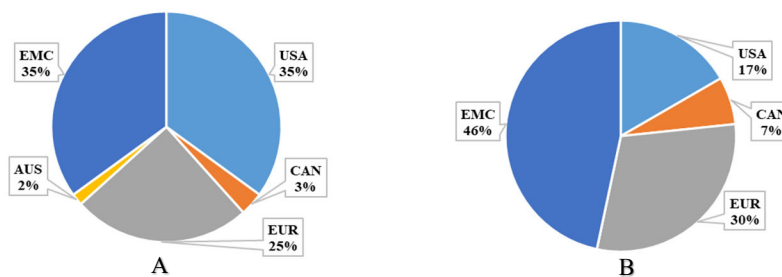


Figure 2. Distribution of the articles based on the authors country/area. Figure 2.A, distribution from all published year of 60 articles, Figure 2.B, distribution from articles published in the last 10 years. Note: EMC refer to emerging market countries while USA, EUR, CAN, AUS refer to developed market.

Although this findings may too early for a solid relationship conclusion, at least some things can be picked up as a reference to see the potential further research that can be summarized into two opportunities. First, this may deliver a evidence that such relationship is exist and become something to be aware of as a global organization. Second, the relationship relatively shifted in to stronger condition in

the latest period and followed by a tendency of increased contribution of the related research from emerging market countries (EMC) as shown in the Figure 2 above.

3. Findings Argument and Further Research Proposition

3.1 Findings Argument

First finding, the relationship of culture, strategy, and capability in an organization well supported by theories from notable experts and papers/articles, however the increase in quantity of articles, quality of each articles analysis, and range of articles scope provide greater opportunity to increase result quality.

Second finding, from research area of origin perspective, should be sought more clearly why the increasing portion of articles that discuss this relationship (between culture, strategy, and capability) from emerging market countries in the last 10 years. Was it caused by an increased awareness of the need of a global organization, or the encouragement of academics who see the relationship as something important to understand when global organizations enter emerging markets? Then how about another potential of emerging market countries that have not become the subject of the research yet? (please see Figure 3 below).

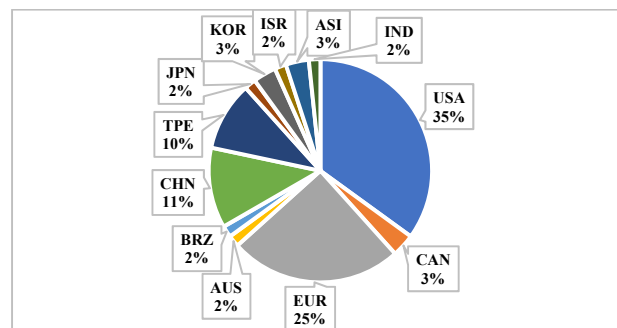


Figure 3. Distribution of country or region representing 60 papers/articles for the analysis. (ASI/Asian, AUS/Australia, BRZ/Brazil, CAN/Canada, CHN/China, EUR/Euporean, IND/India, ISR/Israel, JPN/Japan, KOR/South Korea, TPE/Taipei, USA/United States of America).

3.2 Further Research Proposition

Correspond to findings argument in order to increase confident level of this literature review result and open additional opportunity of wider research targeting important market segment to which the organization may attribute this relationship understanding, author suggest two reasearch opportunities:

3.2.1 To continue and expand this literature review with increase in quantity of articles, quality of each articles analysis, and range of articles scope in order to explore the relationship to innovative performance.

3.2.2 To conduct further research about organizational culture, strategy, and capability influences innovative performance in specific emerging market country or region.

Conclusions

Organizational culture has been recognized as an essential influential factor in analysing organizations in various contexts. Culture and strategy are two important components in an organization that are inseparable from one another. Strategies most often fail simply because they aren't executed well. Consequently, if the success of business strategy is dependent on appropriate behaviour, then it is essential for the organization to have a supportive culture. Some scholars have suggested that the impact of firm capability on performance may be moderated by contextual variables such as geographical location and culture. Organization excess capability or slack also allows the firm to initiate changes in strategy with respect to the external environment. Those are the summary of some scholars opinion to mention that each of culture, strategy, and capability dependent one to another in the context of an organization. This simple literature review with 60 articles showing the existence of the relationship amongs those three keywords, and interestingly extend the interest to another level above just qualitative relationship. There are

opportunities to see quantitative relationship to innovative performance and also to analyse the correlation for the specific region which are getting more attention economically such as emerging market.

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Room C

Session – 3

ICIM 2018

Elucidation of Mechanical Properties for Improving Reliability of Ultrafine Ductile Cast Iron

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Abstract Ductile cast iron is a material whose mechanical properties are improved by spherical crystallization of graphite, which is usually in the form of flake, by inoculation or the like. Co-researcher Haruki Itofuji has developed a permanent mold casting method of ductile cast iron to realize significant improvement of mechanical properties, working process and working environment in casting. However, in order to promote widely permanent mold casting of ductile cast iron, it is necessary to elucidate the mechanical properties and understand the advantages and disadvantages in adopting to design. Therefore, in this study, we prepared test specimens of ductile cast iron which was made by permanent mold casting and compared with conventional product by comparative experiments.

Key Words Ductile iron, graphite, Tensile test, Mechanical properties, casting, melting, permanent mold, chill, cooling rate

1 Introduction

1.1 Problems in ductile iron and casting method

Although sand mold casting is usually used for ductile cast iron, attempts to use permanent mold casting for Ductile cast iron existed from the past [1]. This reason is discussed below.

In ductile cast iron, in order to distribute graphite finer and more uniformly, it is effective to increase the cooling rate after casting. In ductile cast iron, graphite crystallizes along the shape of Mg bubbles in the molten metal, although the time from when Mg inoculation to solidification of the molten metal is long, the Mg bubbles decrease and become large, which greatly affects the graphite shape.

In addition, when sand mold casting is carried out, as asperity of sand are copied to the surface of the product, cutting work is required. It is necessary for a large space and a large amount of sand, to mass-produce these. A large amount of dust and harmful substances are generated when sand mold is broken, and industrial waste is generated.

On the other hand, permanent mold casting can solve these problems because it has a high cooling rate and is superior in surface properties even when these products are as-cast, dust and harmful substances are not generated unlike sand casting.

This is the reason for applying permanent mold casting to ductile cast iron, although recent years the signs of practical application was seen. It can be cited that the casting temperature of cast iron which is usually at 1300 to 1400 °C is too hot for the permanent mold and the cooling rate is so fast that chill structure by which ductile cast iron becomes brittle in the matrix structure is generated, and so on.

Conventionally, it has been common to graphitize chill structure generated in castings by heat treatment [2].

1.2 Outline of the ultrafine ductile cast iron

In the practical application of permanent mold casting in ductile cast iron, the occurrence of chill structure was a major problem. However, the method which was developed by H.Itofuji who is a collaborator of this research succeeded in preventing chill structure by decreasing free nitrogen which present as monoatomic molecules in the molten metal [3]. This was realized by strict spheroidizing, temperature control and inoculation and so on. The point of noteworthy is that inhibiting the generation of nitrogen in the molten metal, and making graphite extremely fine were achieved by casting at a relatively low temperature.

This method made it possible to produce as-cast ductile cast iron which is almost no chill structure in matrix structure and have finer graphite than any other conventional product. In this research we defined it as "ultrafine ductile iron".

When we achieve practical application and widely spread industrially, it will be possible to manufacture parts that are more excellent in mechanical properties than conventional products and to reduce the burden on the environment and workers and to expect to decrease cost by reducing processing steps of the products.

However, at present, it is necessary to elucidate the mechanical properties of ultrafine ductile iron and to be applicable to improvement of conventional products.

1.3 The purpose of this research

The final goal of this research is to clarify mechanical properties and ensure reliability, which is conducted to use ultrafine ductile cast iron in the real society. Therefore, by conducting tensile test and observation of the structure, we will investigate the mechanical properties of ultrafine ductile iron and at the same time do comparison with conventional products.

2 Methods

2.1 Candidate of experiment

In this experiment, test pieces were prepared from castings made of ultrafine ductile cast iron and commercially available materials, respectively. Based on the experiments data, comparison experiments were conducted. Details of each are described below.

2.1.1 Casting made of ultrafine ductile cast iron

Figures 1 and 2 show the dimensions of casting used in this experiment and the schematic diagram of casting, respectively.

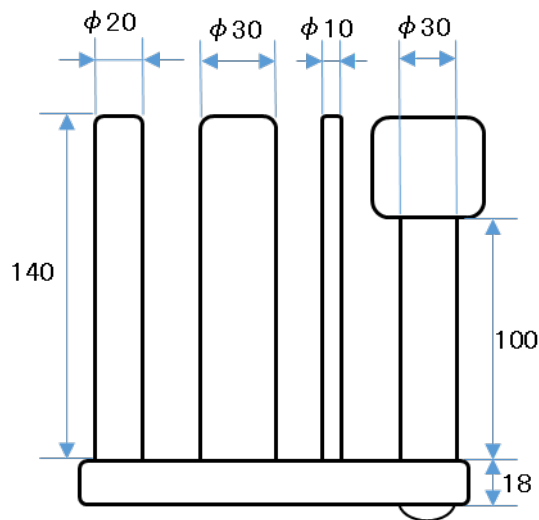


Figure. 1 the casting of ultrafine ductile cast iron (unit: mm)

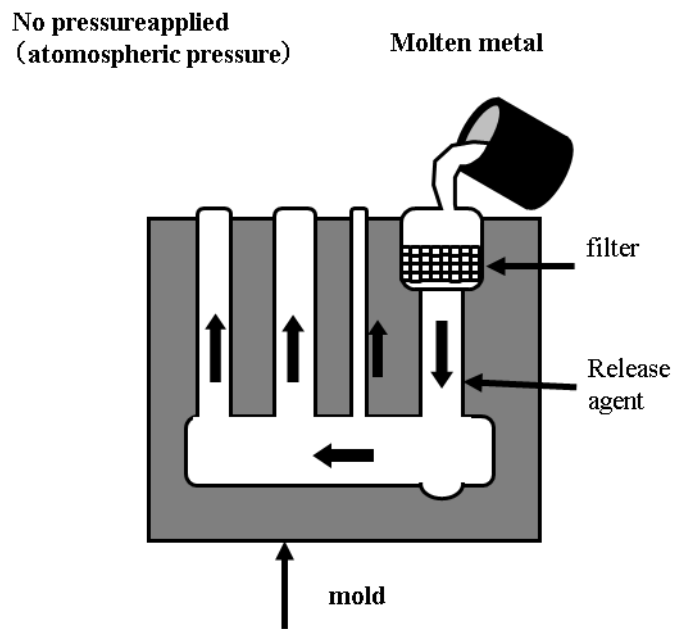


Figure. 2 Schematic diagram of casting

As shown in Figure. 2, mold release agent having heat insulating effect is applied to the permanent mold, and a filter is attached to the sprue of the permanent mold. In addition, pressurization was not performed on the molten metal, thus casting was carried out under atmospheric pressure. The components of this casting were as shown in Table 1.

Table 1 Component table of ultrafine ductile iron (mass %)

Component	C	Si	Mn	P	S	Mg
	3.59	3.28	0.07	0.017	0.009	0.014

2.1.2 Compared conventional products

We used "continuous casting bar of $\phi 40$ mm" which is a product of KOGI Co., Ltd. as a comparative object of ultrafine ductile cast iron castings. This is a round bar of ductile cast iron produced by continuous casting. The

specifications of this product are shown in Table 2.

Table 2 Specifications of products to be compared

Manufacture	Trademark name	Diameter [mm]	Tensile strength [MPa]	Elongation at break [%]
KOGI Co., Ltd.	continuous casting bar of ϕ 40mm	40	400+	12+

Next, how to cut out the test specimen will be described. Figure 3 and 4 show how to cut out each test piece.

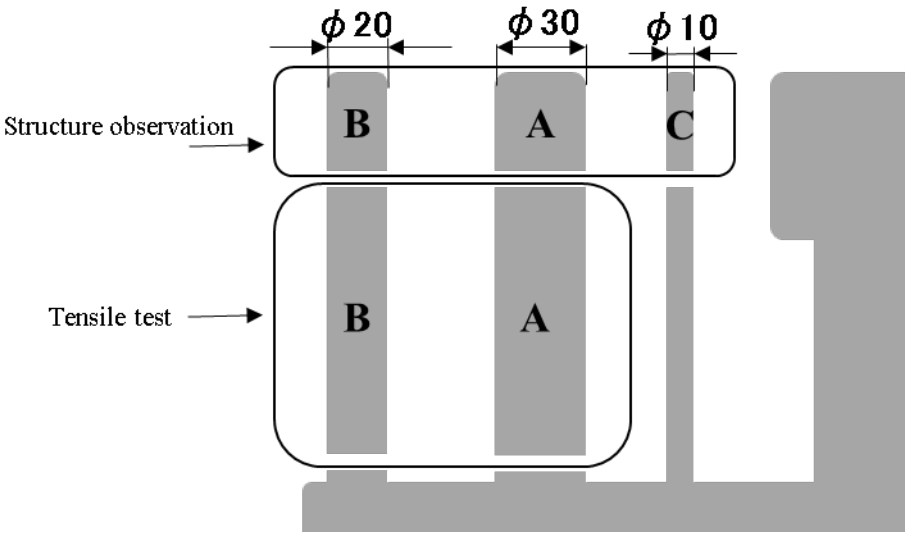
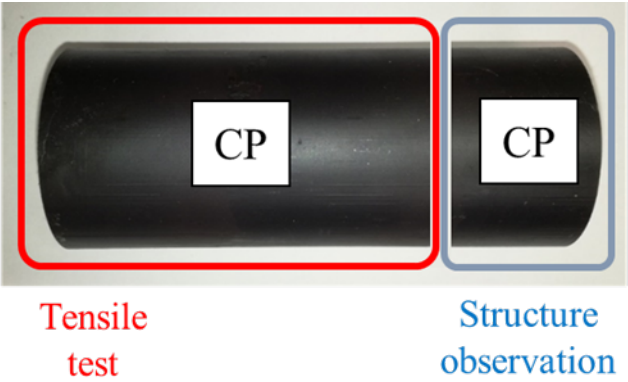


Figure.3 extraction position of ultrafine ductile cast iron sample

Since the test piece could not be prepared due to the dimensional constraint in the portion of the diameter 10 mm in Figure. 3, this cantle was used only for the structure observation.



*CP : Conventional Product

Figure. 4 Cutting position of conventional product

We used a conventional product as a tensile test piece at one end and metal matrix observation at the other end as shown in Figure 4.

2.2 Tensile test and Observation of fracture surface

Figure 5 shows dimensions of the tensile test piece.

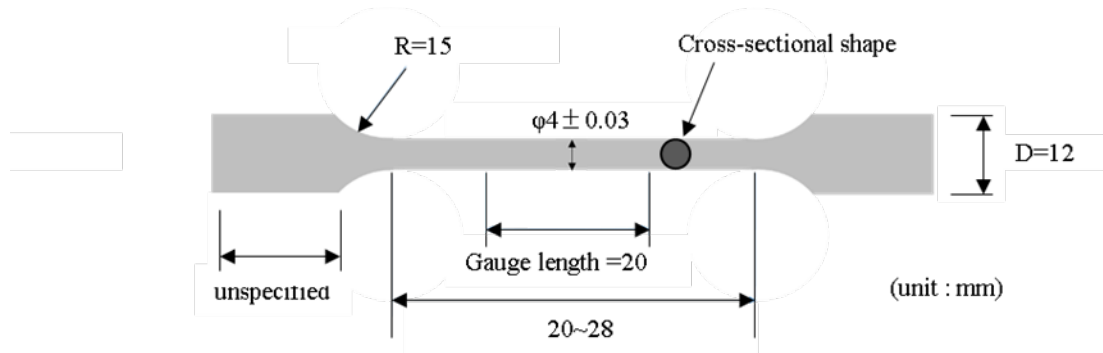


Figure.5 Dimension of tensile specimen

The dimensions in Figure 5 are based on JIS Z 2241 [4]. A photograph of the actual test piece is shown in Figure 6.



Figure. 6 Test specimen prepared

Figure 6, shows that both ends of the test piece were screwed and joined with a tensile tester. After the tensile test, the fracture surface of each test piece was observed with a Scanning Electron Microscope.

2.3 Observation of matrix structure

In order to observe the graphite shape and the matrix structure of castings, samples were taken from each part of the casting. Figure 7 shows the method of observing matrix structure.

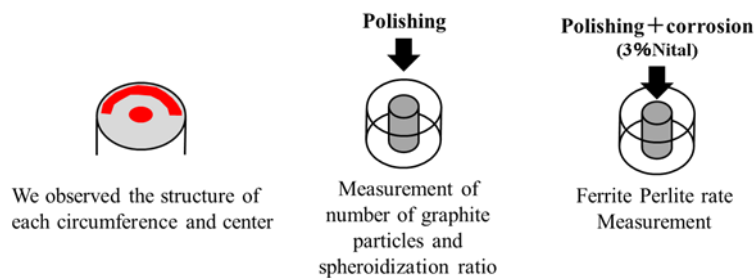


Figure 7 method of observing matrix structure

As shown in Figure. 7, in order to examine the average value such as ratio of graphite spheroidization in each part,

the circumference part and the center part of the test piece were observed five times in each case. Image analysis was used for these measurements.

In order to measure matrix structure and the ratio of graphite spheroidization, we refer to JIS G 5502 [5]. In this experiment, however, as diameter of graphite in ultrafine ductile cast iron is extremely finer than conventional products, we measured graphite particle diameter of which is 1 [μm] or more.

3. Results

3.1 Results of tensile test and fracture surface observation

The stress-strain diagram obtained by the tensile test and the mechanical properties are shown in Figure 8. and Table 3. Respectively.

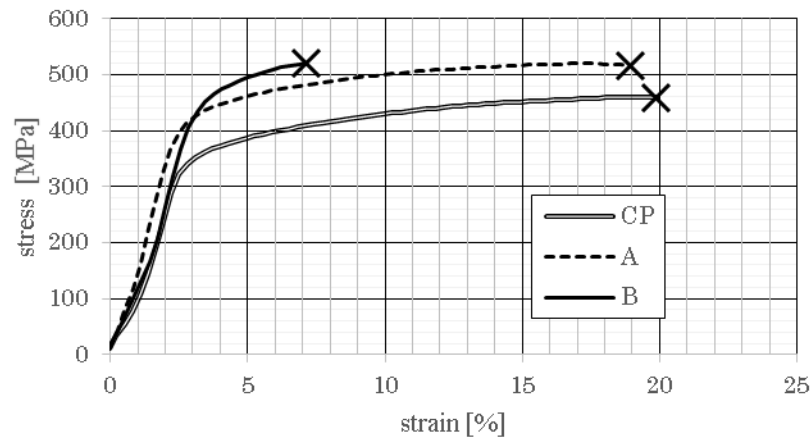


Figure. 8 Stress-strain diagram

Table 3. Mechanical properties of each specimen

Name	Proof strength [Mpa]	Elongation at break[%]	Young's modulus [Gpa]	Tensile strength [Mpa]
Test Piece A	392	16	190	514
Test Piece B	429	3.74	185	520
Test Piece CP	341	17	154	459

In this experiment, Table 3 shows that the test pieces A and B, which are ultrafine ductile cast irons have superior mechanical properties other than elongation at break to the conventional test piece CP. And the observation results of the fracture surface are shown in Figures. 9 and 10, respectively.

Figure. 9 shows that brittle fracture was not observed in the specimen CP, and brittle fracture occurred in the specimen A and the specimen B. and it existed particularly in specimen B. And there were internal defects in test piece CP and test piece B.

In Figure. 10, the circles in the photograph indicate the positions of the internal defects.

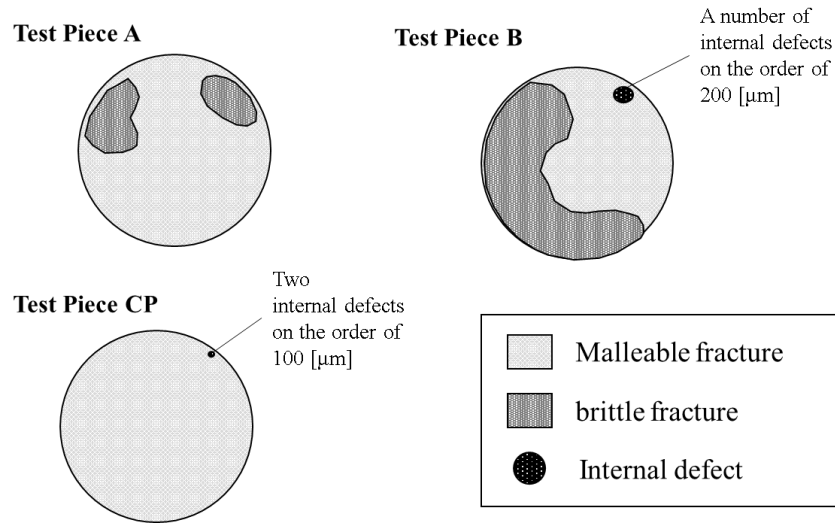


Figure 9 Overall view of the fracture surface of the test pieces

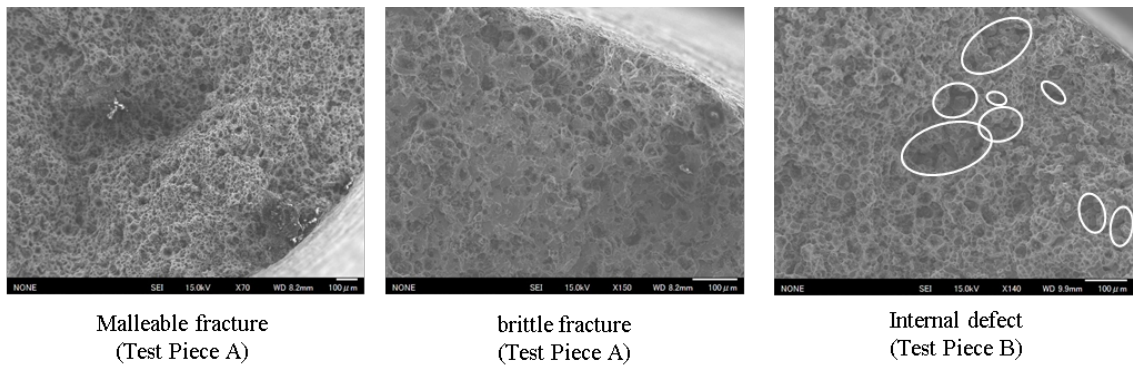


Figure. 10 Fracture surface

3.2 Observation result of matrix structure

The observation results of the matrix structure are shown in Table 4 and Figure. 11, respectively.

Table 4 Observation results of graphite and matrix structure of each specimen

Test piece	Observation point	Number of graphite particles	Particle density [N/mm ²]	Average particle diameter [μm]	Spheroidization ratio [%]	Graphite area ratio [%]	Perlite rate [%]	Ferrite rate [%]
A	edge	1082	1385	11.3	80.9	13.5	6.9	93.1
	center	1514	1932	9	85.9	12.2	6.8	93.2
B	edge	1711	2175	7.7	72.3	9.3	24.8	75.2
	center	1564	1987	6.9	76.8	7.1	18.8	81.2
C	edge	2098	2660	7.1	81.2	9.5	53.2	46.8
	center	2293	2912	6.8	83.1	10.1	47	53
CP	edge	1353	1728	9.4	87.4	13.5	1.4	98.6
	center	677	869	12.1	85.1	13.4	1.4	98.6

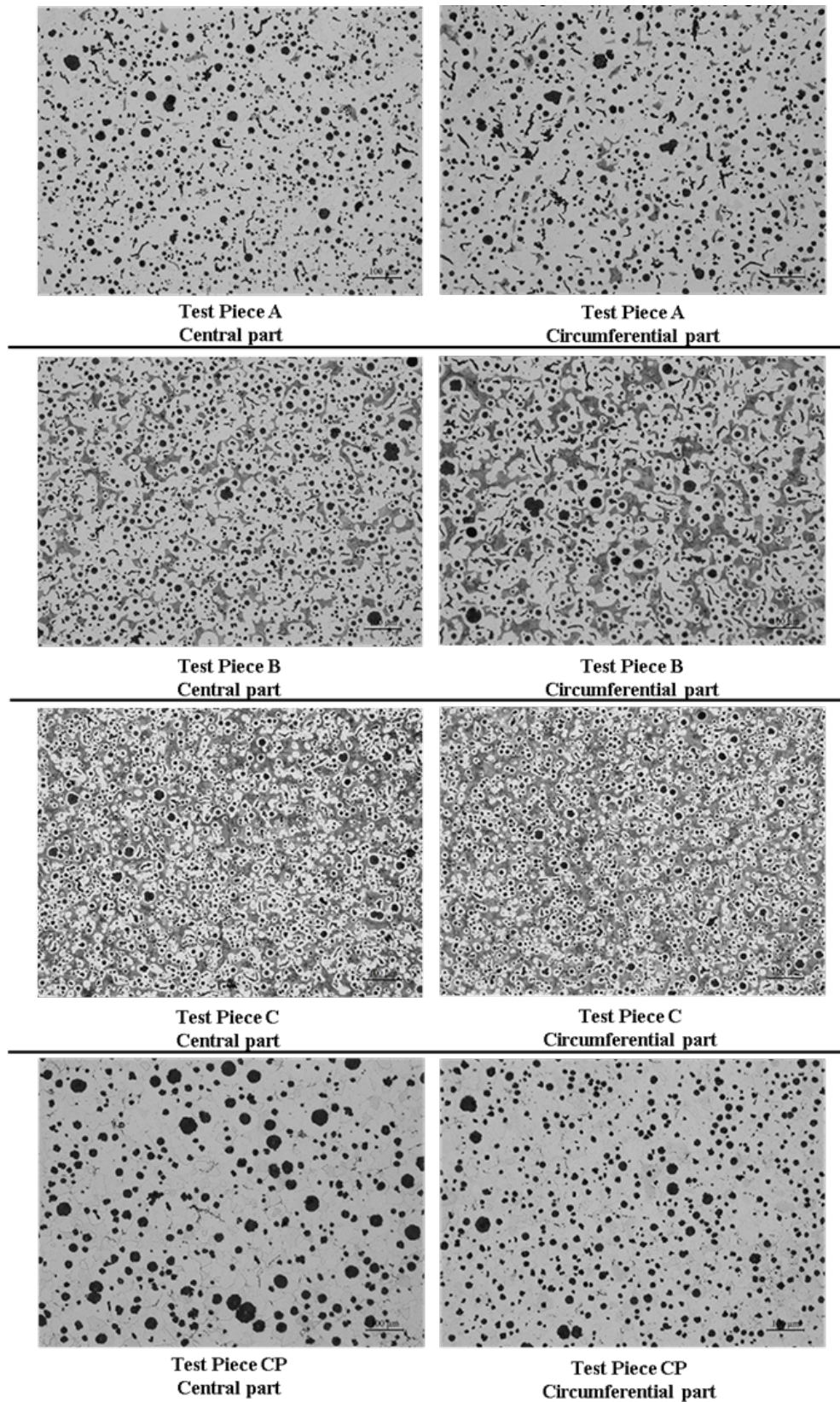


Figure. 11 Matrix structure photograph of each specimen

In Figure. 11, the white part of the matrix structure is the ferrite structure and the gray part of that is the pearlite structure.

4. Discussion

4.1 About the result of tensile test

In Figure. 8 and Table 3, the elongation at break of the test piece B made ultrafine ductile cast iron is 3.74 [%]. We can see that the elongation at break is short even considering the data in Table 4 [6]. The reason of this is presumed to be caused by a plurality of internal defects of about 200 [μm] as shown in Figures. 9 and 10.

Regarding the Young's modulus, the specimens A and B are superior to the specimen CP. The Young's modulus is hardly affected by the matrix structure, and it is greatly affected by the shape and size of graphite [7] [8]. In addition, when we look at the number of graphite and the particle size, which is in the central part of each test piece in Table 4, the test pieces A, B and C are superior to the test piece CP. Therefore, we can conclude that the difference in Young's modulus in this experiment is due to the number of graphite particles and the diameter of graphite particles in each test piece.

Not only the influence of graphite but also the composition of the matrix structure are strongly related to tensile strength and yield strength [7]. The reason why ultrafine ductile cast iron is superior in tensile strength and proof stress is considered to have not only influence of graphite but also that of matrix structure.

4.2 Cooling rate of castings

In ductile cast iron, the larger the cooling rate is, the finer the graphite is miniaturized [9]. Also, since the casting usually cools from the outside, it is thought that the graphite becomes finer as it is on the outside. In this research, as can be seen from Table 4, comparing the center part of each test piece, we can understand that the graphite which is in super ductile cast iron is more finely than the other which is in conventional product.

However, from Table 4, it can be seen that in the test pieces A and C, the outer peripheral part is denser than the central part. These results can be presumed to be related to buoyancy generated in graphite in the molten metal and difference in cooling rate due to the shape of the casting, and so on.

5. Conclusion

In the results of the tensile test of this study, mechanical properties of the superfine ductile cast iron are superior to that of the conventional product except for the breaking elongation of the test piece B. The value of the elongation at break of specimen B was remarkably low, but we can presume that this is due to the internal defect of the casting. Also, in the observation of the matrix structure, comparing the center part of each test piece, the graphite of ultrafine ductile cast iron is much finer than that of conventional product.

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An Explosion of Steel Cylinder Containing Anhydrous Ammonia Without Water Due To Stress Corrosion Cracking

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Abstract: A calamity of incident occurred in the refinery complexes in Malaysia, which caused dead and property damaged is in a risen trend. Thus, this specific incident has been researched and investigated due to complexity of events in occupational accident in the refinery industry. This investigation merely concentration on the factor of a Stress Corrosion Cracking (SCC) which is one of the various of failure mechanisms on a pressure vessel such as steel cylinder which containing anhydrous ammonia without water. Apparently, SCC prone to the carbon steel due to the existing of the oxygen and water elements in a certain level. Hence, the failure could caused the imminent halt to the refinery's operation and probably will consume a huge sum of money in rectification back the refinery from the incident. Therefore, a comprehensive method of analysis must be done such as mechanical analysis by adopting microstructure and microscopic testing in prognosis the SCC appearance and possibility of the vital source of failure of the steel cylinder that cause to exploded. The stretch line of crack propagation thru layers indicated that the attacking of the stress corrosion is very vividly with the existing of pressure element in the ammonia cylinder. As a result from the analysis will prevail the significants of transformation on the severe carbon steel microstructure and stress corrosion cracking appearance at the radius of the cracking area. The mechanical properties of the material decrease compare to the standard setting, in which the material of the ammonia's cylinder will become fragile and brittle due to the exposure. Therefore, risk of explosion might be triggered.

Keywords: Carbon Steel Cylinder, Anhydrous Ammonia without Water, Stress Corrosion Cracking (SCC), Microstructure and Microscopic.

1.0 Introduction

1.1 Literature review

Disaster or calamity always refer to the high toll of death in humans such severe accidents were Bhopal, India, Chernobyl, Russia, Mexico City, Santos, South Brazil and Sungai Buloh, Malaysia [1], [2] the issue of risk disaster essentially related to the consequences of the incident especially in industrial [3], meanwhile in nuclear's risk has the earlier indicator category has a major accident, for instance in a case of fukushima disaster [4]. Then again, there is dependably an unfortunate mix-up and inquiry rises in which is the instability on the perspective of failure mechanism and do the structure adequate and workable. Moreover, what is the best apparatus to be embraced to battle in settling on choice and does the structure suit for all industry. Along these lines, the necessity to study the failure mechanism's fundamental and evolution of the system must be done parallel with the developing of industry in the world.

However, a study case on a specific mishap of explosion of carbon steel cylinder that contains anhydrous ammonia without water has occurred in the early morning, January 14, 2012 in a refinery, which supplies anhydrous ammonia without water. The magnitude of explosion generally caused a mass number of cylinders plunged out randomly of its storage and smashed on to the administration building, workshop and refilling area. (Figure 1). The incident didn't involve any casualties but the damage done really tremendous.

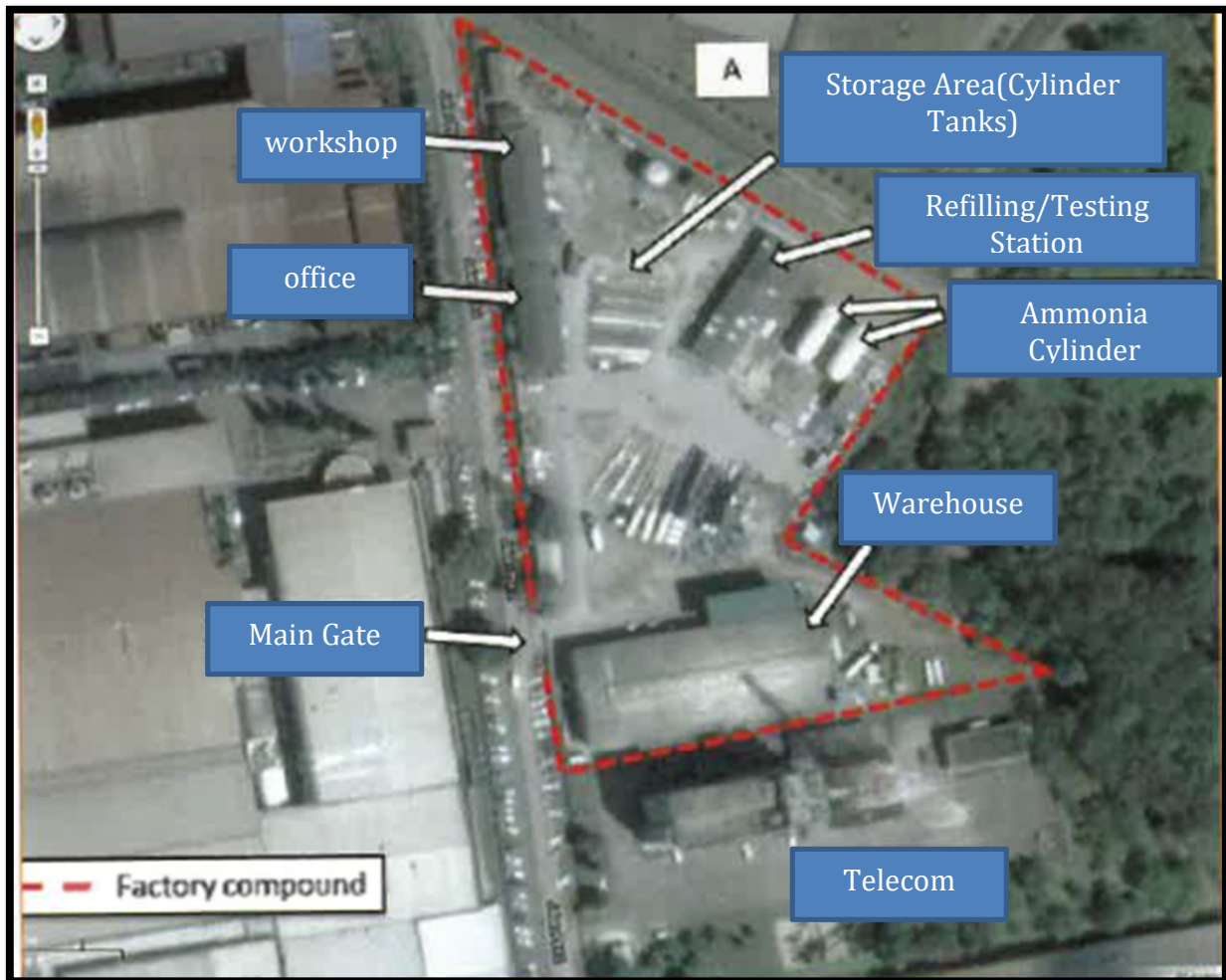


Figure 1: Lay out of the refinery location anhydrous ammonia without water, the location of the cylinder storage and buildings' location in the refinery.

Thus, this explosion occurred for the 2nd time in this refinery in a year of 2012 alone. The 1st case was deteriorated and damaged done much worst which affected the refinery nearby. After the 1st incident, there were few changes in the process, resulted the 2nd incident's magnitude of effected much lesser that the 1st explosion.

Both explosion (1st and 2nd case) that involved cylinders have been operated more than 20 years in operation. Therefore, due to the back-to-back explosion on the cylinders which is a string of the incidents, a thorough investigation in justifying the possibility of failure due to the mechanisms of cylinder's material fatigue. A few samples from the explosion's fragment of the cylinders and the existing material of cylinders have been collected (2 samples for comparison) from the same year of manufacture. Hence, a stress-life line or S-N curve plotted and depicted a fatigue indicator of the material isn't the contribution factor to the explosion [5].

This investigation will discuss prolong on the further research carried out in justifying the root causes and mechanisms of failure due to the 2nd explosion.

1.2 Technical Design of Anhydrous Ammonia Without Water's Cylinder.

The technical design of the anhydrous ammonia without water's cylinder commonly manufactured stipulate in the code of DOT-4A300 (DOT: Department of Transportation, US). Thus, Van Leer Company, Belgium in 1988, manufactured it. The cylinder's properties according to the code with the safe working pressure (SWP) at 21 bar (2.1 MPa) at ambient temperature. The capacity of the cylinder approximately 126 liter and the material itself was made from ST 37.3 or ST 45.3 with the nominal thickness of 4 mm. The material physical properties listed as (Table 1):

Table 1: The Physical Properties According to the Code and Standard [6]

Material	σ (MPa)	σ UTS (MPa)	Elongation min.(%)
ST45	295	460-580	21
ST37	235	340-470	24

The strain properties showed in the table 1, reflect to the old specification of material for carbon steel in Germany. Hence, the mass production of a batch of those cylinders (560 cylinders) was manufactured. A few samples from that batch been selected to undergone a Destructive Test (DT) such as mechanical test and expanding test. All the cylinders also had been undergone a process of hydrostatic test at the pressure of 42 bar (4.2 bar). The weight of the empty cylinder could be range from 54 -57 kg.

Basically, ammonia stored as anhydrous ammonia without water in the steel cylinder at the pressure of 16 bar (ambient temperature) or atmospheric temperature (-33°C). Ammonia can be category as hazardous substance. [7]

1.3 Stress Corrosion Crack (SCC) in the Anhydrous Ammonia without Water

Stress Corrosion Crack has been listed as one of the main factor of failure on anhydrous ammonia without water's storage tank that made of steel [8], [9]. This failure much closely related to SCC has been detected dated as early as end of 1950s, especially related to explosion on the pressure vessel of carbon steel which been used in the agriculture industry in US. As resulted approximately around 3% of this pressure vessel fail in a time of 3 years in operation. Hence, the failure happen such as SCC to the pressure vessel made of carbon steel for instances that mounted for transportation vehicles on the road has been reported in 1960. SCC in refrigerant system also prevails in the condenser.

According to [8], mostly, stress formation in mode of failure such as SCC been detected at the area of the pressure vessel's material that immerse in the anhydrous ammonia without water liquid without the water presents less of 0.2%. The presents of the water about 0.2% in the liquid would avoid the process of stress corrosion cracking. However, the concentration of the liquid is needed to (avoid SCC) that differ with the type of material used. Furthermore, SCC still could propagate especially at the top part of the container, where most of the areas expose to the ammonia's vapors [10]. The crack propagation occurred due to the condensation process and usually presents in midnight stage where the rapid change of surrounding temperature commonly happen.

The possibility of SCC will increase with the increase of the strain magnitude and material's strength. Therefore, it is advisable to use carbon steel with the low strength, with the range threshold of 300-480 MPa. Hence, SCC will be observe and exist to a handful of steel structure in ASTM A515 Grade 70, ASTM A517 Q & T and ASTM A202 Grade B. Therefore, the containing of oxygen in the air will react with the specific agent that caused SCC [11], [12]. Meanwhile, [10] indicated that no SCC occurred in free anhydrous ammonia without water from oxygen, but as low as 0.5-ppm oxygen in the liquid phase is actually enough to create SCC's process. Oxygen will double its potential with electrochemical activities. However, SCC generally generates at the zone of Heated Affected Zone or HAZ in the pressure vessel that no been undergone with the heat treatment after the welding process.

The existing of oxygen in the anhydrous ammonia without water could create a film layer on the surface of the material, where it could increase the potential of corrosion process at the rapid phase. While the stress exertion, the film layer will broke and caused the liquid exposure to the new surface. This new surface will form rapidly a

new film of layer. It will form a cracking process caused by the anodic reaction [11]. Meanwhile [11] spelled out that the longer of the cracking of the SCC only approximately around 0.1 mm and the failure exist due to the displacement of the layer. This process prevail the existing of the cracking in very tedious and complicated to be detected by using any common Non Destructive Test (NDT)

Hence, fatigue is not the main factor of failure mechanisms for the pressure vessel of anhydrous ammonia without water [12]. This scenario supported by the researcher [5], which investigated the root causes of the anhydrous ammonia' without water's cylinder explosion.

2.0 Methodology

2.1 Thickness Measurement

Sample of fragmented cylinder's shell thickness been measured by using the Ultrasonic Thickness Gauging (UTG) model 26MG. Therefore, 9 data of measurements has been captured at the flat shell and random location of the measurement been selected. The surface must be clean prior the measurement process been carried out. Then, the surface of the shell must be swipec with couplant B(glycerin) and the transducer in place directly to the surface of the shell.

2.2 Microstructure Test

They are 2 samples which are the samples put under the microstructure's microscope to seek any irregularity. The 1st sample at the crack area (sample 1) and sample of the good one which is away from the crack area (sample 2). The cutting process has been done in to a small pieces so that the samples easily were carried out and transported to the lab. (Figure 2). This arc cutting has been selected. The cutting into small sizes of samples by using manually cutting (screw cutter player).



Figure 2: Sample 1



Figure 3: Sample 2



Figure 4: Sample 3



Figure 5: Sample 4

The red circle indicated the part of the material (shell wall) that needed to do sampling test.

2.3 Stress Test

Stress test been done on the sample by using Universal testing Machine (UTM) with the capacity of 100kN. The strain rate for the stress test has been set for 1×10^{-3} per second. The sample tested cut into small sizes from the Sample 3 as shown in the figure 3. The Dimension of the sample depicted in the figure 4.



Figure 6: The Cutting shape of sample S3 for Stress Test

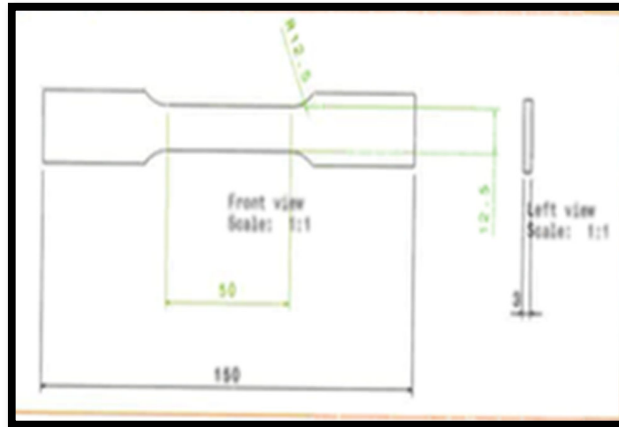


Figure 7: Dimension of Sample for Stress Test

2.4 Bending Test

Bending test been done on the sample by using Universal Testing Machine (UTM) with the method of 3 point of bending. The span distance been set at 60 mm and pressure exertion on the speed of 3 mm per minutes. The sample measure 3 mm x 10 mm x 75 mm

3.0 Result

3.1 Thickness Test

Result from the thickness test depicted that in the Table 2. They are 9 measurements have been recorded for the shell side of the pressure vessel.

Table 2: Thickness Measurement on the fragment's shell from the exploded cylinder

No:	1	2	3	4	5	6	7	8	9
Measurement (mm)	4.2	3.9	3.6	3.4	3.5	3.9	3.7	4.2	3.5
Average	3.7								

3.2 Microstructure Test

Result from the analysis of microstructure of grain depicted in figure 5. Figure 5a explain the condition of the microstructure of grain (10x of magnifying) from the area which is a way from the cracking area, meanwhile Figure 5b show the microstructure of grain (10x of magnifying) at the near area of the cracking area. Hence, figure 5c and d depicted the condition of the both are at the more and high exposure (20x of magnifying). Furthermore, Figure 9 show the microstructure of grain under (20x of magnifying) for both of the difference sample. It is clearly indicated that the propagation of the grain for both of the surface.

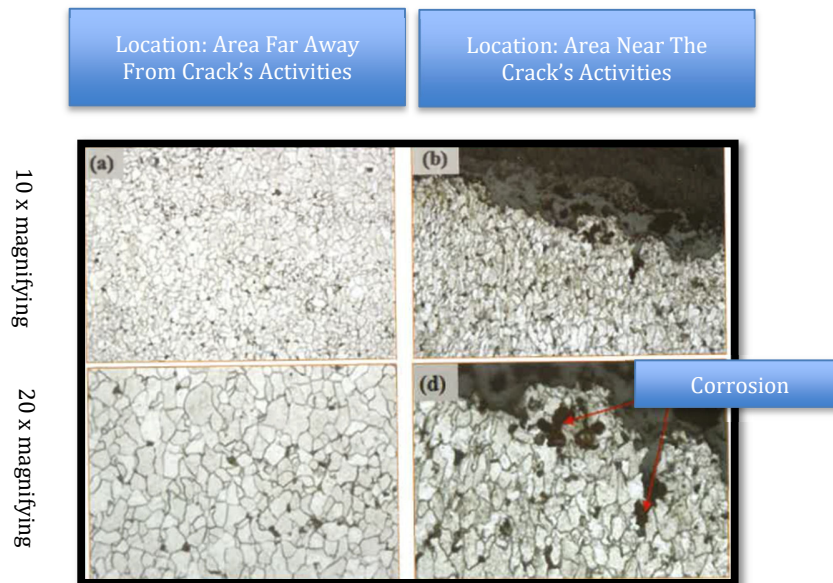


Figure 8: Condition of microstructure with area from far away and area near the crack

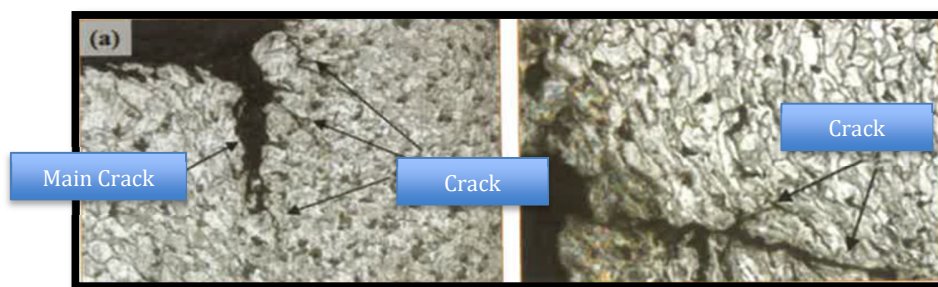


Figure 9: Crack between the granular has been detected in 2 places near the crack area

3.3 Stress Test

Result from the stress test as per below:

Table 3: The Stress Property of the Cylinder

Sample	σ (MPa)	σ UTS (MPa)	Elongation min.(%)
S3-1	419	462	8.0
S3-2	463	488	9.3
S3-3	457	492	7.6
Average	446	480	8.3

3.4 Bending Test

Result from the bending test as per below:

Table 4: The Bending Property of the Cylinder

Material	Bending Force σ_{bend} (MPa)	Bending σ_{bend} (mm)	Bending σ_{bend} (mm)
M3-1	782	1.7	10.0
M3-2	771	1.6	10.5
M3-3	735	1.8	10.5
Average	762	1.7	10.4

5.0 Finding & Discussion

As a result, the researcher found that from the analysis as mention below:

5.1 Thickness Measurement Test

According to the code, the cylinder's shell thickness in a range of 3.4 mm to 4.2 mm. However, measurement done on the samples indicated that an average of the actual cylinder's shell thickness is 3.7 mm. The 3.7 mm showed that the data is lower than the minimum thickness requirement that been rule out by the manufacturer which is 3.8 mm. Therefore, actually, they are 6 points of measurement that showed the lower data from the specification of the minimal thickness (Point 3, 4, 5, 6,7 & 9). Table 2 has depicted the depletion of shell thickness of the cylinder in randomly mode. The rates of depletion randomly cater for the difference of the thickness is very clear between those points of measurement. Thus, the depletion of cylinder' shell due to the corrosion process on the surface of the outer shell. The difference of the thickness caused the stress activities exert on the cylinder's shell wall in the random situation. Therefore, for the area of the thinning area could cause concentration of stress, whereby the value of the stress is much higher than other area (thicker). The area of the concentration of stress is expose to the Stress Corrosion Cracking (SCC) process.

5.2 Microstructure Test

The differ in the microstructure near the cracking area and the area which is far from the cracking area is very vividly presented (Figure 5). Result from the observation as bellowed:

1. Microstructure at the area of the crack depicted a significant changes in a form of elongation and inclination form;
2. Effect from the stress can be seen clearly at the area of crack. Corrosion attack easily forms at the weakest area. In this case, weakest area and easily attacked by corrosion is at the grain boundary, pearlite area and area where the dislocation density is very high;
3. Dislocation density is much higher and concentration at the area of grain boundary is the snag to the dislocation from propagates. Figure 9 explained there is a proof of the corrosion attack occurred at the microstructure than involved in the transformation in shape. This is also, sprawled out the changes of the microstructure formation due to the cylinder explosion; and
4. Phenomena of SCC can be related to the main factor of the cylinder 's explosion. This claim has been supported by the observation on the string line of crack where the stress propagate thru the boundary of intergranular as been shown in figure 9.;

5.3 Stress and Bending Test

Result from the test shown as per statements below:

1. The 3 samples indicated that the percentage of elongation is limited to around 8% compare to the standard material where the percentage of elongation minimum at least 21-24%.

2. Sample has achieved a maximum stress value of 1%. The failure of the material occurred after the value near to necking phase before the total value of strain appears.
3. The gradual stress increasing compare to the standard material approximately 235-295 MPa to 445 MPa. This is a clear prove that the work hardening process in the operation period of the cylinder. The hardening process increases the stress value near to the maximum stress value. Therefore, the material aren't allowed the thermoplastic elongation and become brittle;
4. Thermoplastic of the material gradually decrease when it's brittle, in some way will also decrease to fracture toughness (KIC). This Phenomenon is caused by the value of stress intensity factor (K) at the tip of the small crack (figure 9) that created from the SCC around the granular boundary. It was originally low, beyond KIC's values. The cracking process propagate rapidly and explosion trigger.

6.0 Result and Conclusion

SCC is the common of failure mechanism in carbon steel of pressure vessel especially for anhydrous ammonia without water in it. SCC occurred in the steel carbon due to the exits of oxygen components. Apparently, result from the analysis shown that they're a clearly proven that SCC process emerge as the factor of failure to the cylinder tank which exploded. This is because of:

1. The 3 samples indicated that the percentage of elongation is limited around 8% compare to the standard material, which is the percentage of elongation minimum to 21-24%.
2. The string line of stress propagates to the granular boundary from the crack 's attack with the assist of pressure inside the ammonia cylinder tank.
3. Mechanical property of the material decrease compare to the standard material whereby the material of the ammonia's cylinder become indeed brittle and expose to the risk of explosion.

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Development of experimental device for investigation of deforming processes of polymer film

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Abstract The flatness of separators of lithium ion secondary batteries used for as like electric cars and smartphones is rapidly increasing in recent year. Defects of quality tend to occur in the manufacturing method according to the conventional theory from this background. When many companies are manufacturing, they highly depend on the tacit knowledge of skilled operators. Many companies and University are working on problem solving by using various theories and methods in order to break through this situation. I firstly developed experimental device closer to the manufacturing site in this research. It can change the tension, conveying speed, and heating temperature of the manufacturing parameters. I tried to quantitative evaluation which was difficult in film research by executing binarization processing of the image observed from the camera in order to confirm the correlation between the production parameters of film and the occurrence of quality defects. I conducted a number of experiments and decided high flatness the experimental criteria. The maximum displacement of trough was compared by changing each parameter of criteria independently from each other. As a result, when each condition was changed, I found the singular point the planarity improves instead of the region. It became possible to estimate the cause of the trough by comparing with each condition. This study quantitatively evaluated the amount of displacement of the trough being conveyed. Thereby, indicating the possibility that a singular point improving the flatness of might exist. However, because the cause of the problem is very complex, it seemed difficult to specify the conditions with higher planarity. Establishing theories and methods that surely improve planarity even under various experimental conditions is a future important issue.

Key word planarity, polymer film, trough, wrinkle

1. Introduction

Polymer films are indispensable to our lives such as saran wraps and clear files, and separators used for lithium ion batteries for smart phones and electric vehicles. Lithium ion batteries have particularly become higher in capacity and higher in density in recent years, the flatness of the separator has rapidly been higher. Therefore, because polymer film is thin, soft and width [1], it is difficult to achieve by the manufacturing method based on the conventional theory. Film manufacturing is currently carried out in a state that depends greatly on the experience and intuition that have been accumulated by individual production sites and machine manufacturers. Besides, because it is done in a clean room so that dust does not mix in the film, it is mentioned as being one of difficult reason to instantly respond such as observation and adjustment by the operator. It is necessary to establish planarity improvement theory and manufacturing method which all operators can understand as formal knowledge from this circumstance. Therefore, the ultimate goal of this research is to realize high planarity in the production of polymer films. The gradual goal for achieving that is "clarifying the correlation between planarity and manufacturing parameters" and "elucidating the mechanism of occurrence of quality defects".

2. Previous research

Professor Hiroshi Hashimoto of Tokai University and many companies and research institutions are doing research on polymer films in Japan. For example, Mr. Hashimoto established a theoretical prediction model formula on the occurrence limits of quality wrinkles during conveyance. He compared the theoretical value and the experimental value which changed the thickness, anisotropy, conveying speed, tension of PET film and misalignment of roller.[2] From these results, he said that the important point is peripheral speed of roller, anisotropy of film and the tension. Furthermore, he conducted experiments by using hybrid porous foil bearings and he indicated from the results obtained that the web spacing height can be controlled actively with suitable choice of the combined values of web velocity, air supply pressure and web tension. [3] Mr. Hikita established a theoretical prediction model formula each between slip and wrinkle of roller and researched the correlation. And he mentioned that it should use micrometer grooves and concave shape for roller.[4] Mr. Morikawa researched prediction system of wrinkle occurrence by using web handling theory, and mentioned that web handling theory can use for approach of various phenomena resolution.[5] Mr. Nishimura also compared Mr. Nishimura also compared Mr. Hashimoto's research theory and eleven measures about conveying, wrinkles, pinching doing and he mentioned that wrinkle countermeasures by experience and intuition were very effective.[6] Furthermore, Mr. Matsubara and Mr. Goto analyzed the displacement force and the acceleration that layer shift occurs in the film winding problem and mentioned that it is mentioned that we can predict layer shift if we grasp slide resistance power and slide power.[7] Many of the previous works tried to elucidate the mechanism of occurrence of quality defects by theoretical modeling each part of web handling. However, if we used even with these theories, quality defect of polymer film have occurred and many companies could not solve problem. Therefore, it is necessary to verify the correlation between the elucidation of the mechanism of occurrence of quality defects and the dominant parameters of defects in a state closer to the manufacturing site.

3. Characteristics of this research

This research adds heating temperature during transportation which was not taken into consideration in previous research as a parameter. The evaluation object is the maximum amount of displacement of crease and trough generated in the film being conveyed at the time of changing each parameter. This can elucidate the mechanism of occurrence of quality defects occurring in the film to be transported, and statistically verify the dominant parameters.

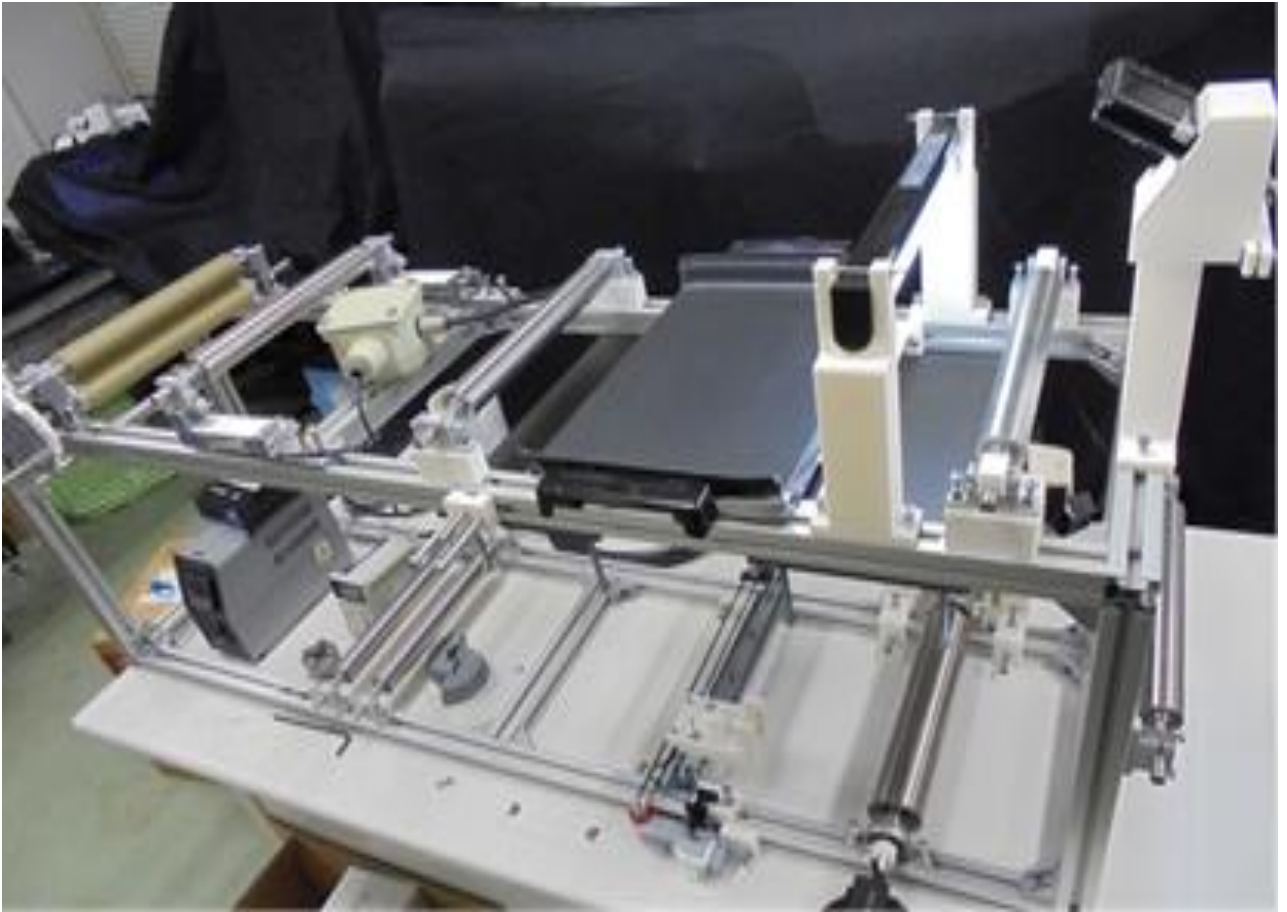
4. Methodology

4.1 Function of experiment equipment

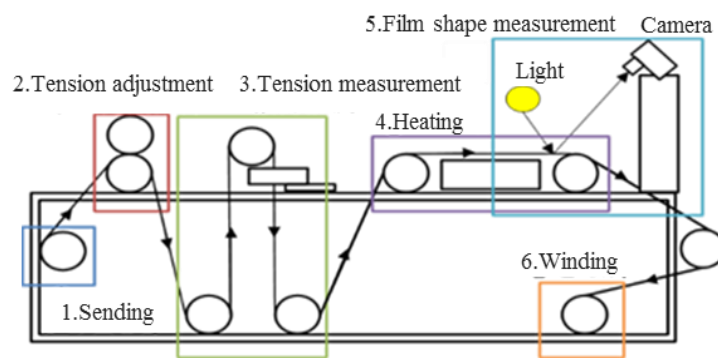
Figure 1 shows an overall view and a schematic view of the experimental equipment produced. The conveying path is the order of "Sending", "Tension adjustment", "Tension measurement", "Heating", "Film shape measurement", "Winding" and there is 10 rollers including rollers of guide and nip. The function of each part will be explained in the order of the route.

Sending part used the resin and the mechanical lock as shown in Fig.2 in order to synchronize the rotation of the film and the delivery roller.

Tension adjusting part adjust the tension by the weight as shown in Fig.3. When the weight is placed, braking torque is generated after by the friction between the brake pad and the rotating shaft and the torque is amplified by the gear ratio 1 (brake shaft): 6 (conveying roller shaft). Also, the urethane rubber roller is pushed from above in order to prevent slipping of the film at the time of increasing the speed.



(a) Overall view of the web experiment device

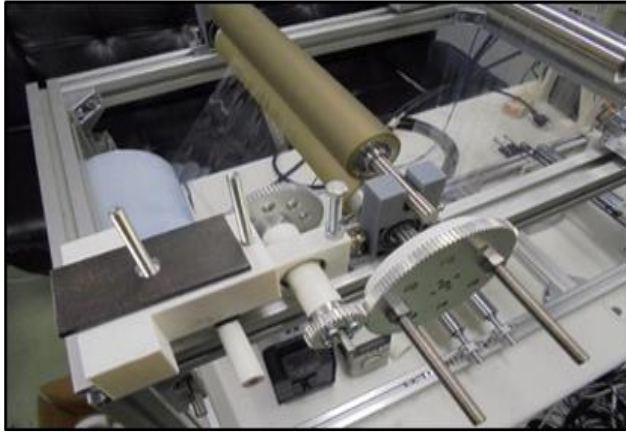


(b) Functional model of the equipment

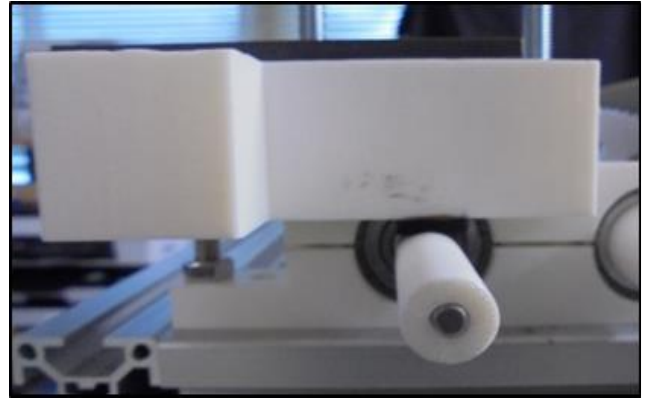
Figure 1 Overall view and its functions of the developed experimental equipment



Figure 2 Sending mechanism of the web polymer



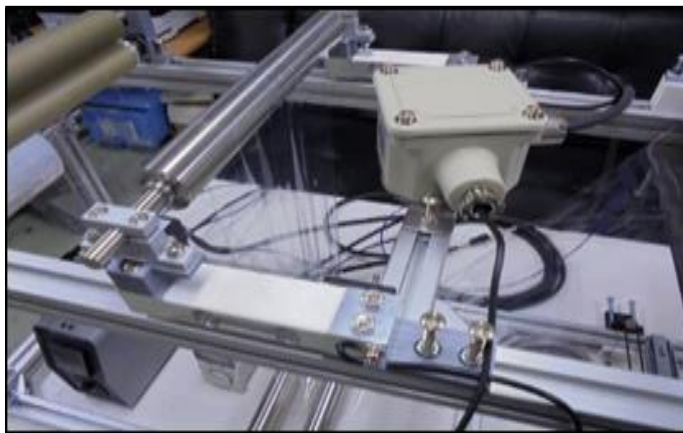
(a) Overall mechanism of the tension adjustment



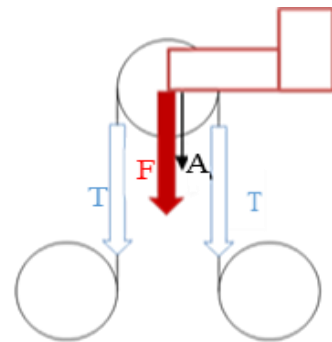
(b) Breaking mechanism to create tension

Figure 3 Adjusting mechanism of the tension of the web polymer

A load cell LCB 03 using a strain gauge was installed at both ends of the roller for the tension measuring. It arranged 3 rollers so that the direction of the tension and the direction of the load applied to the load cell are parallel as shown Fig.4.



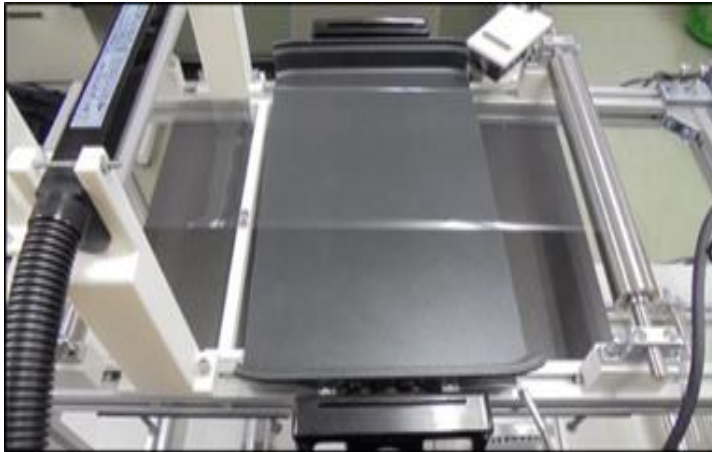
(a) Overall measuring mechanism



(b) Functional model of the tension measurement

Figure 4 Measuring mechanism of the tension of the web polymer

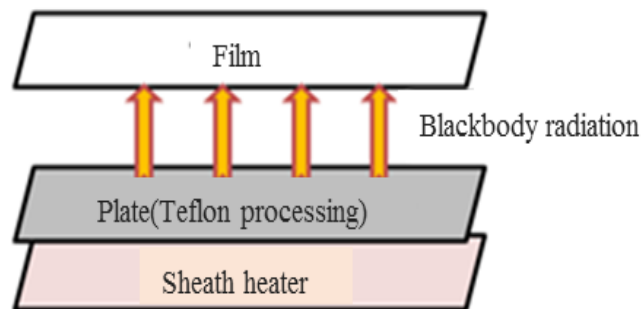
It used Teflon-processed metal plate in Heating part. When it is heated, a blackbody radiation matching the wavelength characteristics of the film is generated. Then, when it irradiates blackbody radiation to polymer film, it becomes the same as the heat treatment at the manufacturing site. It used MTCS that can change from 0 to 450[°C] by PID control in order to control temperature in this time. Although it is really desirable to measure the surface temperature of the film, it is very strict due to be expensive. Therefore, it measured the center of the metal plate with a non-contact type radiation temperature sensor FT-H10 as shown Fig.5.



(a) Overall structure



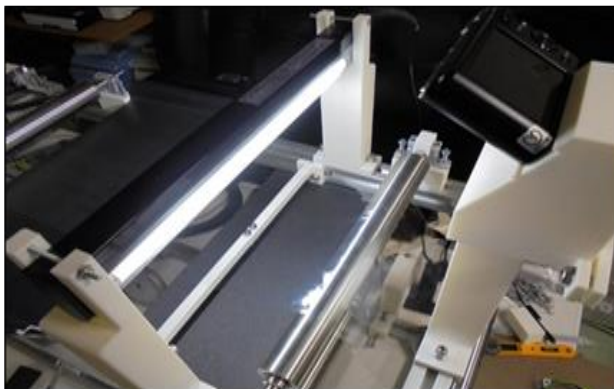
(b) Heating device



(c) Functional model of heating the web polymer

Figure 5 Heating mechanism of the web polymer

It irradiates the light source onto the film at Film shape measurement part and takes the undulation of the light source with the digital camera DSC – W810 during the conveyance. It observed film after passing through the heating section as shown Fig.6 in order to check the influence of the film due to wrinkles and temperature change.



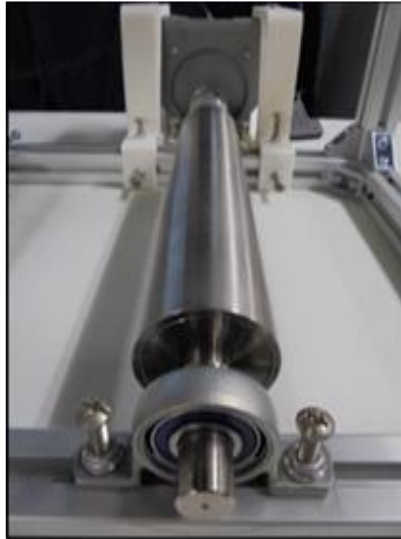
(a) Overall measurement mechanism



(b) Detecting deformation by optical reflection

Figure 6 Measurement mechanism of the deforming shape of the polymer web

Winding part was conveyed at a constant speed by using the motor unit BMU 5120 A - 20 - 1 as shown Fig.7. The speed can be set from 0.01 to 0.54 [m / s].



(a) Overview of the winch drum



(b) Connection between motor, gear and the drum

Figure 7 Winching mechanism of the web polymer

4.2 Setting experiment conditions

It confirms the manufacturing parameters that are dominant against troughs and wrinkles. The experimental conditions are the parameters of tension, conveying speed, heating part temperature, and thickness shown in Table 1. The condition of high planarity decide as reference conditions among experimental. It made independent phenomena occurring in each condition by changing each parameter from it and tried to find the correlation between phenomena and parameters. Also, it compared 16 to 30 revolutions out of 30 revolutions in order to considering the influence at the time of attachment to the winding part.

Table 1 Experimental condition

Tension against width[N/m]	52.32	65.4	98.1	130.8	196.2	261.6	327	
Conveying speed[m/s]	0.046	0.092	0.131	0.164	0.196	0.229	0.262	0.327
Heating temperature[°C]	20	50	80	120				
Film thickness[μm]	20	25						

4.3 Derivation of experimental results

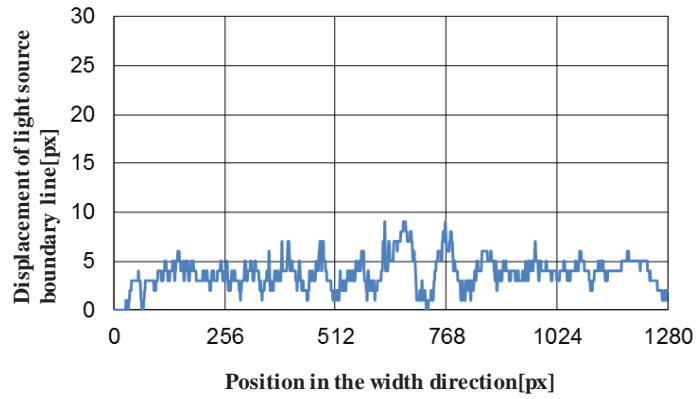
It describes how to derive thing observed in film shape measurement to trough displacement amount. An image obtained from a camera taken during the experiment is shown in Fig.8 (a). It uses high performance free graphic software [GIMP 2] against this figure and only a photograph of a polymer film is cut out and it is converted from projection drawing into a plan view. Then, it classified into white and black by using threshold that be determined by discriminant analysis method of image processing software [Image J] as shown in Fig. 8 (b). When it digitizes the displacement of the original light source boundary line in units of pixels after the processing, it becomes Fig.8(c). Therefore, displacement on the image is obtained from the pixel 720 [px] × 1280 [px]. The actual dimension was 44 [mm] × 150 [mm]. Also, it intentionally generated trough of 1 mm as shown Fig.9 (a). The trough displacement amount was 0.292 [mm] as shown Fig. 9 (b) according to the ratio of the distance from the downstream roller to the point where the pseudo trough and the light source was irradiated. The following relational expression can be finally found from the light source boundary line displacement 4.033 [mm] by the image processing in Fig. 9 (c) and the actual trough displacement amount 0.292 [mm].

$$z \cong 0.072 y[\text{mm}] \left(\begin{array}{l} z: \text{Actual trough displacement amount} \\ y: \text{Light source boundary line displacement} \end{array} \right)$$



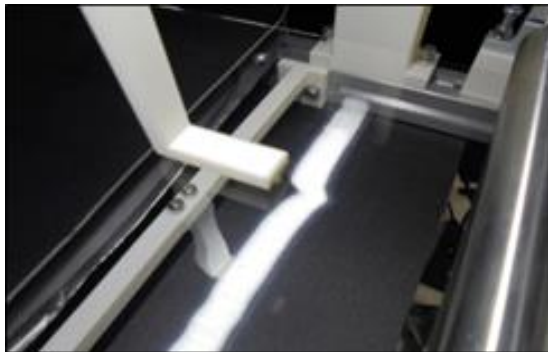
(a) Trough during transport

(b) Binarization processing

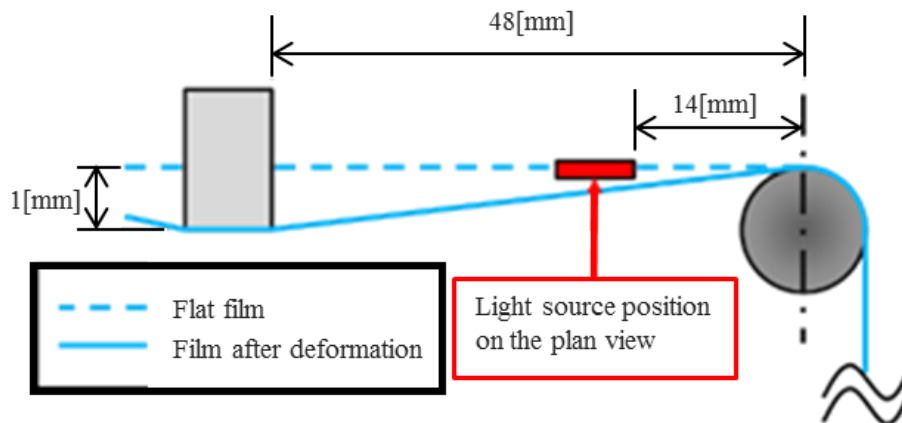


(c) Graph with numerical value of pixel

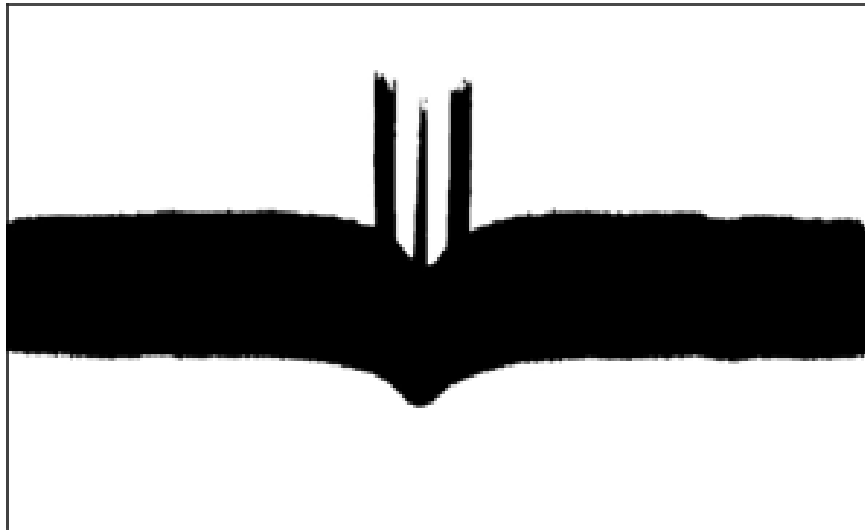
Figure 8 Light source line boundary displacement



(a) Intentionally generated trough



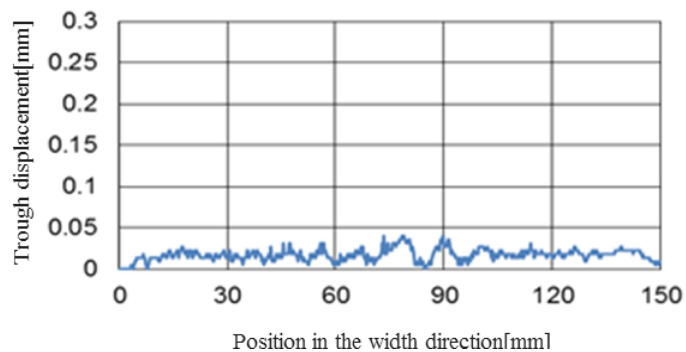
(b) Relational expression model



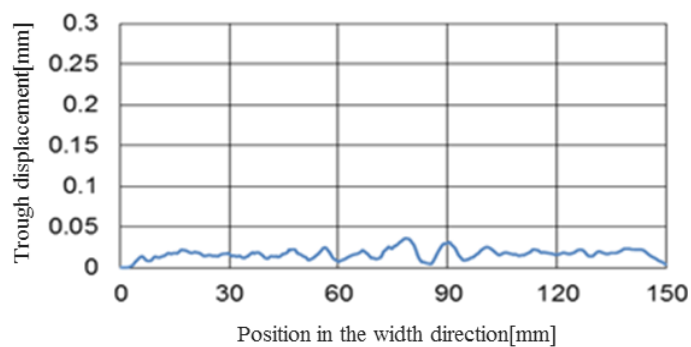
(c) Binarization processing

Figure 9 Actual trough displacement

It eliminated high frequency components above 32 [Hz], that is within trough width 2.23 [mm] by using simple moving average method in order to remove the noise generated by the binarization process. Fig.10 shows the graphs before and after removal. It focused on trough maximum displacement amount that may develop into wrinkles in fatal quality defects from the graph of the amount of displacement of the trough and it did quantitative evaluation by comparing with each condition.



(a) Before noise removal



(b) After noise removal

Figure 10 Graph before and after noise removal

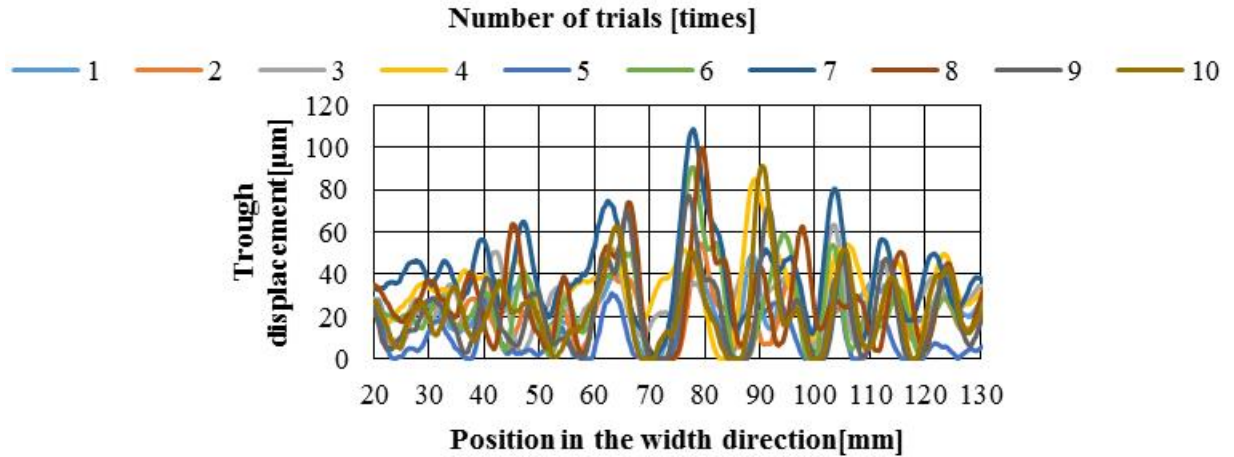
5. Result

5.1 Reproducibility verification

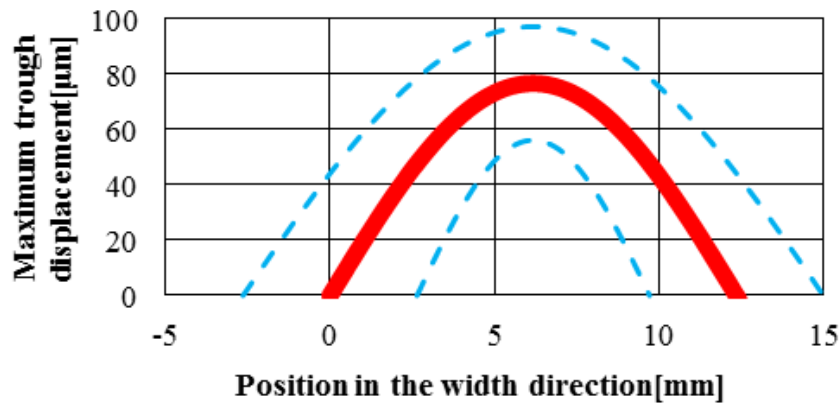
It conducted 10 experiments under the experimental conditions shown in Table 2 in order to confirm reproductibility of trough maximum displacement and trough width. The results are shown in Fig.11 and Table 3. The maximum displacement of the trough was a mean μ 76.75 [μm] and standard deviation σ 20.54 [μm] and trough width was a mean μ 12.34 [μm] and standard deviation σ 2.64 [μm].

Table 2 Experimental condition of reproducibility

Tension against width[N/m]	Conveying speed[m/s]	Heating temperature[°C]	Film thickness[μm]
98.1	0.196	20	25



(a) Trough displacement amount for 10 times



(b)Graph of average and standard deviation

Figure 11 Graph of reproducibility verification result

Table 3 Average and standard deviation of repeatability

	Average μ	Standard deviation σ	2σ
Maximum displacement[μm]	76.75	20.54	41.08
Width[μm]	12.34	2.64	5.28

5.2 Experimental result

Fig.12 is Color mapping that made constant condition of Heating part 20 [$^{\circ}\text{C}$] and the film thickness 20 [μm]. Table 4 is table that digitized Fig.12. When it sees at Figure 12 and Table 4, there were conditions that maximum

displacement amount of the trough was significantly lower than the other conditions. Those were 65.4 [N/m] and 0.229, [m/s], 98.1[N/m] and 0.196 [m/s], 130.8 [N/m] and 0.131 [m/s].The standard condition was decided 98.1 [N/m] and 0.196 [m/s] out of the three conditions described above, and it compared numerical by changing the tension, conveying speed and heating temperature from standard.

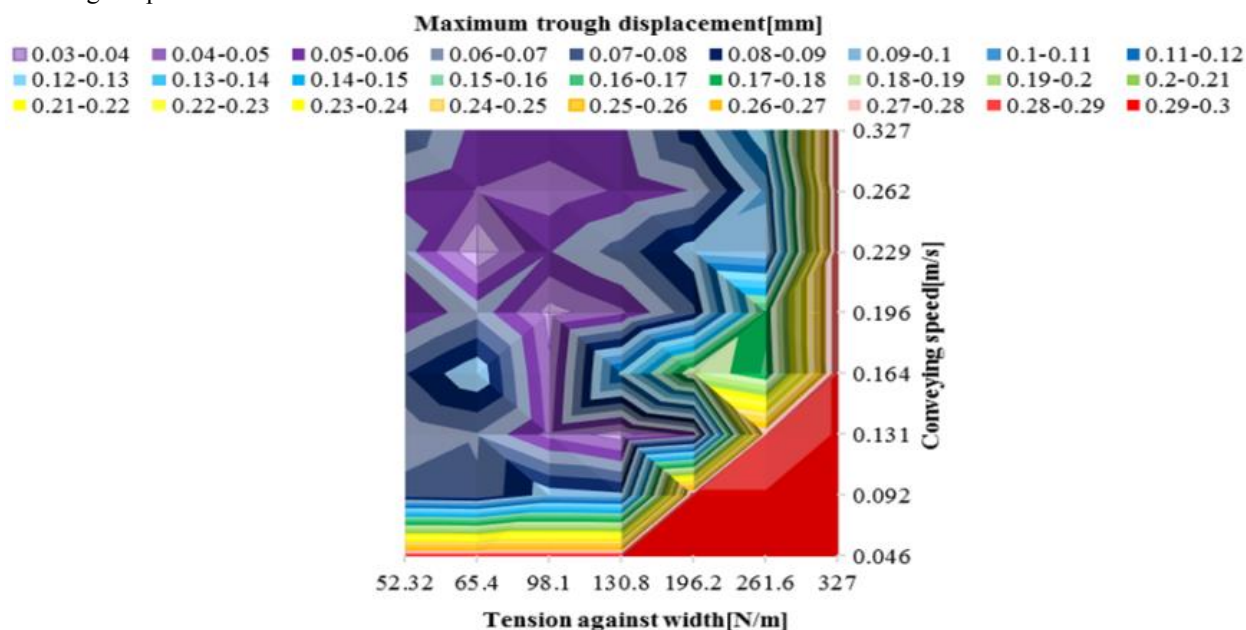


Figure 12 Map of maximum displacement of trough at conveying speed and tension change

Table 2 Maximum displacement of trough during conveying speed and tension change

		Tension against width[N/m]						
		52.32	65.4	98.1	130.8	196.2	261.6	327
Conveying speed[m/s]	0.327	0.0786	0.0561	0.057	0.0579	0.0868	0.133	Wrinkle
	0.262	0.0572	0.0495	0.0433	0.0516	0.0607	0.103	Wrinkle
	0.229	0.0649	0.0307	0.0595	0.0747	0.0961	0.0902	Wrinkle
	0.196	0.0498	0.0668	0.0358	0.0481	0.0779	0.173	Wrinkle
	0.164	0.0795	0.0989	0.0426	0.123	0.192	0.168	Wrinkle
	0.131	0.0623	0.0693	0.0468	0.0347	0.054	0.281	Wrinkle
	0.092	0.0749	0.0709	0.0961	0.0923	Wrinkle	Wrinkle	Wrinkle
	0.046	Wrinkle	Wrinkle	Wrinkle	Wrinkle	Wrinkle	Wrinkle	Wrinkle

5.3 Tension comparison

When it changes the tension from the reference condition, the trough maximum displacement amount was higher than the standard condition. It is considered that the compression force of the width direction increases and buckling occurs when the tension increases in the conveying direction. On the other hand, when the tension decreased, the maximum displacement amount of the trough similarly increased. This is considered that it might refract the light on film when the film was transported in a loosened state during transportation.

5.4 Comparison of transport speed

When it also changes the conveying speed from the reference condition, the trough maximum displacement amount was higher than the standard condition. When it reduced the conveying speed, it is considered that the conveying time became long in order to slowly pull film. On the other hand, when it increased the conveying speed, it is considered

elongation and shrinkage occurred in the film at a fast cycle.

5.5 Comparison of heating section temperature

Fig.13 and Table 5 show color mapping and numeric when it changed heating temperature and tension with conveying speed fixed at 0.196 [m/s]. When increasing the temperature from the reference condition, the maximum displacement of the trough increased. However, when the heating temperature was 50 [°C] and tension was 65.4, 130.8 [N/m], the maximum displacement of the trough was the 2nd and 3rd lowest next to reference condition. This suggested that this may possibly remove a little residual stress in the width direction when film was heated by temperature lower than 95 to 130 [°C] of melting point of LDPE.

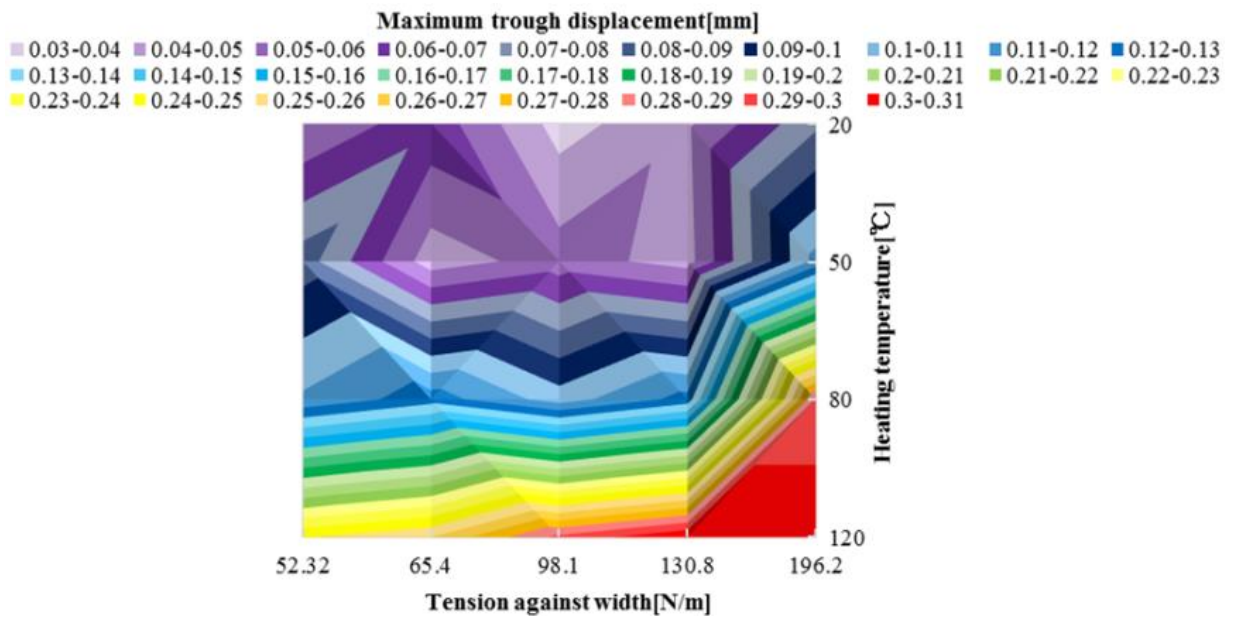


Figure 13 Map of maximum displacement of trough at heating temperature and tension change

Table 3 Maximum displacement of trough during heating temperature and tension change

		Tension against width[N/m]				
		52.32	65.4	98.1	130.8	196.2
Heating temperature[°C]	20	0.0498	0.0668	0.0358	0.0481	0.0779
	50	0.0851	0.0447	0.0547	0.0461	0.114
	80	0.112	0.125	0.105	0.124	0.291
	120	0.285	0.26	0.293	Wrinkle	Wrinkle

6. Conclusion

In this research, it fabricated experimental apparatus that add the heat treatment temperature, which was not considered in the conventional research, and it performed quantitatively evaluate. It digitizes the trough which becomes a source of fold wrinkles among quality defects, it tried to elucidate the correlation between flatness of polymer film and manufacturing parameters and the mechanism of occurrence of quality defects. The following findings were acquired from this research. "It is considered that there are several conditions that improve quality in the manufacturing process. This may occur not a constant tendency but under specific conditions, so we will need to continue our research both analytically and statistically." and "It is considered that it is very difficult to find conditions that completely eliminate troughs, so we

also need to suggest control methods that suppresses trough." In addition, it must incorporate the alignment which is considered in the previous research as a parameter. Furthermore, it must considerate the anisotropy and residual stress of each width of the film because the film width is manufactured at 1 m or more. If we discuss and resolve these issues, research will progress further.

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Innovation in action: edupreneurers' objectives and practices for quality education

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Abstract: Present study aimed to explore the mission statements of schools and intentions of edupreneurs in relation with their practices toward quality of education they are imparting. Objectives of the study were to find out the mission statements and practices of private edupreneurs and to compare it with the perceptions of parents and teachers about quality of education claimed by the schools. Qualitative research design was opted for the study and using purposive sampling technique seventeen edupreneurs running well reputed private schools in cities of Sargodha, Lahore and Gujrat were taken as sample. Teachers (N 26) from these schools and parents (N 19) as stake holders were also the part of sample. Document analysis, Semi structured Interviews of the owners and principals of schools and focus group interviews of parents were conducted to gather the data for the study. Three indicators of quality i.e. input, process and product were studied. Thematic and content analysis of data revealed that majority of the mission statements of schools had included community service, innovative ways to impart education, to increase quality of education, to develop leadership qualities among students, as their major targets. There were no defined ways established by the schools to assess the achievement of school targets. Majority of the teachers and parents reported earning money as the major focus of the school administration in contrast with the mission statements of schools which spoke of innovation and quality education as the first priority. Parents perceived high fee structure and load of foreign text books as the major indicator of quality of education. The findings indicated discrepancies between the passion and practices of edupreneures. Findings also highlighted general perception of the society where schools with high fee structures are reputed as status symbol in society and are equalized with quality education. Research findings may be implied by adding the element of accountability to check balance between the intentions and practices of edupreneurers. Future research might investigate the mission statements and practices for quality education by using mixed method research design applied to larger sample.

Key words: edupreneurers, private schools, mission statement, quality education, stake holders

1. Introduction

Edupreneureship is relatively a new concept in Pakistan though it has been used in developed countries for more than last two decades. International Academy for Educational Entrepreneurship refers edupreneur under the broad theme of educational entrepreneurship. Some other institutes include edupreneurs in the category of social entrepreneurship. Edupreneureship as a concept means initiative of any entrepreneur in educational filed (Vivek and Upadhyaya, 2015).

The concept of Edupreneur cannot be understood without tracing its root word entrepreneur's growth in the dictionary. Historical sources say that the Irish political economist Richard Cantillon coined the word entrepreneur in 1730 (Casson, Mark C., 1990). According to the Webster dictionary, "an entrepreneur is a person who organizes and manages an enterprise with considerable risks" (<https://www.merriam-webster.com>). Edupreneurs can be defined as educational entrepreneurs who plan, open and successfully operate educational services. In this venture edupreneurs handle legal and illegal hurdles with consistent risks and crisis management skills. The enterprise created by an edupreneur can be for profit or non-profit nature. But with the aim of getting social attention edupreneurs, innovate their educational services. Broadly, edupreneurs can be divided into two types – public and private. Literature reports many traits of Edupreneurs: Passion for education change; Technical knowledge; Crisis Manager; Multi-tasking; Micro Management; Human Resources management; Pedagogical Innovations; Hurdle Jumper; Self Guidance; High Creativity. Some other attributes of educational entrepreneurs declare them as tenacious, optimistic, creative, courageous, persistent, willing to take risks, resourceful, independent, opportunistic, and thoughtful. (Leisey, Donald E. & Charles Lavaroni; 2000). All the above mentioned attributes contribute

towards the make of edupreneure but Self-motivation, which is a nonmonetary drive, should be the essential desire for operating the enterprise (Vivek and Upadhyaya, 2015). Edupreneures put their skills in action for the improvement of existing system of education.

Education is considered the solution for problems of society. Public and private institutions continuously put their efforts to contribute in making the system of education better and effective for the development of society. For education of high quality to flourish, it is believed that entrepreneurship in education is the key to identifying and implementing those changes. Establishment of every new school is taken as a step toward betterment in education system. System is established keeping in view the objectives. Objectives can be reflected in mission statement of the institution and can be achieved through the implementation of activities based on the objectives. In other words it can be said that the school practices are a reflection of the mission of the school.

In recent years, there has been a significant growth in the number of private schools. These schools are an entrepreneurial response to meet the urgent education need of the country by expanding access to the community children. (Meril Antony 2014). Edupreneurial companies are presently experiencing substantial growth worldwide. For-profit educators have the ability to provide education which meets parental expectations. They are free to vary the curriculum and teaching methods they wish to offer (Farrelly, 2005).

In order to retain and compete, schools have to strive hard. It requires the identification of the aims and objectives, and the methods to reach these aims and objectives. Schools have to adopt a long-term and future-oriented approach (Güven ÖZDEM 20011). When an organization prepares strategies of makes choices between different alternatives, mission statement guides the strategies. Mission is the reason for being of an organization. A well-prepared mission statement needs to identify the specific purpose of the organization and its field of activity in terms of products and markets, and thus differentiate the organization from others (Ülgen & Mirze, 2004). Mission statement is a set of goals that help the organization reach its aims and that express its strategic objectives (Tutar, 2004). According to Dinçer (2004), mission is a long-term goal, a shared value and belief, is unique to the organization and special, and is about quality not quantity. When businesses have a strong vision, it helps them predict future events, be prepared for changes and innovations, have courage to face the future, predict changes in customer demands, and improve employee efficiency (Güven ÖZDEM 2011).

One way of exploring the diversity of private schools is to examine their vision/mission statements. The school mission arises from a set of values that answer fundamental questions about the purpose of education and how the educational program should be carried out. The school mission provides the context for governance decision making and the way the school is managed. The mission clarifies the outcomes that the teaching and learning core technology work toward (Boerema, Albert J. 2006).

Keeping in view the importance of mission statements and their role in keeping the practices aligned towards the achievement of goals, the present study was designed. The study aimed at exploring the points of innovation in terms of their aims and practices of well reputed private schools as an endeavor toward improvement of educational system.

2. Methodology

Qualitative research design was opted to deal the in depth nature of the problem.

2.1. Sample

The sample included owners/ principals (N 17) of well reputed private schools of Sargodha, Lahore and Gujrat; teachers (26) and parents (19). Purposive and convinence sampling technique assisted the researchers to take the sample from schools where the enrollment of students was higher than five hundred and the school administration consented to participate in the study.

2.2. Research instrument

Data were collected from the principals, teachers and parents using semi structured and focus group interviews respectively. The interview Questions were pilot tested and validated through experts' opinion. Initially fifteen questions were constructed and afterwards modified to 10 questions each for all the three groups of respondents.

3. Data analysis

The interviews were recorded and transcribed. The data were analyzed using content and thematic analysis. This qualitative method is a "data reduction and sense-making method that takes a volume of qualitative material and attempts to identify core consistencies and meanings through coding of textual material (Hodson, 1999). Content

analysis can be used for many purposes, including to reveal the cultural patterns of groups, institutions, or societies and to reveal the focus of individual, group, institutional, or societal attention (Weber, 1990, p. 9).

The following section presents the samples of answers obtained from all the three groups of the respondents:

Q1 What is the mission statement of the school?

All school leaders declared that schools have mission statements placed either on the school gate, classwork copies, in principal office, or written on the inner side of the boundary walls.

The statements included number of goals. The major school goals mentioned in the statements were service to community, provision of quality education, all round development of students, development of leadership qualities among students.

Teachers: very few teachers were aware of the mission statement. However they responded that the school was working to achieve the goals of students' high performance in exams.

Parents: only a few educated parents (3) reported that school had learning as its major goal.

Q2 what is the action plan to achieve the set goals of school?

There were no written action plans available in schools. Majority of school heads reported that they are successful in the achievement of the set goals of the schools. It seems that action plans were inherited and observed verbally. There is no defined practice of making assessment of the achievement of the goals.

Principals

Case 3: "I share my goals and action plans with my team members but I do not need to write it."

Case 5: "I have action plan in my mind to achieve goal."

Case 16: "We have been observing the same action plan for years, and we still follow it".

Teachers

Teachers reported that there was no written action plan shared by the school. However they were given time to time instructions by the administration about their classroom teaching and other duties.

Case 7: "I don't know what is the action plan of school but I get instructions from the coordinator in staff meetings and sometimes randomly to improve my teaching and classroom discipline"

Parents

Case 9: "I am also teaching here. I think school administration wants to show outstanding results in board exams and we have to work hard in the classrooms".

Case 13: I have no idea as I am only concerned with the study of my children. They have very heavy bags and we have to pay heavy fee too. School continues to charge through the year for different purposes".

Case 2: I think school administration wants to earn at first.

Q3 what are distinguished features of school?

Principals

Principals were asked to describe the salient features of the school which make it different from other contemporary schools. All respondents claimed that their schools were performing differently with particular distinguished features.

Case 2: "We are offering clean and neat environment."

Case 1: "Sports and co-curricular activities are our distinguished feature of this institution."

Case 10: "Teachers are well educated and professionally developed."

Case 3: "Homework checking and continuous testing"

Teachers

Case 7: teachers' continuous evaluation

Case 11: discipline and co-curricular activities

Parents

Case 5: study routine of children. School engages them all the day in homework

Q4 what are the facilities and infrastructure provided?

Principals

All the respondents claimed that they are providing all possible facilities to their students, e.g. drinking water, shelter, cycle stand, canteen etc. in case of infrastructure, building was sufficient including classrooms, washrooms etc.

Case 7: "my school has all classrooms separately for all classes"

Case 9: "well, I think all facilities are at their best."

Case 5: "we have building according to education department code."

Teachers

Case 1: classrooms are big and airy

Case 6: computer lab is available

Parents

Case 3: play ground is not available in the school

Case 8: fee is high but sufficient facilities are not provided

Q5 what skills teachers possess? The selection criteria; teachers training

Teachers were selected on need bases. Tests and interviews are two selection criteria for teacher selection. No scheduled training was reported by any head teacher.

Principals

Case 2: "Teachers become skilled when they encounter with class problems."

Case 3: "No such training is conducted for teachers."

Teachers

Case 7: "Sometimes micro teaching sessions are arranged."

Case 10: "teachers discuss their teaching problem with each other and resolve it"

Case 3: " demo sessions are arranged for selection of the teachers"

Parents

Most of the parents had no idea about the teachers' selection.

Case 9: " I think interview is major tool to select the teachers"

Q9 what is the fee structure? Is it justified?

Majority of selected schools have fee structure ranging from Rs 3000 to 4500 per month. Although an amount of Rs 13000 to 20000 was taken as security and admission fee.

Case 1: "Yes, fee is little bit higher than other schools but we are providing many facilities too."

Case 3: "I think it is appropriate."

Case 6: "we are serving the community and other expenditures are too high, so fee structure is appropriate."

Teachers

Case 2 : fee is charged according to the services provided

Case 18: it is expensive for the middle class but many children come from business families or land owners. Teachers' salary is not sufficient. Fee is hardly affordable for some of the parents. But facilities should be improved to match the fee charges.

Q 10 do you think the school is successful in its practices to achieve the targets mentioned in mission statement?

Principals

Case 2: yes we practice the same as we have mentioned in our mission.

Case 4: yes sure. My team works hard and they make it possible.

Case 17: we achieved our target last year our student got outstanding position in board exam.

Teachers

Case 6: I don't know about the mission statement but we make our best in classroom.

Case 10: yes our students get position in board exam every year.

Parents

Case 3: I don't know the school targets but children have no time to do other activities. I am happy because they get busy whole day

4. Discussion

This study explored the mission statements prepared by schools to represent the ideas and hopes of what they want their school to be. The analysis provides an insight into what is the target and intentions of the people that make up and lead schools. It is found that majority of edupreneurs had either no mission statement or it was not documented. Without a statement that reflects the intentions of the school leaders, it is difficult to understand how a mission can appear in practice. The mission statement is the necessary condition for many different individuals to pull together through numerous activities to achieve central shared purposes. (Jack Meacham 2006). Witten plans of actions were also absent and teachers were directed verbally to perform various tasks and duties. Majority of parents had no idea of targets of school. It is usual in our society where parents are less educated.

The analysis revealed that edupreneurs had some targets in common as community service, provision of quality education, and development of students as future leaders. However the salient features which were reported by the respondents as unique, were shared by all the schools in sample.

The study concludes that there is a gap between the mission statements and the practices of schools. The obvious reason is the absence of any written and chalked out plans to put forth the objectives into actions. There was also difference in parents' response about the mission of schools. Parents reported the money making as priority of the schools as compared to the edupreneurs' statements who declared the provision of quality education at their first.

5. Recommendations

- On the bases of findings it is recommended to device an assessment procedure to evaluate the mission statements of the edupreneurs against their practices.
- Accountability of every school business is also needed to promise the provision of appropriate facilities and services against the fee structure of the school.
- Further research is needed to determine the degree to which the variety of goals expressed in the vision statements are carried out by the schools.
- The future research may include all types of schools from the community to have more clear view of the problem.

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Room C

Session – 7

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Hybrid of the Fuzzy C-Means and Level Set Methods for Extracting Exudates on Fundus Image

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Abstract Diabetic retinopathy is one of the diseases caused by diabetes mellitus. It can cause leakage of blood vessels in the retina or bleeding, and blurred vision. Early diagnosis of diabetic retinopathy is an important task to prevent blindness. The appearance of exudates is one of the symptoms of diabetic retinopathy. Ophthalmologists use the fundus image of patient to evaluate the exudates. Therefore, it is important to extract the exudates on the fundus image in the diagnosis of diabetic retinopathy. The exudates extraction of the fundus image is a difficult task for ophthalmologists because the fundus image often has poor qualities, such as the boundaries between objects in a less clear and low contrast and noisy. A good extraction method becomes a necessity in the diagnosis of diabetic retinopathy. Segmentation method is one of method used for exudates extraction. There are many methods of segmentation. Level set method is one of the very well-known methods for image segmentation. It is also widely applied for many applications in image segmentation. The level set method has been successfully used in the medical image segmentation. It has several advantages over the methods of snake, region growing and thresholding. However, when the level set method is applied in the noisy images, it cannot work well. The noise in the images often causes the curve of the level set stopped prematurely in the process of evolution curve, resulting in unsatisfactory results. For this reason, this research uses the level set with fuzzy C-means. The fuzzy C-means is used as preprocessing to handle the noise of image for avoiding from the stopping premature of evolution curve in the level set. Based on these reasons, this paper proposes the hybrid of the fuzzy C-means and level set methods for extracting exudates on fundus image. From the experiment results, it is obtained that the hybrid of the fuzzy C-means and level set methods is able to work better in extracting the exudates on the fundus image than the standard level set method.

Key words level set, edge stopping function, fuzzy C-means, extract, exudates, diabetic retinopathy, fundus image

1 Introduction

Diabetes mellitus is one of the chronic diseases which is caused by deficiency in production of insulin by the pancreas, or by the ineffectiveness insulin production. It is a characterized by the above normal increased blood sugar levels. Indonesia is among the top 10 countries in the diabetes mellitus patients. In 2013, diabetes mellitus patients in Indonesia is estimated to reach about 8.5 million people with an age range of 20-79 years. This disease causes many complication diseases. Vascular complication is one of the complications of diabetes mellitus. Classically the vascular complications of diabetes mellitus are divided into microvascular and macrovascular. The microvascular complications are the diabetes mellitus complication caused by damage to small blood vessels, while the macrovascular complications are caused by damage to larger blood vessels. The most common microvascular complication of diabetes mellitus is diabetic retinopathy.

Currently diabetic retinopathy is the leading cause of blindness in the working age population in the western world [1]. In the early stages, diabetic retinopathy is characterized by a narrowing of blood vessels in the eye which is caused by the accumulation of fluids and fatty material in the retina. It can lead to bleeding in the retinal blood vessel. This condition can lead to blurred vision and be left then it can cause severe vision damage as well as blindness. The risk of diabetic retinopathy can be reduced by early detection, controlling blood sugar, blood pressure, and lipids appropriately [2].

Ophthalmologists use the retinal images of patients to diagnose diabetic retinopathy. This retinal image is known

as the fundus image. The details of fundus images such as small blood vessels, microaneurism, and exudates may be in low contrast. Ophthalmologists usually use the fundus image of patient to evaluate the exudates. The exudates is one of the symptoms of diabetic retinopathy. Therefore, it is important to extract the exudates on the fundus image in the diagnosis of diabetic retinopathy. The exudates extraction of the fundus image is a difficult task for ophthalmologists because the fundus image often has poor qualities, such as the boundaries between objects in a less clear and low contrast and noisy. A good extraction method becomes a necessity in the diagnosis of diabetic retinopathy. Therefore, a method that automatically aided computers will help an ophthalmologist to recognize and extract the signs of diabetic retinopathy disease.

Segmentation method is one of method which can be used for exudates extraction. The purpose of image segmentation is to divide the image into a separate set of regions with uniform texture attributes, etc. [3]. The image segmentation method can be applied to divide the fundus image area into two parts i.e. the exudate area and the non exudates area. There are many methods for image segmentation. The image segmentation approach can be divided into four categories: thresholding, edge detection, area extraction and clustering [4]. The thresholding method has several disadvantages, as it relies heavily on peaks and spatial details not considered. While the method of regional extraction is an expensive method in terms of time and memory [5]. The edge detection methods are sensitive to noise and produce inaccurate results [6]. Level set method is one of the very well-known methods for image segmentation. It is also widely applied for many applications in image segmentation. The level set method has been successfully used in the medical image segmentation. It has several advantages over the methods of snake, region growing and thresholding. However, when the level set method is applied in the noisy images, it cannot work well. The noise in the images often causes the curve of the level set stopped prematurely in the process of evolution curve, resulting in unsatisfactory results. For this reason, this research uses the level set with fuzzy C-means. The fuzzy C-means is used as preprocessing to handle the noise of image for avoiding from the stopping premature of evolution curve in the level set. For this reason, level set and fuzzy C-means methods for image segmentation will be considered in this paper.

In this paper proposes the hybrid of the fuzzy C-means and level set methods for extracting exudates on fundus image. The results of the exudate extraction of the fundus image will provide the information of diabetic retinopathy sign for ophthalmologists in diagnosing diabetic retinopathy disease.

2 Related Works

This section will describe some theory and the previous research related with this research, such as diabetic retinopathy and fundus image, image segmentation, Perona-Malik diffusion filter and level set method.

2.1 Diabetic Retinopathy and Fundus Image

Diabetes mellitus is a chronic disease which is caused by acquired deficiency in production of insulin by the pancreas, or by the ineffectiveness of the insulin produced. It is a characterized by the above normal increased blood sugar levels. Diabetic retinopathy is a micro-vascular complication caused by diabetes that can cause blindness. The first detected abnormality is microaneurism that causes enlargement of retinal capillary enlargement. Broken microaneurism can cause hemorrhage to be seen in Figure 1. (a).

After that it may appear hard exudate as shown in Figure 1. (b). Hard exudate is a leaky lipid formation of weakened blood vessels. Along with the severity of retinopathy disease, the blood vessels may become inhibited causing microinfarct in the retina called soft exudate as shown in Figure 1. (c). The lack of oxygen caused by microinfarct causes the development of new brittle vessels (neovascularization), as shown in Figure 1. (d). This phenomenon can cause a sudden loss of vision. The diagnosis of diabetic retinopathy using fundus image is necessary because the disease is progressive, the example of the fundus image can be seen in Figure 1. (f).

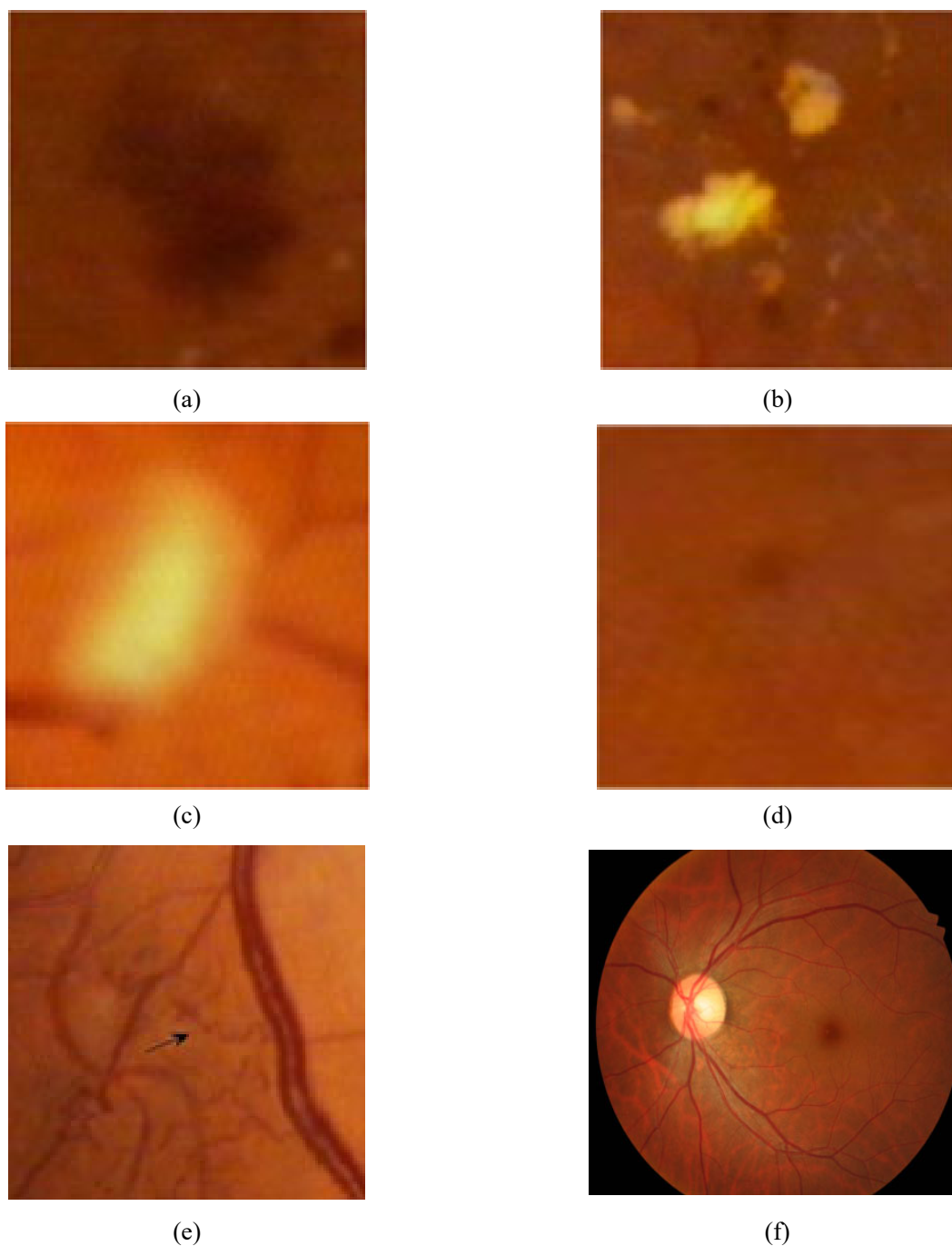


Figure 1. The abnormal findings on the fundus image caused by diabetic retinopathy. (a) Hemorrhage, (b) Hard exudate, (c) Soft exudate, (d) Microaneurim, (e) Neovas-cularization, (f) Fundus image.

2.2 Segmentation

Information technology is very rapid development in many fields. It has been utilized in medical, such as image processing technology. Image processing technology with artificial intelligence and robotics becomes a promising technology in medical. Anam et. al. in [7] proposed a texture analysis and modified level set method for automatic detection of bone boundaries in hand radiographs. The bone boundaries in hand radiograph is needed for segmenting the bone areas and the other areas. Anam et. al. in [8] also proposed a combination of PSO and fuzzy inference for calculation of coronary plaque boundary in IVUS (Intravascular Ultrasound) image. The plaque boundary in IVUS image is necessary to calculate the plaque area. Boundary extraction of an image is one of the image segmentation method

Image segmentation is one of the image preprocessing methods in the classification or identification task. Image segmentation is a stage where the image is divided into homogeneous regions based on criteria of specific similarities

between the gray level of a pixel with the gray level pixel neighbors. There are many the conventional image segmentation methods to such as gradient-based method (sobel, Prewitt, Canny and Laplacian methods) and template-based methods. Mazid in 2013 [9] proposed a image segmentation method for segmenting the tobacco leaves by using Canny method. Canny method has shortcomings can not produce smooth results. Li et al. [10] proposed a segmentation method in 2005 by using the snake method. This method cannot work well when the image has two or more objects.

The other image segmentation method is level set method introduced by Osher and Sethian [11]. It is one of the very well-known methods and also widely applied for many applications in image segmentation. The level set method has been successfully used in the medical image segmentation. However, if the level set method compared with the conventional image segmentation methods has many advantages. The level set method is very robust and accurate for tracking moving interfaces are complex. The level set method has been widely applied in various fields, in particular for the image segmentation [7,8].

2.3. Fuzzy C-Means Algorithm

Clustering is a process of grouping objects based on the objects characteristics, so that all members of each cluster has a certain similarity. The clustering methods can be divided into two categories, i.e. the conventional hard clustering and the fuzzy clustering. The conventional hard clustering method restricts each element of the dataset to exclusively just one cluster. As a result, with this approach the segmentation results are often very crisp, i.e., each pixel of the image belongs to exactly just one class. However, in many real situations, the hard image segmentation is a difficult task because the image often has a limited spatial resolution, overlapping intensities, poor contrast and noise and intensity in homogeneities variation [12].

Due to the fuzzy situation, fuzzy set theory [13] was proposed. It produced the idea of partial membership of belonging described by a membership function. The fuzzy clustering has been widely studied and successfully applied in image segmentation. Among the fuzzy clustering methods, the fuzzy C-means (FCM) algorithm [14] is the most popular method used in image segmentation. It is also one of the best known and the most widely and has been utilized in a wide variety of applications. The FCM algorithm has robust characteristics for ambiguity and can retain much more information than hard segmentation methods [15].

2.3 Level Set Method

Level set method was introduced by Osher and Sethian [11]. It has been widely applied for many applications, especially for detecting the image boundary. The level set method has been successfully used in the medical image segmentation. The contour of level set is represented by the zero level set of a higher dimensional function. It is called a level set function. The contour of level set formulates the motion of the contour based on the evolution of the level set function. The curve evolution of a parametric contour $C(x(s,t), y(s,t))$, is defined by equation (7).

$$\partial C / \partial t = FN \tag{7}$$

t and s denote a set point in time and a curve parameter, respectively. N and F are the inward normal vector to the curve C , and the speed function. The speed function F controls the motion of the contour. The curve evolution of (7) can be converted into a level set formulation by embedding the dynamic contour C as the zero level set of a time dependent level set function $\phi(x, y, t)$. It is assumed that the level set function ϕ gets the positive values outside the zero level contour, and the negative values inside. The inward normal vector can be expressed as equation (8), where ∇

$$N = -\nabla \phi / |\nabla \phi| \tag{8}$$

is a gradient operator.

From equations (7) and (8), the curve evolution in equation (7) is converted to equation (9),

$$\partial\phi/\partial t = F|\nabla\phi| \quad (9)$$

which is referred to as a level set evolution equation. In this paper, we use the level set $\phi(x)$ defined by equation

$$\begin{aligned} \partial\phi/\partial t = & \mu \operatorname{div}(d_p(|\nabla\phi|)\nabla\phi) \\ & + \lambda\delta_\varepsilon(\phi)\operatorname{div}(g\nabla\phi/|\nabla\phi|) + \alpha g\delta_\varepsilon(\phi), \end{aligned} \quad (10)$$

(10), where δ_ε is a dirac delta function, div is a divergence operator, and g is a edge stopping function, which is given by

$$g = 1/(1 + |\nabla(G_\sigma * I)|) \quad (11)$$

equation (11), where G_σ is the Gaussian filter and I is the image to be processed [16].

3 Proposed Method

This paper proposes a method for extracting exudates on fundus image proposes the hybrid of the fuzzy C-means and level set methods. The data used in this research is the fundus images as shown in Figure 2. The flowchart of the proposed method can be seen in Figure 3. In the flow chart, it can be seen that the first step is to input the fundus image. Furthermore, the image in the RGB (Red, Green, Blue) is converted to the CIE L*a*b format. CIE L * a * b has an element L (Luminance), a (range from green to red) and b (range from blue to yellow). Since the reddish-greenish and yellowish-bluish components of the format CIE L*a*b can differ the exudates area and non exudates area, the components are taken for the input of the fuzzy C-means algorithm. Therefore, the image of the fuzzy C-means result is used to input for the level set method. The final step is to extract the exudates in the fundus image by the level set method.

Input : X (matrix $n \times m$), where n is the number of pixels in the fundus image and m is the number of components image (the reddish-greenish and yellowish-bluish components).

$c (\geq 2)$ is the number of cluster. We use $c=2$ because we want to segment into two areas (the exudates area and non exudates area) and $w = 2$ (weighted)

MaxIt (Maximum iteration)

ξ (Termination Criteria)

Output : V (Cluster Center)

U (Partition Matrix)

Step in Fuzzy C-means Algorithm

1. {Initialization}

$t=1$; $\Delta=1$.

2. Generate partition matrix, U^0 .

3. While ($\Delta \geq \xi$ and $t < \text{MaxIt}$) do

4. Calculate cluster center (V) for each cluster by using Equation (12).

$$v_{ij} = \frac{\sum_{k=1}^n (u_{ik})^w x_{kj}}{\sum_{k=1}^n (u_{ik})^w} \quad (12)$$

5. Calculate distance each data to each cluster center (d_{ik}) by using Equation (13).

$$d_{ik} = d(x_{kj}, v_{ij}) = \sqrt{\sum_{j=1}^m (x_{kj} - v_{ij})^2}. \quad (13)$$

6. Update the membership degree for each object on each *cluster* (update partition matrix) by using Equation (14).

$$\mu_{ik} = \left[\sum_{j=1}^c \left(\frac{d_{ik}}{d_{jk}} \right)^{1/(w-1)} \right]^{-1}. \quad (14)$$

7. Calculate objective function by using Equation (4).

$$J_w(U, V; X) = \sum_{k=1}^n \sum_{i=1}^c (\mu_{ik})^w d_{ik}^w, \quad (15)$$

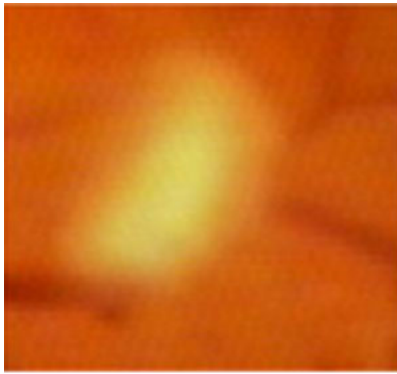
with constrained

$$\sum_{i=1}^c \mu_{ik} = 1, 1 \leq k \leq n.$$

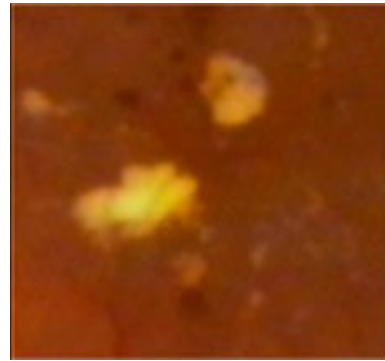
8. Calculate the difference of partition matrix on the current iteration with the previous iteration, by using Equation (16).

$$\Delta = \|U^t - U^{t-1}\|. \quad (16)$$

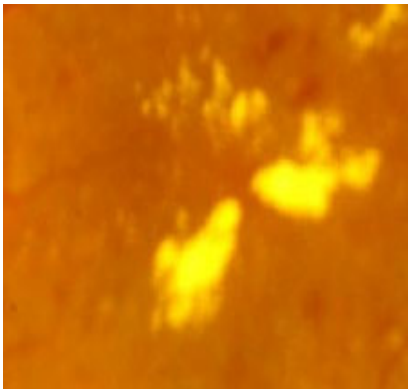
9. $t = t + 1$.



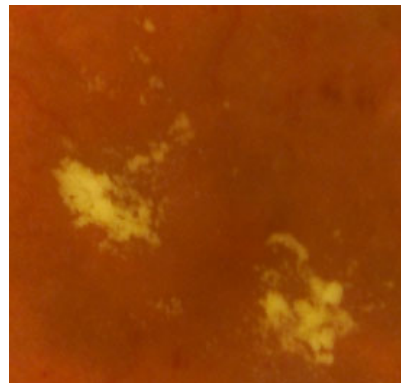
(a)



(b)



(c)



(d)

Figure 2. Fundus image used for the experiment. (a). Test image 1st. (b) Test image 2nd. (c) Test image 3th. (d) Test image 4th.

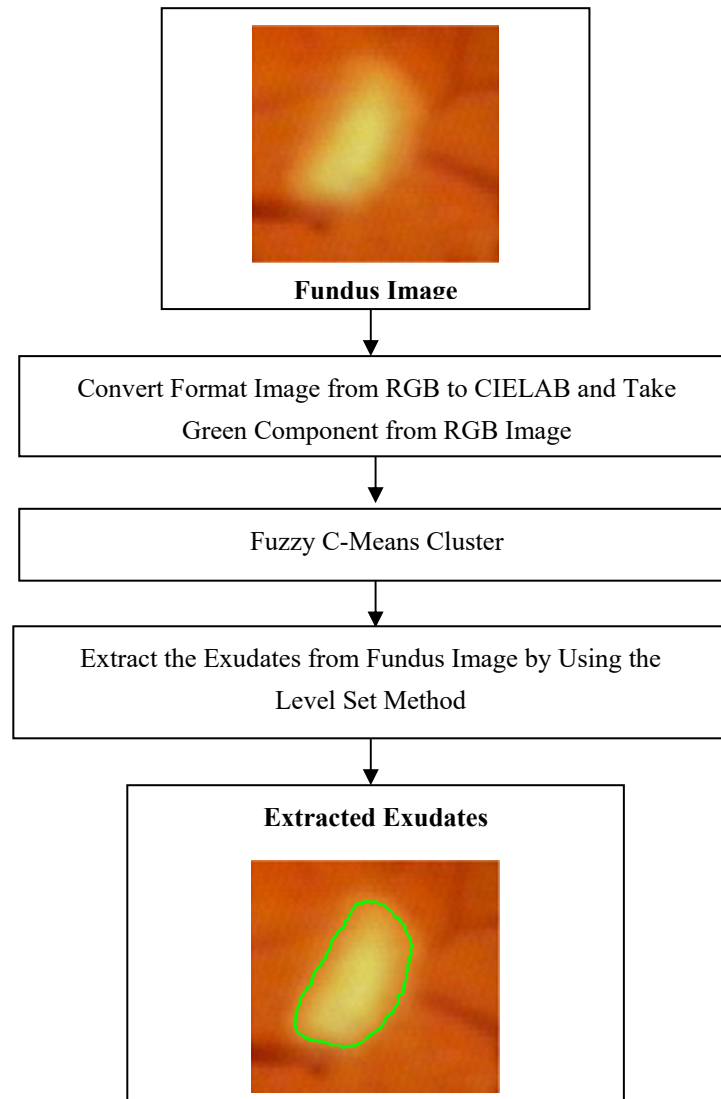


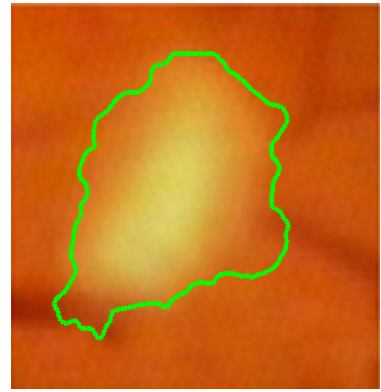
Figure 3. Flowchart of the proposed method

4 Results and Discussion

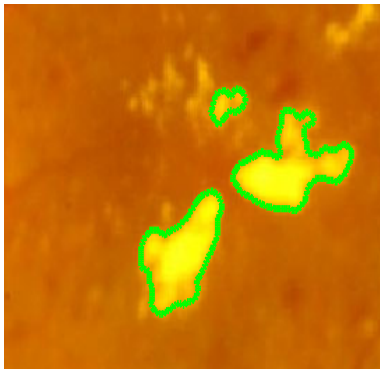
For evaluating the performance of the proposed method, we use the four images of the fundus with the exudates. The various fundus images for evaluating are shown in Figure 2 (a)-(d). The images of Figures 4 (a) - 4(d) show the segmentation results by using the hybrid of the fuzzy C-means and level set methods and the images of Figures 4 (e) - 4(h) show the segmentation results by using the standard level set methods. Figures 3(a)- 3(d) show that the hybrid of the fuzzy C-means and level set methods successfully extract between the exudates areas and non exudates areas for almost all images. However, this method fails to differ the exudates areas and non exudates areas in several area as shown in Figure 4 (b), (c), (d). It is caused by the fuzzy C-means algorithm cannot works well to differ the exudates areas and non exudates areas. Since some exudates areas have similar color intensity with the non exudates areas. To solve this problem, it needs to try other operation to enhance the quality of the fundus image.



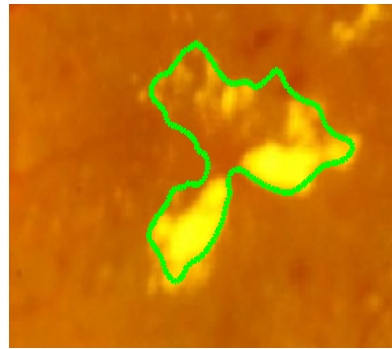
(a)



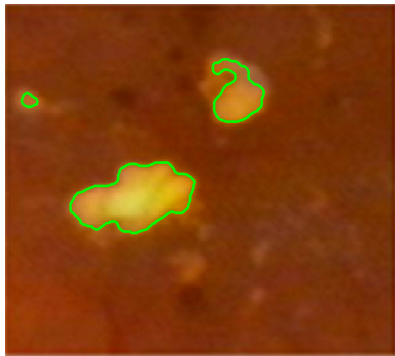
(e)



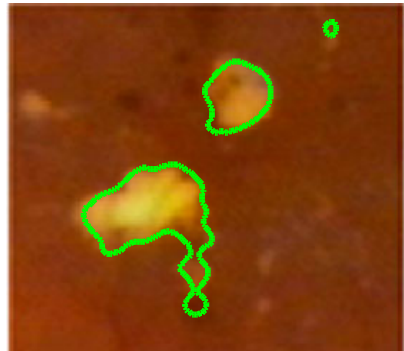
(b)



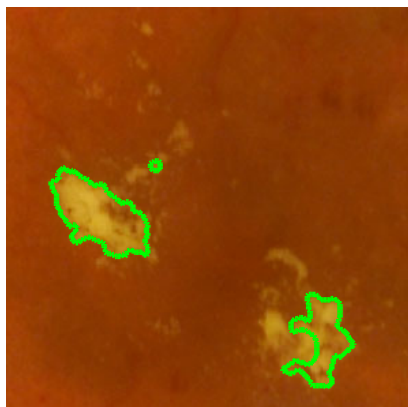
(f)



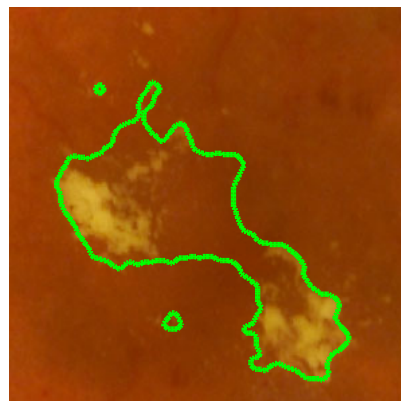
(c)



(g)



(d)



(h)

Figure 4. Exudates extraction results. (a)-(d) Exudates extraction results by the hybrid of the fuzzy C-means and level set methods. (e)-(h) Exudates extraction results by the standard level set method.

5 Conclusion

It can be concluded that the hybrid of the fuzzy C-means and level set methods is able to work better in extracting the exudates on the fundus image than the standard level set method. The hybrid of the fuzzy C-means and level set methods can avoid to the curve of the level set stopped prematurely in the process of evolution for almost all images used.

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Room C
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14 - IDC

ICIM 2018

GARBAGE SORTER

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Abstract In recent years, the problem is that the amount of garbage is increasing. Our garbage affects the whole earth. It also places a burden on waste manufacturers. The purpose of our project is to pick up the waste thrown away in the town, Classifying according to the material, to make a healthier and cleaner environment. Working mechanism of our robot The rhythm is easy. Garbage exists in places where many people gather. Set up this robot here, ruin the road and throw it away Automatically collect waste. Thanks to this robot, we can save the resources on the planet and reduce waste, and the living environment will become healthier and cleaner.

Key words waste management, mixed garbage, recycle garbage, clean environment

1 Introduction

A clean environment is essential for us to live comfortably. In addition, we can protect the environment by reducing waste it is important. However, in places where many people such as parks gather, waste is often not discarded and is often thrown away. This paper addresses on this problem by designing a robot that can collect and classify the waste thrown away on the road which is developed on international design project [1] organized by Malaysia and Japan.

2 Concept Sketch

Figure.1 shows concept sketch of our robot. There are three functions of this robot.

- (1) Search garbage
- (2) Pick up garbage
- (3) Separate garbage

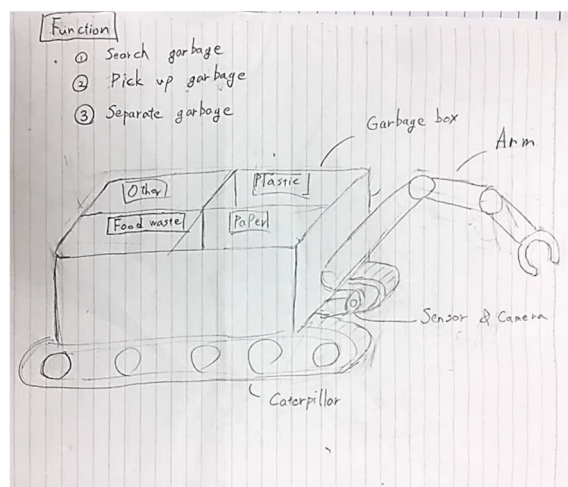


Figure 1. Concept sketch of the Garbage Sorter. Autonomous running device detects and picks up the garbage.




This robot is equipped with Sensor & Camera for detecting waste and Arm for gripping objects. The rear of Arm is equipped

with Garbage Box, which can be divided into four types, Paper, Food waste, Plastic, Other. This robot is equipped with Sensor & Camera for detecting waste and Arm for gripping objects. The rear of Arm is equipped with Garbage Box, which can be divided into four types, Paper, Food waste, Plastic, Other.

3 Competitive Benchmark

Table 1 shows a competitors of this idea. ZenRobotics develops a automatically organizing equipment which is using computer vision technologies. Based on the deep-learning neural network technology and machine learning, the equipment picks recycled materials from moving conveyor belts. Another competitors could be the one equipment developed by Sadako Technologies. Also the device using the AI technologies based on the multi-layered neural network system, identifies variety of food and beverage. Compare with these commercial products, this paper's idea have a function to pick and sort the materials by arm picking based on self-moving technology and material sensor.

Table 1 Competitive Benchmark

	Our Prototype	ZenRobotics	Sadako Technologies
Product			
components	Distance sensor, material sensor	computer vision, machine learning, artificial intelligence (AI), neural network	multi-layer neural network system, AI-infused
function	Arm to sort and pick caterpillar for movement	run synchronized robotic arms to sort and pick recycled materials from moving conveyor belts	identify variety of food and beverage can grab and separate them from the rest of recycling

4 Conclusion

We solved the waste disposal problem where various problems arise due to the waste being thrown away We proposed a robot. By using GARBAGE SORTER proposed by us we can expect the following improvements: 1. Helps classify garbage into the correct boxes 2. Improve waste management 3. Do all the waste generated.4. Reduce final disposal costs of waste 5. Can create a healthier and cleaner environment 5. Can increase recycling waste instead of mixed waste.

References

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Robot for Progressive and Comprehensive Childcare Support

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Abstract Mothers who are busy with housework or babysitter cannot always look after the baby. As a result, the baby may mess up the room or get dirty. Sometimes a serious accident occurs. The purpose of our project is to build a robot that watches the baby instead of busy mothers and at the same time secures home safety. This robot has four main functions. First, the robot always monitors the baby with a camera or sensor. Second, if the robot detects obstacles and walls, avoid it. Third, the robot cleans up small objects and garbage in the room and prevents accidents caused by baby's mistake. Fourth, when there is abnormality around the baby or the baby itself, the robot notifies the danger by using sounds and incoming calls. As a future prospect, we aim to increase variations by making robots for higher age groups, and to enrich the functions suited to the baby's habits.

Key Words robot, safety, babysitter

1. Introduction

Babies are very lovely beings and extremely weak creatures. Children develop in many ways at the same time. Different aspects of children's development are never at rest or waiting for other parts to catch up. Instead, development is simultaneous. While physical growth and maturity are the most obvious signs that development is occurring, children also develop cognitively (mentally), socially, emotionally, and sexually. Babies always need protection of mothers and babysitters, but cases where babies are killed or wounded irrespective of their intention or negligence will not fail. Referring to the report of **Child Abuse and Neglect Fatalities 2016: Statistics and Interventions, Children Bureau (July 2018)**, it can be seen from Figure 1 that babies from less than 1 year old to 3 years old occupy more than 70% of children's casualties due to abuse and neglect.

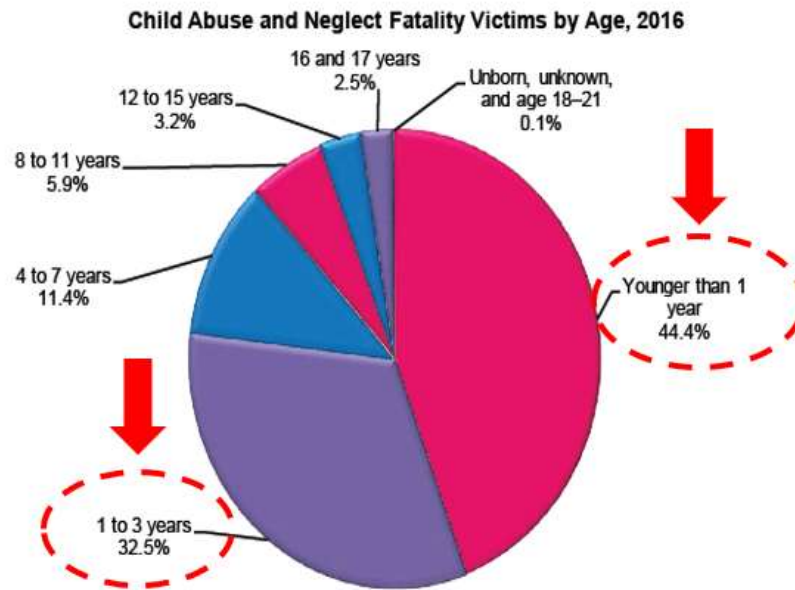


Figure 1: Child Abuse and Neglect Fatality Victims by Age, 2016[1]

Next, Figure 2 shows the Child Abuse and Neglect Fatalities by Reported Maltreatment Type, 2016 which Neglect factor contributed to 74.6% of the casualties, injuries and death among children.

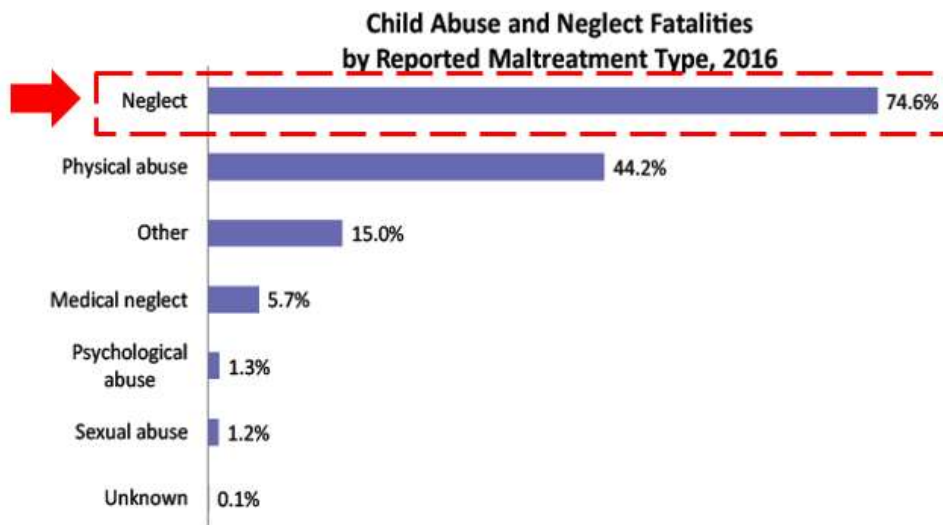


Figure 2: Child Abuse and Neglect Fatalities by Reported Maltreatment Type, 2016 [1]

Fatal child abuse may involve repeated abuse over a period, or it may involve a single, impulsive incident (e.g., drowning, suffocating, shaking a baby). In cases of fatal neglect, the child's death does not result from anything the caregiver does; rather, it results from a caregiver's failure to act. The neglect may be chronic (e.g., extended malnourishment) or acute (e.g., an infant who drowns after being left unsupervised in the bathtub). These two factors which are children below 3 years old and neglect is very important to be considered in this paper. The number of casualties can be reduced by reducing the number of neglect issues among children below 3 years old.

While some are still in their own world, this is serious concern to be overcome especially for developed countries and developing countries. This is because, in average a family will have one to two children for developed countries and three to four child per family for developing countries. The rate of birth is decreasing by year and when combined with the issues of babies' fatalities will make the number of baby survivor's smaller than ever. From Data Bank [3], only 25% population ages of 0-14 years old available to this date compared to age 15-64 by 65.36% and the least followed by senior citizen. The number of births is decreasing by year as people aim for advancement in their life and it makes life even more precious.

Therefore, this paper aims to propose a robot that protect , oversee and accompany babies especially from fall and accidental injuries as well as complement the role of mothers and babysitters.

This project is developed in International Design Project [2] organized by Malaysia and Japan.

2. Purpose

From building cars to assisting in high-precision surgeries, robots today are taking on more complex roles than ever before and getting smarter and more sophisticated every day. With recent advances in programming algorithms and artificial intelligence, the possibility of robots moving from the factory floor into our homes and even looking after our children is a fast-approaching reality. Think Rosie, the space-age robot maid and nanny to "The Jetsons."

Some of these robots are already being developed. Consider Pepper, a 4-foot-tall interactive robot able to recognize human emotional states by analyzing voice tone, facial expressions, and other non-verbal cues. Or Jibo, an 11-inch-tall personal assistant, storyteller, and communication device being marketed as the first "family robot."

The purpose of the project is to support the baby's development and the comfortable life in the home by protecting the baby's safety in the home and acting as an aid or substitute for mothers, babysitters and nursery. It will not replaced nanny or mother but as a social robot. It is important for current generation to be aware of this issue regarding to the death by neglect of baby. This is because, it will act as an eye opener and creating awareness for people to improve the situation especially for developed countries. Few characteristics of the robots are to be highlighted such as Find and Follow Baby, Wall and Obstacle Avoidance, Hole and Stairs Prevention, Object Discovery and Pickup, Child Friendly, Alarm System, Easy User Interface and Mobile Device.

Find and Follow Baby is important as the robot need to be able to identify the target(baby) and follow the baby's movement. For this project, baby will be equipped with a tag/ bracelet for identification by the robot plus they can keep children entertained by playing games.

Wall and Obstacles Avoidance can not be neglected to ensure the robot work effectively. It is essential for the robot to avoid and obstacles especially walls and things that easily found in a house such as chair.

Hole and Stairs Prevention is one of the features embedded in the robot. When the robot detects any plausible stairs or hole, the robot will take charge to protect the baby from the danger by blocking baby pathway. At the same time, robot will notify the parent or caretaker using **alarm system** as well as alarm provided through baby monitor application. This will help user to be able to do other chores and no need to worry about baby safety.

Object Discovery and Pick Up is a special feature added to the robot. Area that full of small toys will make the robot's movement inconvenient. In addition, the baby will open to more risks either by choke or eating small object which is very harmful to themselves. Therefore, robot is designed with pick up arm and storage system to collect and store the objects.

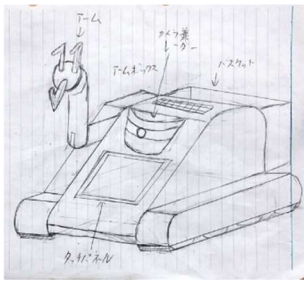
Child Friendly is robot's distinguished creation. This is important as the robot also design in such a way not to frighten the baby, alarming the baby in a dangerous way.

Easy User Interface is necessary because the interface allows the user to control the robot for effective operation and obtain feedback from the robot. Graphical user interfaces allow users to interact with electronic devices through graphical icons and visual indicators as opposed to text-based indicators.

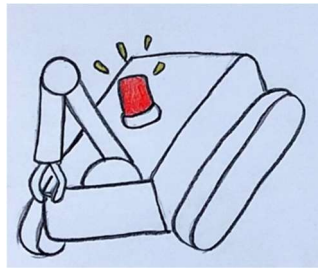
Mobile Device is a must attribute of the robot. Robot must be mobile so that it can follow the baby whenever and wherever baby goes. It is built to move across stairs without issues.

3. Concept Sketch

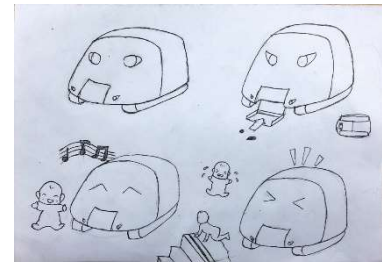
Figure.3 shows concept sketches with robot's body.



Sketch 1



Sketch 2



Sketch 3

Figure.3 Concept sketches

Considering the outline of the robot and the functionality of the robot arm, Sketch 3 is chosen due to its mobility, child friendly and functionality.

4. Prototype

The prototype robot has four functions. The first one is the ability to follow babies. The robot moves parallel and in fixed distance with the baby by implementation of the infrared distance sensor at the horizontal direction. The second is the obstacle avoidance function. If the front touch sensor detects obstacles and walls, the robot will move to avoid the obstacles or walls. The third is the baby's fall prevention function. The robot will turn its direction to block the path of baby when the distance sensor detects staircase either upwards or downwards direction. At the same time, the alarm system will be activated, and mother/caretaker will be notified.. The fourth is the cleaning function. Detection small garbage etc. with a sensor attached downward and take it to the bottom of the car body. This robot function's is always in active position unless it's being switched off. Robot's prototype can be seen at Figure 4.

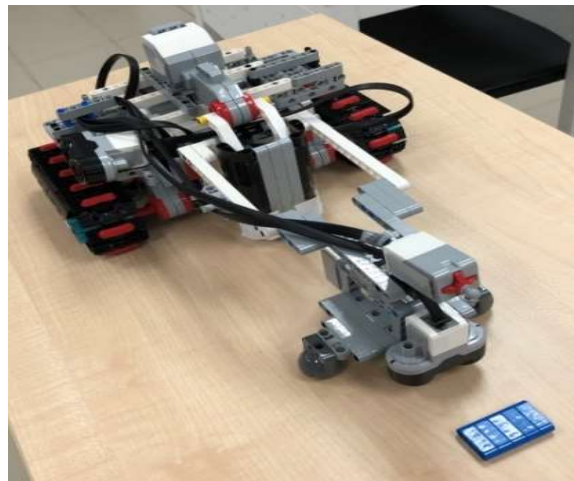


Figure.4 Prototype robot

5. Future Works

Research about baby's behaviour will helped in contributing to the robot's Artificial Intelligence. Further research should be made to increase the safety of both robot and baby. It is expected in the future to expand and develop the robot according to age group.

6. Conclusion

This robot has the potential to reduce problems associated with child rearing. If we can provide robots not only as a single product but also as a service with the cooperation of IT and administrative organizations, we will be able to make childcare system better.

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<https://www.childwelfare.gov/pubPDFs/fatality.pdf>

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<https://data.worldbank.org/indicator/SP.POP.0014.TO.ZS?contextual=population-by-age&end=2017&start=2017&view=bar>

The Money Counting & Separating Machine

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Abstract There are a lot of money all over the world. Although, there are various different types of coins and banknotes in each country, the money is hard to be organized. Hence we need to develop a machine for organizing money to save time. This paper proposes a robot which is based on a color sensor with five motors. It detects and differentiate the banknotes by color sensor. The motor will moves and carry the money to its specific space. This is how this robot organize the banknotes.

Key words money differentiation, color sensor, motor, handsticks.

1 Introduction

There are various kinds of coins and banknotes which is used in each country of all over the world. Therefore, it is difficult to count the amount of the money. Also, the money is not in orderly arrangement and time is wasted on counting money. This paper addresses an automatic counting machine by inputting various kinds of banknotes. This project is developed in International Design Project [1] organized by Malaysia and Japan.

2 Story

As there are a lot of money all over the world, it is very difficult to detect and differentiate the various kinds of banknotes especially for frequent traveler, money changer and shops. How many kinds of banknotes are used in all over the world? Tus, we want machine for organizing money. It can be used in various places. For example, home, convenience store shop.

3 Concept Sketches

Figure.1, shows concept sketch. This robot's user put into each money in the machine. Then, This robot divides each money automatically and displays the total amount money. Accordingly, we adopted the Sketch 2.



Sketch1



Sketch2



Sketch3

Figure.1 Concept Sketches

4 Prototype

Figure.2 shows the prototype robot. This robot consists of color sensor, 5 motors and 3 handsticks. Also, this robot has 3 boxes with counting mechanism. At first, the money puts into this robot. Then, this robot's motor moves. This robot determines the money by color sensor and carries the money in front of each boxes. Next, another motor moves and rotate handsticks. Then, Handsticks hit the money and put into boxes. Also, handsticks hit the gear and count the money.

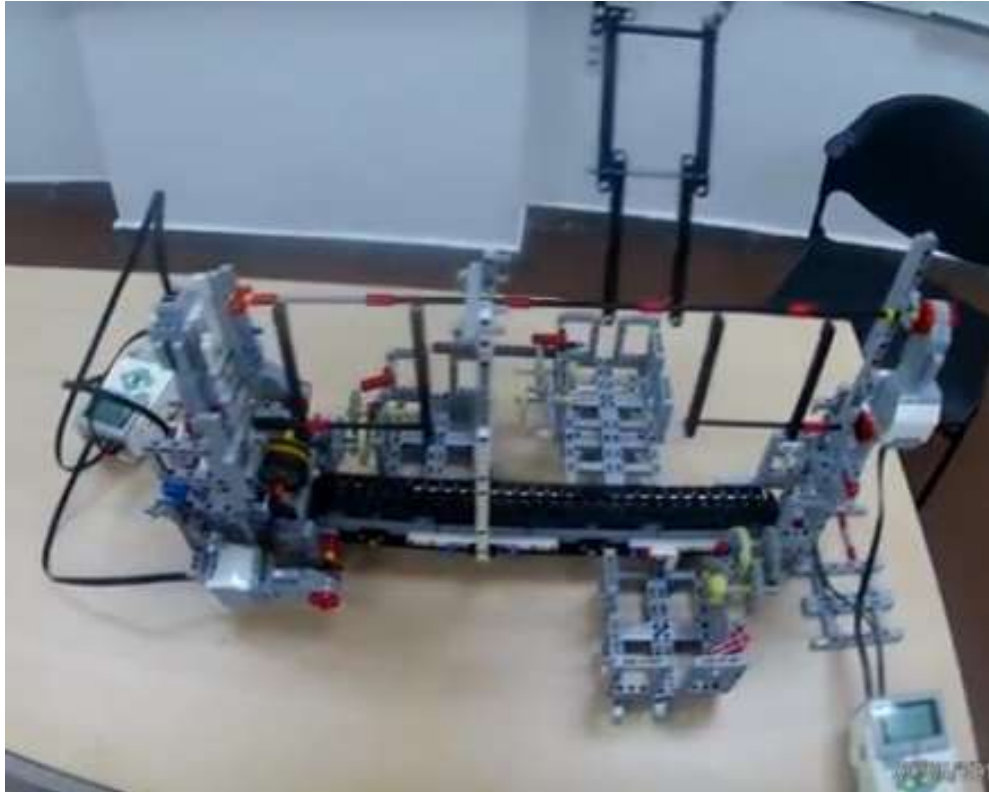


Figure.2 Prototype

5 Conclusion

This product is needed in society especially in business scope. There are still flaw on this machine that can be improved in the future such as entry section area. If false money put into this robot, it cannot be determined. Also, when it used in the store, the change doesn't come back. In a nutshell, this machine has a lot of rooms for improvement.

References

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4. Prototype

Our robot can pass between the tables placed at regular intervals and collect object like tray, dish or trash in box attached to the robot by using sensor.

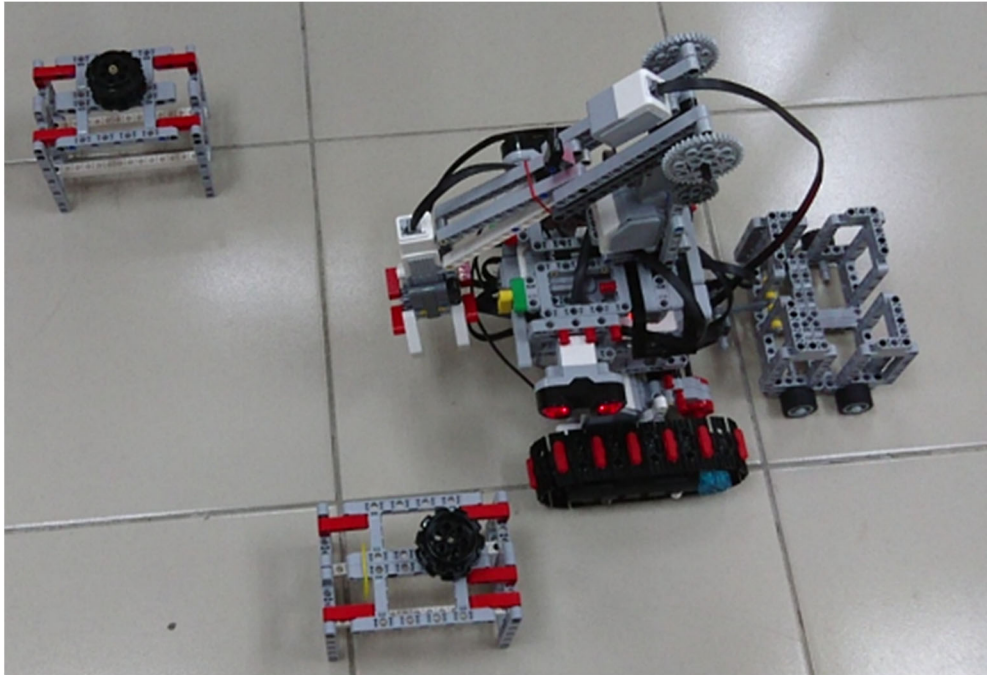


Figure. 2. Prototype and description

5. Conclusion

The robot which can clean over tables automatically after a meal can't only improve the rotation rate of shop but remove the stress of customer use the table next.

Furthermore, as you can see sketch, if the robot has a function of separating objects (tray, dishes, trash and so on), we can assume that efficiency of taking out the garbage or recycling dishes become higher. Although we need to discuss its cost and to take measured for the robot's keeping out of everyone's way, if it is realized, it will be beneficial for both shops and customers.

6. Acknowledgement

This work is supported by Malaysia-Japan International Institute of Technology (MJIT) of Universiti Teknologi Malaysia and Yamaguchi University, Japan.

References

- [1] Takamasa OKATE, Tsuyoshi KOGA and Ken KAMINISHI, Prototyping of automatic tracking luggage carrier in Asia Creative Design Project [C], Proceedings of the Design and Systems Division conference of Japan Society of Mechanical Engineers, 2013.23(0), 2507-1 - 2507-10, Okinawa, Japan.

Smart Table Cleaner

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Abstract At the place has large space as food court, in Japan, there is a habit of returning the tray after having a meal, but all countries are not always the case. In the case of Malaysia, clerks collect trays left by customers just like general restaurants. However, the so large space is needed because there are many shops, so they often don't have enough time to collect trays. As the result, next customer can't use tables and seats turnover rate gets low, therefore, that may influence on benefit of shop. The purpose of our project is to support clerks to collect trays and to improve the rotation rate of shop in food court.

Key words collecting trays, food court, automatically

1. Introduction

At crowded food court, rotation rate of the table is one of the important indicators for shops. But there is a risk that rotation rate become low because anyone cannot use the table after someone finished meal immediately if the dishes are not collected. In Malaysia, employees constantly patrolled in own space and collect the dishes left by customers. However, this method of collecting all dishes left by them has a limitation. As the solution which does not worse the rotation rate of the table, we suggest producing the robot which has functions of collecting dishes automatically after our meal and going to tables if we call it by pushing a button. This project is developed in international design project [1] organized by Malaysia and Japan.

2. Purpose/Background

The purpose of our project is to improve the seat turnover rate by cleaning tables automatically and making a used table available quickly. (For example, at the crowded food court without return space which there is in a big shopping mall and highway's rest area)

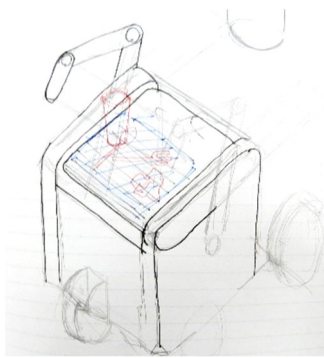
3. Concept Sketch

Figure.1 shows concept sketch.

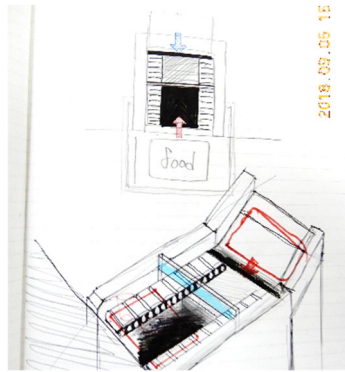
4. Prototype

This robot moves along the guide line written on the floor. When it comes in front of the table, robot will adjust the angle of the car body so that it is plumb to the table. Then, robot will extend its arm to the table and will catch the dishes. The robot caught dishes will move to the original position or drop-off point.

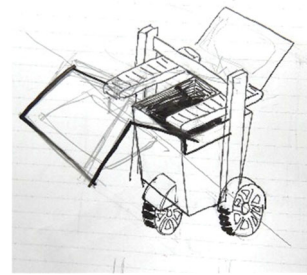
Figure 2 shows the prototype and description.



Sketch 1



Sketch 2



Sketch 3

Figure.1 Concept Sketch

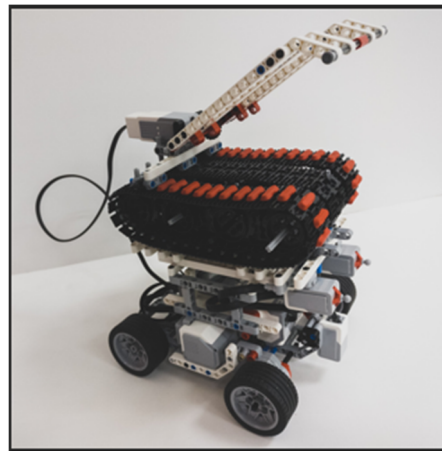


Figure.2 . Prototype and description

5. Conclusion

There has been the robot to collect trays automatically. In Japan, there is a habit of returning the tray after having a meal, however that has disadvantage in that the washing space has to be in the front side of the shops. This carrying system by the robot will enable to place washing space to far side of shop and keep the appearance of the shop clean because there is no chance seen by customer's eyes directly. We are sure that even if it takes much cost to build this robot, shops will get higher benefit than its cost.

6. Acknowledgement

This work is supported by Malaysia-Japan International Institute of Technology (MJIIT) of Universiti Teknologi Malaysia and Yamaguchi University, Japan.

References

- [1] Takamasa OKATE, Tsuyoshi KOGA and Ken KAMINISHI, Prototyping of automatic tracking luggage carrier in Asia Creative Design Project [C], Proceedings of the Design and Systems Division conference of Japan Society of Mechanical Engineers, 2013.23(0), 2507-1 - 2507-10, Okinawa, Japan.

Automatic sorting machine for shopping counter

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Abstract Have you ever been kept waiting for checkout at the cash register when you go shopping? Although it is pleasant that a store clerk puts the product in a plastic bag, considering the burden of the clerk and the waiting time of the customer, it is considered beneficial to substitute the way to put it in the plastic bag by another means. We propose a machine which can automatically pack items into plastic bags. It is a machine that identifies goods with sensors and puts goods such as raw and other items in separate bags. If you introduce this machine to a store, you can reduce the burden on clerks and reduce waiting time for customers. As a result it leads to time savings, which can also be effective in improving the sales of stores.

Key Words shopping, time saving, safety

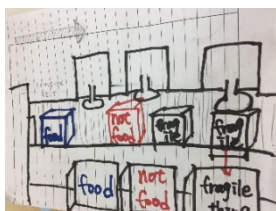
1. Introduction

The cashier staff need to sort all the items before put it in the plastic bag. Because of that, customers need to wait for bagging time, and clerks need more work to do. If we can eliminate the time to pack items in plastic bags, we will be able to bring profits for both store clerks and customers.

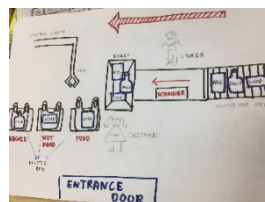
2. Purpose

The purpose of the project is to reduce the burden on store clerks and waiting time for customers at supermarkets and convenience stores. It would also be useful for housewives to separate garbage from garbage and recyclable refuse at home. This project is developed in international design project [1] organized by Malaysia and Japan.

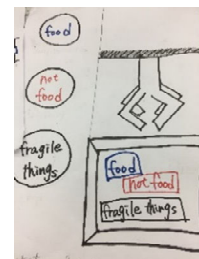
3. Concept Sketch



Sketch 1



Sketch 2



Sketch 3

Figure.1 Concept sketches

Figure.1 shows concept sketch.

As a result of considering product safety and cost, we adopted Sketch 3. Based on sketch 3, we considered the rough shape of the robot. This machine has three functions. First, This machine will sort the item after cashier scan the barcode. Second, It selects one of the item. Third, It classifies items depend on the type of the items which is food, not food and fragile things. Figure.2 shows the finalize sketch.

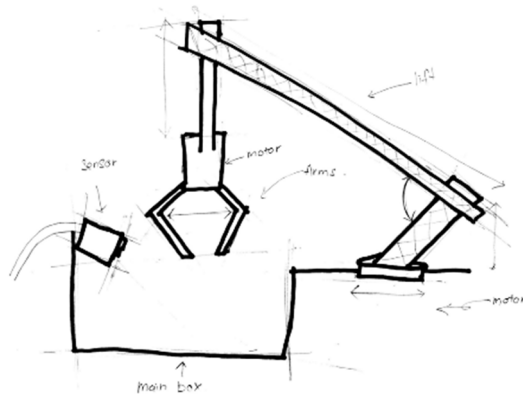


Figure.2 Finalized sketch

4. Prototype

If the sensor detect red color, the arm will rotate for 0.6 sec if yellow, 0.4 sec and blue ,0.9 sec. After the arm has grab the product, it stops for a certain degree, after the rotation, and it stop above the categorized box, it falls slowly and carefully so the customer's goods not break. The arm releases the goods slowly and then rise up to a certain degree. The arm rotates back at the center box. Figure.3 shows the porotype.

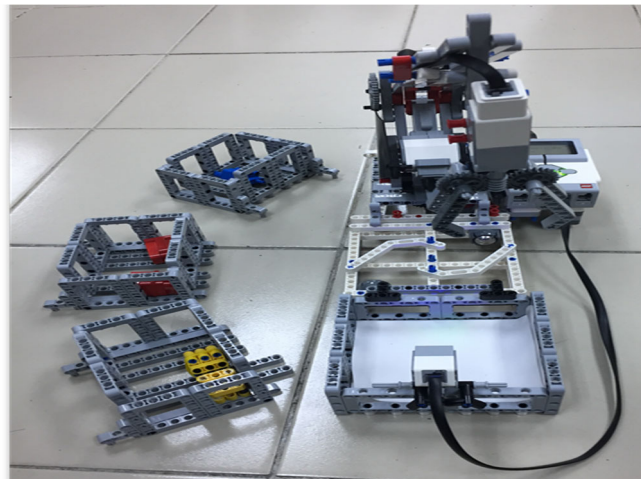


Figure.3 Prototype

5. Conclusion

The customer at supermarket do not have to wait for a long time at counter to pay their items. Cashier has less time to serve each customer. Then, the lines to queue will not be long.

References

- [1] Takamasa OKATE, Tsuyoshi KOGA and Ken KAMINISHI, Prototyping of automatic tracking luggage carrier in Asia Creative Design Project [C], Proceedings of the Design and Systems Division conference of Japan Society of Mechanical Engineers, 2013.23(0), 2507-1 - 2507-10, Okinawa, Japan.

PARKING ASSISTANCE

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Abstract

Malaysia and other countries have difficulty finding parking lots easily. So I used space efficiently on the street and thought of parking that could park. When placing the car in a predetermined position, it automatically rotates 90 degrees, put on a conveyor in a state perpendicular to the roadway, parallel translate the car to a suitable distance with a distance sensor, and park the car in a narrower space than the parallel parking. I park a car perpendicular to the roadway so I can leave without worrying about the next car. There is also a merit that it can be made cheaper than a multi-level parking lot seen in Japan.

Key words : Parking, Save time, rotate

1 Introduction

The first thing you need to think about when you go shopping with a car is parking. But in countries such as Malaysia, I have trouble finding parking spaces. I think that there is a way to easily secure a parking space and propose the following parking assistance.

2 Purpose

We propose parking assistance with the purpose of reducing the time to look for parking spaces and utilizing space more efficiently than parallel parking and parking easy to get out. This project is developed in international design project [1] organized by Malaysia and Japan.

3 Concept Sketches

Figure 1 and 2 shows a concept sketches which explain a working principles and final pictures after installation.

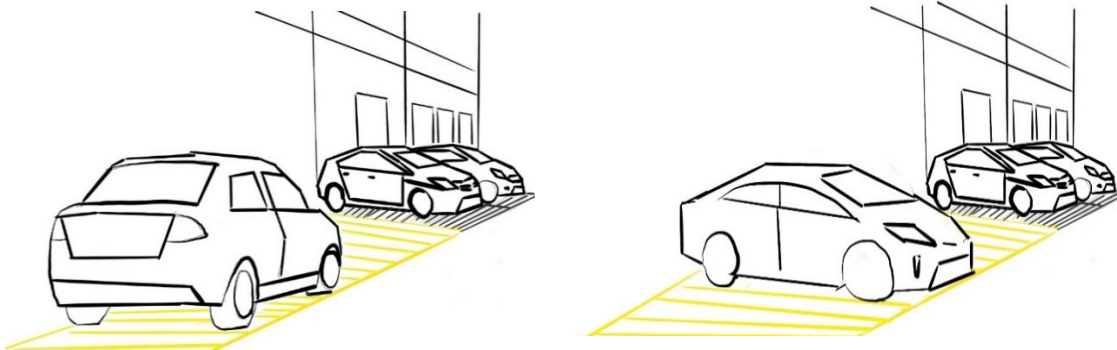


Figure 1 Concept Sketches of Completed Image

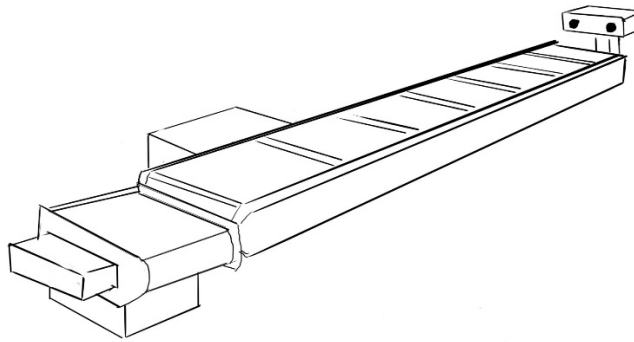
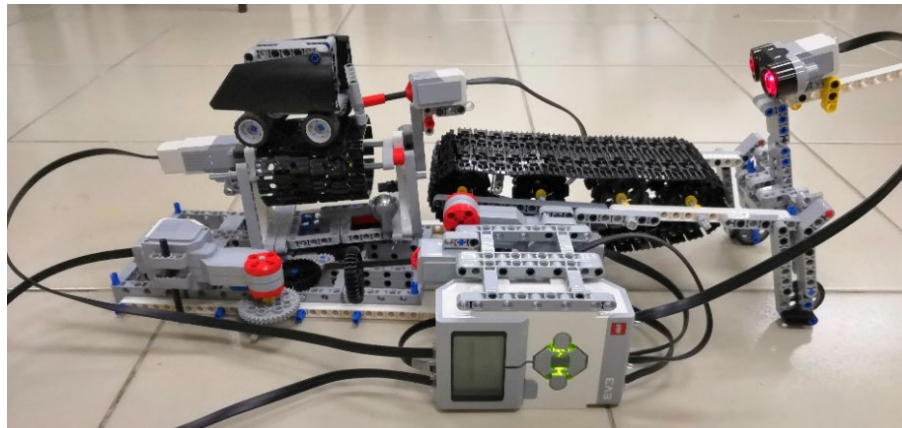


Figure 2 Prototype sketch

4 Prototype

The function of the parking assisting system is developed by a working prototype shown in the figure 3. The main functions of the prototype are shown as follows:

- 1st car will enter the designated area which is at the rotating platform.
- 2nd the touch sensor which is the camera detect the presence of car.
- 3rd the platform rotated.
- 4th the conveyor belt start moving.
- 5th the car was sent to the parking space.
- 6th the infrared sensor detect the presence of car at the parking space.
- The conveyor belt stop moving.



● **Figure 3 Working prototype of the function of the parking assistance system**

5 Conclusion

After implement the parking assistance, people no longer take time to search for parking space, they can leave their car at the designated area and let the parking assistance to do their work. By using this system it is possible to park more than 10 cars if there are 5 parking spaces in parallel parking.

References

- [1] Takamasa OKATE, Tsuyoshi KOGA and Ken KAMINISHI, Prototyping of automatic tracking luggage carrier in Asia Creative Design Project [C], Proceedings of the Design and Systems Division conference of Japan Society of Mechanical Engineers, 2013.23(0), 2507-1 - 2507-10, Okinawa, Japan.