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Risk Communication Framework towards High-Performance Food Supply Chain

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Abstract

The rapid growth in world population implies that a high-performance food supply chain need to be developed to avoid food crises. Past research were conducted to investigate various strategies to increase supply chain performance but studies on risk communication are scant. Therefore, this research aims to develop a risk communication framework for high performance food supply chain by exploring best practices in risk communication among food supply chain members and its influence on supply chain performance. A qualitative methodology where semi-structured interview and observation will be conducted among food supply chain members in Perak. The sample will be selected based on purposive sampling technique and the data will be analyzed by using thematic analysis. The proposed risk communication framework for food supply chain will be validated by participants of the research to established research credibility.

Keywords: Risk Communication Framework, Supply Chain Management, Risk Management, Food Supply Chain, Dual Process Theory

Introduction

World population has reached 7.5 billion (World Bank Group, 2019) and five Asian countries namely China, India, Indonesia, Pakistan and Bangladesh are among the top ten countries with the largest population (US Census Bureau, 2019). The rapid growth in world population means that a high-performance food supply chain particularly in Asia need to be developed to avoid food crises. Earlier in 1973, 1974, 1980 and 2008, food crises occurred due to several supply and demand factors such as global abnormal climate and the increase in production cost caused by the oil shocks as well as some political factors (Lee, Lee, & Lee, 2012). In transportation context, the availability of trucks and drivers, network structures, loading practice, maintenance for transportation units, good communication between supplier, and

transporter and receiver posed challenges in sustaining food supply chain(Sharma, Mangla, & Patil, 2019). It is found that 20-30% of food waste occurred in the post-harvest phase in developing countries (Krishnan, Agarwal, Bajada, & Arshinder, 2020). Other researches explained various sources of uncertainty in food supply chain as depicted in Table 1. As a consequence, numerous developing nations have to import food with scarce foreign exchanges or ask for donations to cope with food shortage (Zhou, 2008).

Table 1.
Uncertainty Sources in Food Supply Chain

Sources	Description
Supply	Weather, plagues, natural disasters, diseases, seed quality, effects of fertilizers, ripening pace, agricultural machinery breakdowns, inherent uncertainty
Process	Machine breakdowns, scrap rate, inherent uncertainty
Demand	Changes in trade agreements between countries or regions, customer demand, competitors influence, inherent uncertainty
Planning and control	Input data available for a decision
Administrative and decision processes	Waste rare, strikes, illness of staff, product quality decay influences shelf life, product loss at transport/distribution stage because of accidents, delivery time overdue because of traffic congestion or vehicle breakdown, changes in laws and regulations, new descriptions or technological/biological advances

Source: (Ortiz, Alarcón, Pérez, & Alemany, 2019)

In order to improve the performance of food supply chain, many researchers investigated various strategies that influenced it. For example, long-term partnership with a small number of suppliers has been suggested to increase economies of scale, on-time delivery and inventory minimization (Dinu, 2016). Meanwhile, supply chain coordination which is the cooperation, integration and collaboration between actors in a supply chain was also investigated to improve food supply chain performance (Handayati, Simatupang, & Perdana, 2015). From the management perspective, strategic leadership practices applied by chain coordinator was found to improve food supply chain performance (Akhtar, Kaur, & Punjaisri, 2017). More recent investigation was focusing on performing horizontal logistics collaboration to improve the performance of food supply chain management (Badraoui, Van der Vorst, & Boulaksil, 2019). The case studies revealed that information sharing specifically pertaining to sales, projected demand, inventory levels and shelf life, and promotional activities influence supply chain performance in terms of cost, quality of service and responsiveness (Badraoui, et al., 2019).

Analyzing past studies, it became apparent that all strategies implemented to improve supply chain performance including long-term partnership (Dinu, 2016), supply chain coordination (Handayati, et al., 2015), strategic leadership (Akhtar, et al., 2017) and logistics collaboration (Badraoui, et al., 2019) are leading to a common goal which is better

communication among supply chain partners. Nevertheless, none of these researches have actually studied in detail about communicating and sharing information about risks between supply chain partners. Many earlier studies were restricted to demand information sharing (Labaran, Hird, & Whitfield, 2018). Therefore this study aims to investigate this matter, particularly to propose a risk communication framework in food supply chain to improve supply chain performance.

Literature Review

Food Supply Chain

Numerous research has been conducted on regards to food supply chain. Agricultural sector was placed among the top three income generator in Malaysia, thus strategies were implemented to increase food production such as by opening new agricultural land and introducing modern agricultural techniques (Zainol, Abas, & Ariffin, 2016). Arshad (2016), further described the changing structure of food supply chain in Malaysia (refer Figure 2) which was due to the emergence of store-based retailers who demand quality agri-food from farmers in Malaysia including the majority small farmers. Without much capitals, the small farmers are lined up along with the commercial farmers to comply with high agri-food quality standards that among others require efficient distribution and progressive storage, cold rooms, transportation and warehouse (Arshad, 2016).

However, findings revealed that poor technology in Malaysia affected warehouse utilization and current warehouse layout did not optimize space for inventory storage (Karim, Rahman, & Shah, 2018). Specifically, only 59.83% of the surface in the warehouse was allocated to the storing of goods (Karim, et al., 2018). In addition, the logistics industry in Malaysia showed a decline, which was expected from insufficient technological improvement and lack of innovation (Wong, Soh, & Goh, 2016).

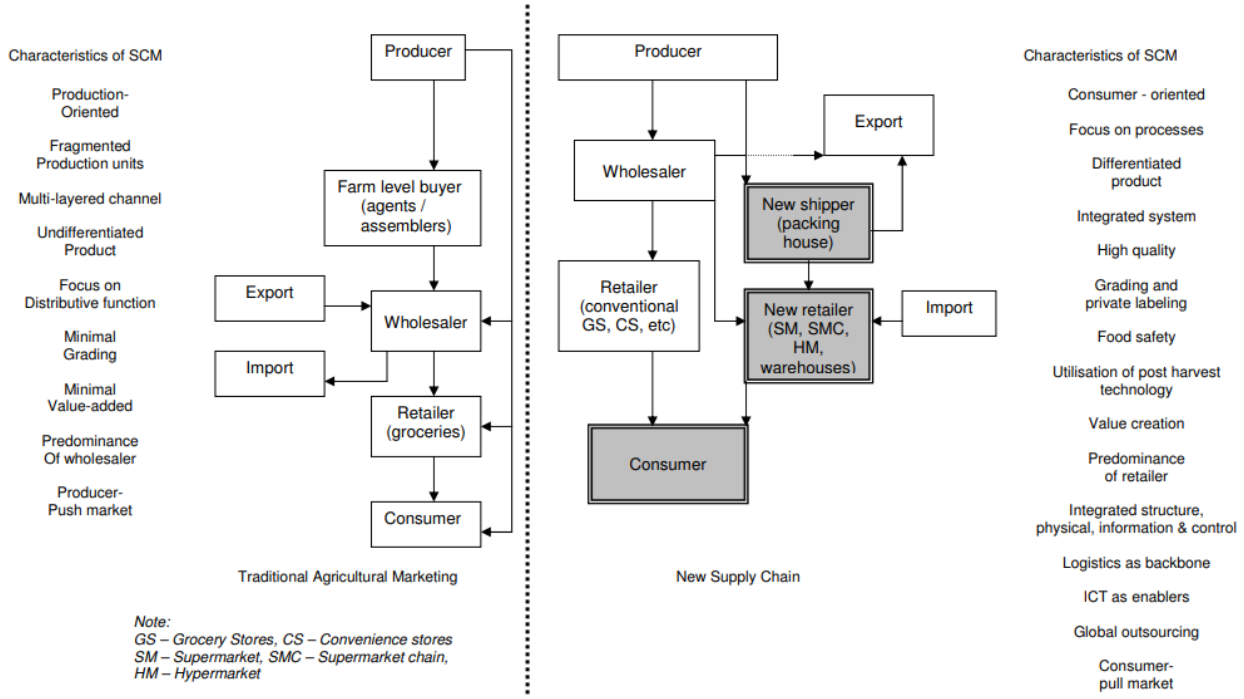

Figure 2. Comparison of traditional and new food supply chain in Malaysia (Arshad, 2016)

Food industry also has its unique characteristic that require better supply chain management. In particular, the perishable nature of food products magnifies the importance of efficient supply chain(Radzi, Saidon, & Ab Ghani, 2015). Climate change further challenges food supply chain in Malaysia. Global warming floods, droughts, increase in temperatures, changes in rainfall patterns and a rise in sea levels reduce food production (Ariffin, Abas, & Baluch, 2015). In 2014, big flood occurred in the East Cost of Peninsular Malaysia and damaging crops (Baqutayan, Mohamad, Azman, & Hassan, 2017). Recent evidence showed the emergence of resistant bacterial strains in South East Asia food supply chain (Thapa, Shrestha, & Anal, 2020) and Vibrio parahaemolyticus risks (Love et al., 2019).

Supply chain performance has been measured in terms of supply chain resilience and supply chain disruption (Labaran, et al., 2018). It means that the ability of a supply chain to return to a stable condition after a disruption occurred symbolized the performance of a supply chain. However, supply chain resilience can only be developed by a systematic risk management and effective risk communication among supply chain members. If risk information is properly shared with supply chain members, risks in regards to poor quality, increased price, late delivery, damage reputation and cold chain which refers to the freshness of food from production until it reaches customers, should be able theoretically to be minimized (Yong Wang, Zhang, Lu, Semere, & Du, 2019). In parallel, flexibility, agility, customer service, delivery times, quality, financial performance, inventory and transportation were explained as the main attributes of supply chain performance (Avelar-Sosa, García-Alcaraz, & Maldonado-Macias, 2019).

Risk Communication

Risk communication has been studied in multidisciplinary fields including supply chain risk management (SCRM). Through a seminal work undertaken by National Research Council (1989), a formalized definition of risk communication was developed as follows.

> *"Risk communication is an iterative process of exchange of information and opinion among individuals, groups and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management."*
>
> (National Research Council, 1989: 21)

It also involves making available to supply chain partners the current status of the inventory level, faulty materials, market volatility, transportation delay, limitations in production and purchases, and labor disputes (Kim, Youn, & Roh, 2011). With appropriate risk communication which covers discussions about the nature and level of risks as well as risk management strategies, knowledge about risks issues and collaborative decision making can be increased (Dethridge & Quinn, 2016; Zsidisin & Ritchie, 2008). Moreover, sharing views on risks help to recognize and understand common opportunities and threats in a more comprehensive way (Hallikas, Karvonen, Pulkkinen, Virolainen, & Tuominen, 2004). Despite that, research evidences concerning the level of risk communication among supply chain partners have always come to unfavorable outcome. It was found that almost half of the respondents claimed that their supply chain partners never or rarely share information on their exposure to specific risks (Jüttner, 2005). Furthermore, less than third of the respondents believed that their suppliers and customers have plan against risks but higher number of respondents claimed that they have risk management plans within their organizations (Jüttner, 2005) suggesting that companies have limited information about their partners' exposure towards risks.

In consistence, information sharing only appeared at the 1st- and 2nd-tier customers and suppliers (Kersten, Hohrath, & Böger, 2007). Joint agreement among supply chain partners which was established to increase supply chain visibility, risk-exposure information sharing and the preparation of joint business continuity plans only occurred with key suppliers (Jüttner, Peck, & Christopher, 2003). One explanation of the lack of information sharing is that a company with special vulnerabilities may dedicate every incentive to conceal their risk exposure from other supply chain partners (Kleindorfer & Saad, 2005). Apart from that, another research discovered that small companies only held information exchange in reactive fashion such as when supply problem arise instead of conducting it proactively to learn about supply markets and the associate risks (Ellegaard, 2008). However, internal communication was found to be better in SMEs (Hill & Stewart, 2000). As a result, Blos, Quaddus, Wee, and Watanabe (2009) concluded that imperfect communication led to increasing risks in companies.

This situation happens because many firms feel uneasy to share information with others. Supply chain members are often reluctant to share risk information because of fear of

opportunistic behavior, i.e. partners exploiting information for self-interest which jeopardize competitive positions to other companies (Kembro & Selviaridis, 2015). Obviously, risk information sharing is dependent upon trust, high level of long-term orientation between supply chain members (Parast & Shekarian, 2019) and open communication among supply chain participants (Jüttner, 2005).

An attempt to construct risk communication framework in a supply chain (refer Figure 3) has been produced in a work of Wang, Tiwari and Chen (2017). This framework linked five stages of risk management with the process associated in each stage. Nevertheless, the current research argues that this framework paid too much attention to SCRM process compared to the risk communication itself. Therefore, a risk communication framework will be developed in this research based on criteria of effective decision making while taking into consideration of the unique nature of food supply chain.

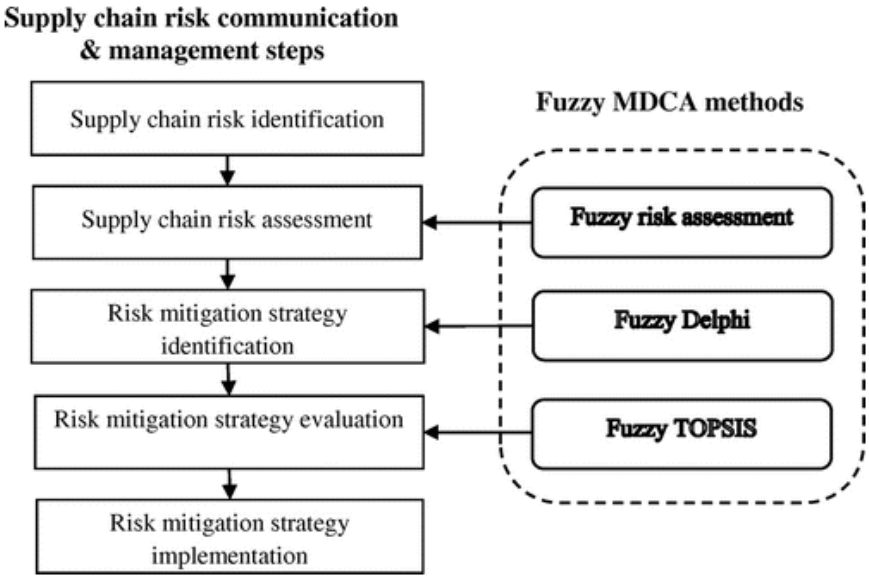

Figure 3. Supply Chain Risk Communication and Management Framework (Wang, et al., 2017)

Effective risk communication depends on several dimensions namely (i) characteristics of the audience, (ii) characteristics of the source of message (perceived competence and trustworthiness), and (iii) content of the message (Breakwell, 2000). In conjunction with the characteristics of the audience, decision makers in a supply chain comprised of manager directly related to supply chain performance such as purchasing manager and logistics manager, as well as manager indirectly related to supply chain performance such as financial manager. These two groups are hypothesized to have different views about similar set of risks because layman risk perception is irrational and heavily influenced by subjective perceptions of risk (Carlson, 2015; Paek & Hove, 2017). In relation to the source of message, most trusted source is university scientist and followed by medical doctor (Breakwell, 2000) but in supply chain, parent and sister companies could also be more reliable sources (Hudin, Hamid, & Chin, 2015). Finally, the content

of the message means that a risk information should be able to galvanized decision makers' attention by providing unambiguous, definitive and easily interpreted information (Breakwell, 2000). On the other hands, Boholm (2019) identified six main criteria of effective risk communication that are (i) or*ganizational planning and strategic decision making, (ii) collaboration and responsibility, (iii) knowledge and understanding, (iv) the message, (v) connection to risk management, and (vi) trust. The most important factor that contributes to successful risk communication as explained by participants in this research is how an organization taking up a long-term endeavor to plan a transparent risk communication that can support decision making.*

In simple terms, earlier studies concluded that risk-related information sharing occurred up to 2nd-tier suppliers primarily due to the lack of trust. However, with increasing trend of risk occurrence disturbing food supply chains today, it is doubtful and even shocking if firms in food industry do not enhance their risk communication and rely solely on their own to gain risk-related information. Therefore, this research argues that a risk communication framework should be developed so that all risk-information sharing between supply chain members can be explicitly linked, thus creating a high performance food supply chain.

Dual Process Theory

In general, most people associate risks with a negative outcome. In conveying a message about risk, it is common that the receiver will feel worried, and in some cases he will very quickly resort to a strategy that he perceived as the best to his situation. This instance shows an emotional, intuitive and spontaneous reaction called System 1 in Dual Process Theory (Roeser, 2012). On the other end of the spectrum, System 2 consider a risk with rational, computational and analytical mind. This theory hinges the psychological field with risk communication when it rises a question of why some people or in the context of this research a supply chain member act intuitively while others rationally. Although System 1 is much easier and taking less time in decision making, it is not always the best way to make decision especially when the decision could affect other supply chain members and supply chain performance as a whole. Therefore, it came down to the risk communication which this research hypothesized to be influencing decision making and hence supply chain performance.

Conceptual Framework

Figure 4 depicts the link between risk communication, supply chain performance and risk communication framework. It shows that risk communication will be explored in terms of (but not limited to) characteristics of the audience, characteristics of the source of message, content of the message, or*ganizational planning and strategic decision making, collaboration and responsibility, knowledge and understanding, connection to risk management and trust. Meanwhile, in-depth understanding on how supply chain performance is influenced by risk communication will be explored from the perspectives of supply chain resilience, quality, price, delivery, reputation and cold chain. Finally, based on data about risk communication and supply chain performance, a risk communication framework will be developed to exhibit an explicit link*

between the best practice in risk communication and its influence on certain dimensions of supply chain performance.

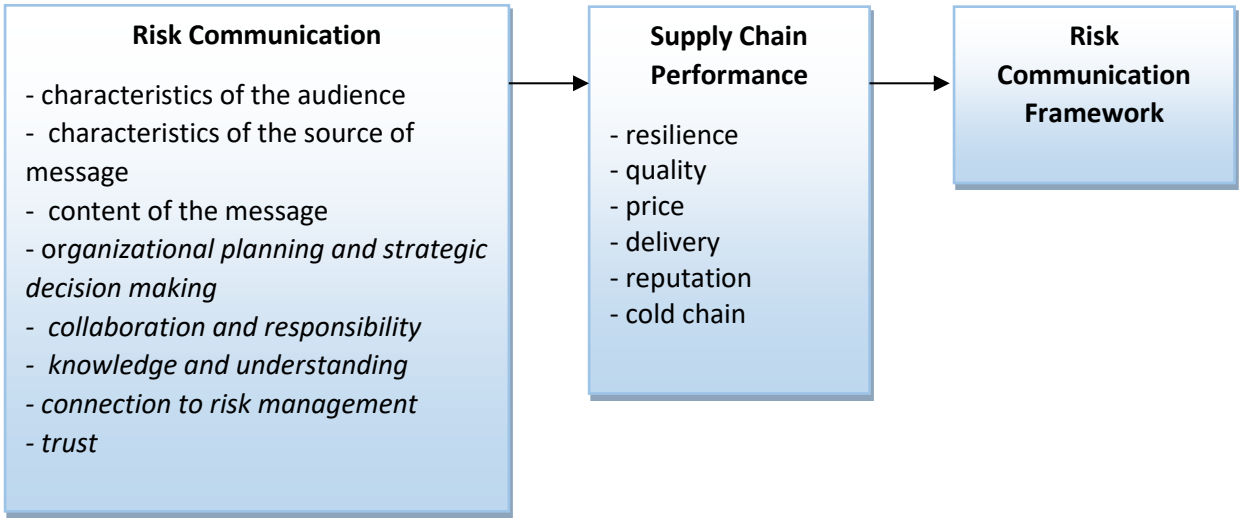

Figure 4. Research framework

Methodology

Based on the research onion, this research will employ a qualitative methodology by using an inductive approach. This research design is selected due to the infant nature of risk communication in SCRM area. Besides, rather than focusing on producing a reliable results as in quantitative research, this study is the first attempt to embed risk communication and supply chain in a framework, thus the validity is on the top concern of this study. Food industry in Malaysia particularly related to agri-food will be the focus of this study.

According to Table 2, Perak is selected as the sample for this study because it shows the highest crops yield for three consecutive years. In detail, Kinta district has the highest crop yield (108,288 mt)(Malaysia Department of Agriculture, 2018), thus unit of analysis will be driven from farmers in this district. The selection of the sample will be based on purposive sampling technique. First, Department of Agriculture will be approached. Second, a selection criteria will be explained to obtain suggestion on short-listed farmers who exhibit excellent performance in their supply chain. The selection criteria are adapted based on Wang et al. (2019) as shown below:

- Company which demonstrates high resilience, high quality crops, low price, on time delivery, good reputation, high cold chain performance.
- Good rapport and communication with the Department of Agriculture.
- Willing to participate in the research.

Table 2.
Crops yield 2016-2018

State	Production (mt)		
	2016	2017	2018
Johor	49,730	42,424	46,365
Kedah	5,157	5,439	5,945
Kelantan	16,823	13,134	14,354
Melaka	5,383	5,457	5,964
Negeri Sembilan	6,849	3,631	3,968
Pahang	11,426	11,896	13,001
Perak	**53,111**	**68,209**	**74,546**
Perlis	457	122	133
Pulau Pinang	1,085	834	912
Selangor	20,093	20,445	22,345
Terengganu	7,326	6,525	7,131
Sabah	13,576	12,516	13,678
Sarawak	28,017	27,180	29,705
W.P. Labuan	34	35	39

Source: (Malaysia Department of Agriculture, 2018)

The interview protocol will be developed by the researcher based on two major constructs; best practice in risk communication and supply chain performance. Then, it will be sent to the Department of Agriculture and three farmers for validation purpose. Accordingly, revision will be made as per suggested by the experts. After that, the participants of the research will be interviewed in semi-structured manner at their farms and observation will be conducted to support the interview data. Data collection will be ended once data saturation is reached (Fusch & Ness, 2015; Liamputtong, 2019). Roughly, more than 3 participants will be interviewed as recommended by Giorgi (2009) but not more than 25 (Klenke, 2016).

Data analysis will be performed by using thematic analysis due to its flexibility and ability to produce unanticipated insights (Braun & Clarke, 2006). Researcher will get familiarized with the data and transcribed the interview in verbatim. The participants' responses will then be coded to summarize the issue that he described. A collection of similar codes will be checked and revised to develop a theme. It will be an iterative process where themes will be developed and reevaluated by different researchers until agreement is reached. Finally, the themes will be named and defined to prepare the report. To ensure research trustworthiness, the final report will be return to participants for validation purpose and increased credibility (Creswell & Miller, 2000).

Conclusion

This study aims to propose a risk communication framework in food supply chain to improve supply chain performance. The food supply chain risk communication framework will

consist of six main criteria of effective risk communication (Boholm, 2019) that are (i) o*rganizational planning and strategic decision making, (ii) collaboration and responsibility, (iii) knowledge and understanding, (iv) the message, (v) connection to risk management, and (vi) trust, and three effective risk communication dimensions proposed by Breakwell (2000) which include* (i) characteristics of the audience, (ii) characteristics of the source of message (perceived competence and trustworthiness), and (iii) content of the message. Meanwhile, supply chain performance refers to resilience, quality, price, delivery, reputation and cold chain. A qualitative methodology where data were collected through semi-structured interview will be conducted to identify themes which will be used to construct the high-performance food supply chain.

This is the first attempt to develop a fundamental risk communication framework in food supply chain which has been known to be challenged by more risks compared to other products. Creating a high performance food supply chain is more complex especially because food supply chain is influenced by the nature of perishable products and freshness which demands for better risk communication and more information on volatility of consumer demands, climate and temperature changes, transportation and seasonality factors. Moreover, risk communication has not been discussed thoroughly in supply chain risk management area, thus leaving a knowledge gap to be filled by the findings of this research. The proposed fundamental framework will benefit the society as it can food crises or in other words, increase food production by minimizing waste resulted from the occurrence of risks. On the same note, the food supply chain risk communication framework could increase food quality in terms of freshness and nutrition, hence reduce food crises by allowing supply chain actors to plan their mitigation strategies earlier to combat against risks. The risk communication framework can be easily applied by many sub-sectors of food industry in Malaysia which share common supply chain characteristics including livestock, manufactured foods, agri-food products and cash crops in dealing with waste due to unexpected supply chain risks. By sharing risk information effectively among supply chain members, risks which have the likelihood to reduce food production and food quality could be identified as early as possible and appropriate mitigation strategies could be developed accordingly. In a long-term, the food supply chain risk communication framework could become a basis in leading Malaysia towards a more prosperous and competitive economy and nation by extending the current food supply chain in Malaysia to international level.

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