Vertical Integration in the Taiwan Aquaculture Industry

Tzong-Ru Lee (Jiun-Shen)
Yi-Hsu
Cheng-Jen Lin
Kongkiti Phusavat
Nirote Sinnarong

The study aims to improve the distribution channels in the Taiwan aquaculture industry through a better vertical integration. This study is derived from a need to improve the distribution performance of agricultural-based industries in response to increasing food demands in Asia and elsewhere. Based on a four-by-eight matrix derived from both a value chain and a service profit chain, thirty different strategies are developed. This development is based on key success factors and strategies for vertical integration interviewed and cited in the literatures. The findings are identified by applying the Gray Relational Analysis (GRA). For this study, the key success factors for aquaculture wholesale markets include the communication, integration and cohesion of opinion within the wholesale market; government support; and mutual trust between members of the vertical integration scheme. The suitable vertical integration strategies are an improved safety and hygiene inspection of aquaculture products, accuracy of aquaculture product categorization, and precision in product weighing.

Key Words: aquaculture industry, grey relational analysis (GRA), channels integration
JEL *Classification:* M30, R41

Dr Tzong-Ru Lee (Jiun-Shen) is a Professor in the Marketing Department, National Chung Hsing University, Taiwan.

Dr Yi-Hsu is an Associate Professor in the Business Administration Department, National Formosa University, Taiwan.

Cheng-Jen Lin is a graduate student at the National Chung Hsing University, Taiwan.

Kongkiti Phusavat is an Associate Professor in the Industrial Engineering Department, Kasetsart University, Thailand.

Nirote Sinnarong is a PhD student at the National Chung Hsing University, Taiwan.

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Introduction

Improving the performance of agricultural-based industries has gained more attention from practitioners and researchers alike for the past decade. This is due to continuous economic expansion and population growth in Asia, especially China and India (McKay 2007). Based on his viewpoint, the operational performance needs to be constantly improved across all agricultural products, including crops, livestock, and fishery. Timmer (2010) argued that, although many Asian countries such as Thailand and Vietnam, have significantly increased their exports of agricultural goods around the world, there was a need for operational improvements to ensure an effective and efficient farm-to-table chain (i. e., farmer-to-consumer integration). This improvement has taken place in many shapes and forms such as crop yield, contract farming, organic farming, traceability, Good Agricultural Practice, processing, and more importantly distributions.

In fact, the urbanization (i. e., more than 300 million in China and 170 million in other Asian countries such as Indonesia, the Philippines, Vietnam, Thailand, and Malaysia will be living in the cities by 2020) has led to a call for a comprehensive review and assessment in how agricultural foods should be distributed to consumers, including wholesalers, retail outlets, supermarkets, and restaurants (Lem et al., 2004; Timmer 2010). The food distribution should result in less cost and higher quality to customers. Not only is there a need to deal with the trend in urbanization, but one must recognize the ongoing change in a demographic factor that is taking place in many regions, especially in East and Southeast Asia (with the exception of Indonesia, Malaysia, and the Philippines).

According to Manasserian (2005) and McKay (2007), the median age in the Asia-Pacific region would increase from 29 to 36+ years old in 2020 while the proportion of the aging population will be greatly increased. These increases are expected to impact the region's food consumption patterns and behaviors. Meat consumption would probably decline while the demand for fresh fish, fruits, and vegetables would gradually increase. Several initiatives have been made previously in many countries to increase the flows of fresh produce to consumers as fast and cheaply as possible. They are: e. g., the use of technology to improve schedules, route planning, and distribution channels, and the application of a cool chain to increase a product's shelf life. Moreover, the vertical integration concept has been revisited and re-examined repeatedly during the past ten

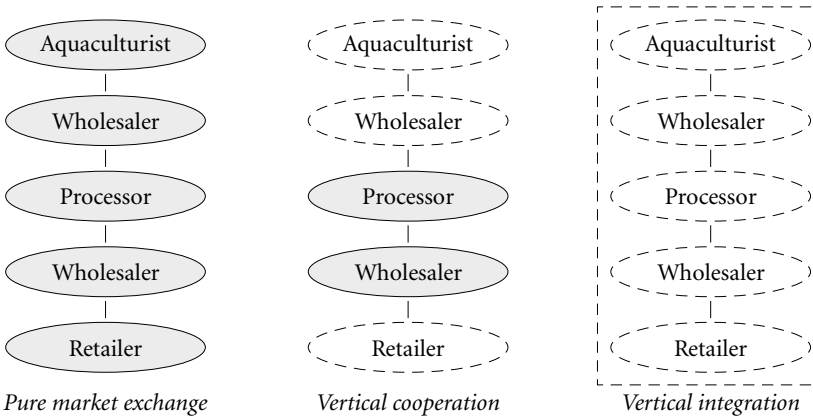

FIGURE 1 Vertical integration (adapted from Lem et al. 2004)

years as a way to respond to the higher demand for food around the word, including local and regional demands among Asia countries (Lem et al., 2004; McKay 2007; Timmer 2010).

The nature of agricultural-based industries in Asian countries has pointed to the need to reexamine how effective and efficient the vertical integration has been in practice. Many firms in these industries are considered to be Small and Medium Enterprises or SMEs. They are required to work and cooperate closely together as individual firms simply cannot meet the overwhelming demands. Vertical integration indicates how companies, especially SMEs, are integrated in a supply chain (Lem et al., 2004). These companies are united through a common ownership or partnership arrangement. Each member of the supply chain typically produces a different product or service. But when combined, their products and services aim to satisfy a common need of consumers. It is widely practised in processed foods (e. g., starch and sugar) and fishery-related products. Beside the vertical marketing channels as considered, the aquaculture product flow can follow various market channels from the aquaculturalist to the final consumer. Therefore, these market channels were divided into three main stages: the producer stage, the wholesaler stage including processing, and the retailer stage (Lem et al. 2004; see figure 1).

Background to the Problem

One-third of the total quantity and value of seafood products sold in Taiwan originates from fish farms. Traditionally, the fish farming distribution channel consists of – from upstream to downstream – the farmers,

local sales representatives, wholesale markets, retailers and consumers. The demand for healthy and safe food in Taiwan has increased in recent years. The up-, mid- and downstream operations of the local fish farming industry have striven to meet this increased demand. Further, increased vertical integration and coordination between production and sales have simplified distribution channels, which is favourable for maintaining the freshness and nutritional value of aquaculture products.

Wholesale markets provide facilities and management so that suppliers and salesmen can conduct their business in a highly specialized fashion. Large scale trading and wide dispersion achieves orderly transportation and sales, regulation of supply and demand and promotion of fair trade practices. The aquaculture wholesale markets, located midstream of production and sales channels, provide functions of price formation, concentration and distribution of aquaculture products, and serve as a bridge between supply and sales. These institutions handle most production and are operated by managers with extensive experience in sales and handling of seafood products; thus, they are well-suited to lead the process of vertical channel integration. Therefore, this study starts from the management level of the aquaculture product wholesale markets to investigate applicable strategies for vertical channel integration. The aims of this study are to determine the key success factors necessary for aquaculture industry integration, and to develop viable strategies for channel integration based on the characteristics of the fish farming industry and vertical integration.

Literature Review

To investigate the major success factors and strategies, a literature review for this study focuses on several aspects of vertical channel integration, including systems, channel integration, introduction of key success factors, structure of strategic analysis, value chain and service profit chain.

DEFINITION OF THE VERTICAL INTEGRATION SYSTEM

'Vertical Integration' suggests that firms internalize trade by establishing their own systems and complete the intermediate input and production of finished products to replace trading behaviour in the open market (Coase 1937). This so-called vertical integration combines technically different processes such as production, distribution, sales and other economic practices under the jurisdiction of a single organization. Thus, a company integrates upward with suppliers which control sources of

supply as well as downward with wholesalers or retailers which control where the goods are sold (Porter 1985). Vertical integration allows products and services to integrate up-, mid- and downstream of operation procedures toward the sources of raw material as well as delivery and distribution networks (Williamson 1979; Hill and Jones 1998; Waterson 1984; Glenn et al. 2000; Dawson 2003).

CHANNEL INTEGRATION AND ITS KEY SUCCESS FACTORS

A 'marketing channel,' also known as a 'distribution channel,' consists of a group of interconnected organizations tasked with enabling products or services to be used or consumed by consumers or industry users (Kotler and Armstrong 1994; Stern, El-Ansary, and Conghlan 1996). From a management perspective, the marketing channel is defined as a contractual relationship between organizations to accomplish distribution tasks through managed operations. These joint organizations may include manufacturers, distributors, retailers and many other firms involved in the marketing channel before goods are finally delivered to industry users or consumers (Kotler and Armstrong 1994; Berman 1996; Rosenbloom 1999). To survive and succeed in an industry, a firm must excel in three to six specialized aspects of that industry, and the key success factors that determine whether it is successful must be achieved in order to succeed. The so-called 'special parts' are key areas where a firm must perform effectively to succeed. To maintain growth, a firm must make efforts in these few key management areas; otherwise, the expected goal will not be achieved (Daniel 1961). In order to succeed, an enterprise must have certain key advantages or assets and perform relatively well so that a competitive advantage is realized (Aaker 1984; Ellram and Hendrick 1995; Lester 1998). The competitiveness of technology or assets owned by an enterprise can be measured by analyzing the advantages of the enterprise and the coordination between key success factors. If the advantages of the enterprise reflect well on the KSF of the enterprise, then it has a competitive advantage (Wu 1988; Simchi-Levi, Kaminski, and Simchi-Levi 2003).

VALUE CHAIN AND SERVICE PROFIT CHAIN

Porter (1985) proposed the idea of a 'value chain,' indicating an enterprise that performs a series of 'value-creating activities' such as valuable products, labour to upstream customers such as raw materials suppliers and end buyers of products or labour. It describes the accumulation of

customer value in each operation. The value chain is the presentation of total value mainly consisting of value operation activities and profit. Value is the price a customer pays for the product or labour purchased. Total value reflects the price and sales of products or labour, and the value operation activity is the activity that contributes to the value of final products or labour. Profit is the difference between total value and the cost paid for the execution of value operation activities. Porter divided the value chain operation activities of an enterprise into two categories, major activities and supporting activities, based on the technical or strategic characteristics.

Heskett et al. (1994) suggested that the service profit chain is constructed through a series of value exchanges. Service quality in an organization affects employee satisfaction, and employee satisfaction improves productivity, retention and loyalty. As a result, able workers are more willing to stay, and the costs of recruiting, hiring and training new employees are minimized. Therefore, to improve customer satisfaction, the satisfaction of employees must be surveyed and improved as much as possible. As the profits and growth of an enterprise are affected mainly by customer loyalty, and customer loyalty is directly influenced by customer satisfaction, both of which are in direct proportion. This study indicated that the service quality of a firm is closely related to employee satisfaction, and employee satisfaction greatly influences customer satisfaction and loyalty. The Heskett study further revealed that the most important factors affecting employee satisfaction are: work, training, promotion opportunities, respect, teamwork and whether the firm is genuinely concerned about the welfare of employees. Thus, enterprises devoting more effort to these factors can maintain a good employer-employee relationship. The purpose of this study is to identify vertical channel integration strategies in the Taiwan fish farming industry by using a four-by-eight matrix representing the major activities of the value chain and the service profit chain.

GREY RELATIONAL ANALYSIS

Deng (1982) pioneered grey system theory in 1982. Grey system theory (GST) is concerned with solving problems that involve uncertainty or systems with incomplete information. Using system relational analysis, model construction, forecasting, or decision analysis, grey system theory can effectively resolve various problems that involve uncertainty, multiple variables or discrete data.

GST has received attention from scholars of all academic circles and many practitioners. Especially, successful applications of GST in several scientific fields have won the affirmation and attention of international academic spheres. At present, many scholars are occupied in research and applications of grey systems in many countries, regions and international organizations, such as in England, USA, Germany, Japan, Australia, Canada, Austria, Russia, Taiwan, Hong Kong, the United Nations, Turkey, South Africa, and so on (Liu, Forrest, and Vallee 2009).

Grey relational analysis (GRA) was originated by GST. This method has become an effective method for solving problems with high uncertainty. GRA has been developed to study problems of small samples with poor information, with successful applications in industry, energy, transportation, meteorology, geology, hydrology science, medicine, military science, business, agriculture, and so on (Salmeron 2010). For the advantages of this method, Song and Shepperd (2011) stated that GRA provides an alternative approach to identify the correlations among factors without traditional statistical assumption (e. g. data distribution, errors distribution, and sufficient data).

The calculation process for GRA is expressed as follows (Deng 1982).

Let X be a factor set of grey relation, $X = \{x_0, x_1, \ldots, x_m\}$, where $x_0 \in X$ denotes the referential sequence; $x_1 \in X$ represents the comparative sequence, and $i = 1, \ldots, m$. Both x_o and x_1 include n elements and can be expressed as follows.

$$x_0 = (x_0(1), x_0(2), \ldots, x_0(k), \ldots, x_0(n)) \tag{1}$$

$$x_i = (x_i(1), x_i(2), \ldots, x_i(k), \ldots, x_i(n)) \tag{2}$$

Where $i = 1, \ldots, m$; $k = 1, \ldots, n$; $n \in N$, and $x_0(k)$ and $x_i(k)$ are the numbers of referential sequences and comparative sequences at point k, respectively. In practical applications, the referential sequence can be an ideal objective and the comparative sequences are alternatives. The best alternative corresponds to the largest degree of grey relation. If the grey relational coefficient (GRC) of the referential sequences and comparative sequences at point k is $\gamma(x_0(k), x_i(k))$, then the degree of grey relation for x_0 and x_i will be $\gamma(x_0, x_1)$ when the following four prerequisites satisfy:

1. Normal interval:
   $0 < \gamma(x_0, x_i) \leq 1$,
   $\gamma(x_0, x_i) = 1 \Leftrightarrow x_0 = x_1$,
   $\gamma(x_0, x_i) = 0 \Leftrightarrow x_0, x_1 \in \emptyset$.

2. Dual symmetry:
   $x, y \in X$,
   $r(x, y) = r(y, x) \Leftrightarrow X = \{x, y\}$.
3. Wholeness:
   $x_i, x_j \in X$,
   $\gamma(x_i, x_j \neq \gamma(x_j, x_i)$.
4. Approachability:
   With $|x_0(k) - x_i(k)|$ getting larger, $\gamma(x_0(k), x_i(k))$ becomes smaller.

The essential condition and quantitative model for grey relation are produced based on the above four prerequisites. The GRC of the referential sequences and comparative sequences at point k is expressed as follows:

$$\gamma(x_0(k), x_i(k)) = \\ = \frac{\min\limits_{i \in I} \min\limits_{k} |x_0(k) - x_i(k)| + \zeta \max\limits_{i \in I} \max\limits_{k} |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \zeta \max\limits_{i \in I} \max\limits_{k} |x_0(k) - x_i(k)|}, \quad (3)$$

where ζ is a distinguished coefficient with a value between zero and one. The ζ can be adjusted to suit practical requirements and it is normally set at 0.5.

The grey relational grade (GRG) stands for the degree of grey relation between the referential sequences and comparative sequences is defined as a GRC mean and can be expressed as follows:

$$\gamma(x_0, x_i) = \frac{1}{n} \sum_{i=1}^{n} \gamma(x_0(k), x_i(k)). \quad (4)$$

A larger GRG corresponds to a stronger degree of grey relation between the comparative and referential sequences.

Research Method

Given the research purpose and results of the literature review, the design of this study included three parts: the research process, the research objective and questionnaire design.

THE RESEARCH PROCESS

First, experts and specialists were interviewed at several large and representative aquaculture wholesale markets throughout Taiwan to clarify distribution, delivery and sales in the industry. After data collection and

a literature review, the major activities in the value chain and service profit chain were reviewed to develop a questionnaire for the aquaculture wholesale managers. After the questionnaires were retrieved, grey relational analysis was utilized to elucidate the key success factors and strategies identified by industry managers.

RESEARCH SURVEY

In principle, questionnaires were sent to the fish markets where seafood is bought and sold. The investigation focused on management level personnel in these markets. The questionnaires regarding vertical integration in the fish farming industry were delivered to fifty fish markets throughout Taiwan (except those on the outer islands). Ten copies were sent to big wholesale markets in Taiwan and five copies were sent to small wholesale markets. Three hundred questionnaires were distributed, of which 100 copies were sent to these big markets and 200 to small markets.

QUESTIONNAIRE DESIGN FRAMEWORK

This study made a value chain categorization on the operation process in the wholesale markets of aquaculture products: (1) Major activity: 1. Logistics: product inspection and weighing, categorization and classification, product cutting and processing, ice making. 2. Production: product preservation, auction (manual and computerized). 3. Logistics management: product storage, freezing and refrigeration, auction ground cleaning, sewage treatment. 4. Marketing and sales: advertising, selection of sales channels, space leasing. (2) Support activity: 1. Purchasing: fish cage purchasing, polymer cases. 2. Technology development: auction equipment improvement and auction system upgrade. 3. Human resource management: recruiting, employment and training of administrative, auction and marketing personnel. 4. Corporate infrastructure: general administration management, planning, finance, accounting, official business and quality control. This study emphasized business activities related to up-, middle- and downstream integration, which are the major operations of aquaculture product wholesale markets, as well as the major activity in the value chain. Human resources, which is the only relevant supporting activity, was investigated as well.

The service profit chain consists of a series of value exchanges and includes eight aspects: 1. internal service quality, 2. employee satisfaction, 3. employee loyalty, 4. employee productivity, 5. external service values,

Revenue and Profit	29	30	31	32
Customer Loyalty	25	26	27	28
Customer Satisfaction	21	22	23	24
Outsider Service Value	17	18	19	20
Employee Productivity	13	14	15	16
Employee Loyalty	9	10	11	12
Employee Satisfaction	5	6	7	8
Inside Service Quality	1	2	3	4
	Logistic Incoming	Production	Logistic shipping	After sales service

FIGURE 2 The four-by-eight matrix representing the major activities of value chains and service profit chains

6. customer satisfaction, 7. customer loyalty, and 8. income and profit growth. The principal process of the service profit chain is the following: high quality service and policies provided by an organization to employees (internal service quality) elevate employee satisfaction; employee satisfaction leads to loyal and productive employees; 'external service value' is created by satisfied, loyal and productive employees who deliver products or services to customers. Customer satisfaction depends greatly on the service received by customers, and customer loyalty comes from satisfaction. Loyalty promotes earnings and growth in corporate profit. Through the service profit chain, this study investigated how wholesale markets can improve these eight aspects of operations.

After categorizing the major business operations of aquaculture product wholesalers, four major activities were identified: logistic incoming, production, logistic shipping, marketing and after sales service. The service profit chain consists of a series of value exchanges and includes eight aspects. As figure 2 shows, this study employed a four-by-eight matrix representing the major activities of value chains and service profit chains.

The four employee-related aspects included in the matrix were internal service quality, employee satisfaction, productivity and loyalty. The four major activities in the value chain proposed by Porter were used to create a four-by-four matrix with cells numbered from 1 to 16. The four aspects related to customers outside the organization, 'external service values, customer satisfaction, customer loyalty and income and profit,' and the four major activities of the value chain were used to create another square matrix with cells numbered from 17 to 32.

Relevant domestic and international literatures regarding vertical integration were reviewed in addition to interviews with managers of aquaculture wholesale markets in Taipei, Taichung, Changhua, Puhsin and Chiayi. As table 1 shows, the literature review and interviews yielded thirty strategies for improvement of vertical channel integration in each cell. How these strategies were derived will be elaborated with the aspect of 'inbound logistics' as an example: In 'inbound logistics,' this study proposed 2 variables, processing and checking and acceptance. This aspect was converted for these 2 variables to develop a vertical integration strategy for the fish farming industry. The 'processing' variable proposed by Azzam and Wellman (1992) in a study of the pork industry is favourable to vertical integration of inbound logistics; this study developed a 'product cutting (level 1 processing)' strategy. Glenn et al. (2000) proposed the 'checking and acceptance' variable in their study of the dairy industry. Categorization, classification, hygiene and safety inspection and weighing accuracy were identified as favourable to vertical integration of logistic incoming. Three strategies developed in this study were 'accuracy of product categorization and classification,' 'enhanced product hygiene and safety inspection' and 'product weighing accuracy.' Four strategies have been developed for inbound logistics, one from variable 'processing' and three from variable 'acceptance,' and all helped improve the operations of cells 17, 21, 25 and 29; the six strategies developed from 'logistic shipping' helped improve the operations of cells 19, 23, 27 and 31; the four strategies developed from 'marketing and after service' helped improve the operations of cells 20, 24, 28 and 32; finally, the twelve strategies developed from 'internal supporting activities of a firm,' which are mainly related to employee training, welfare and internal service quality, helped improve the operations of cells 1 through 16. From this four-by-eight matrix, strategies that helped improve the operations of each cell were used as descriptions in the questionnaire, and the questionnaire was used to gather management level input regarding strategies for these wholesale markets.

Results

Research results are discussed from perspectives of key success factors and vertical integration strategies. Three hundred questionnaires were distributed, and 164 were retrieved, of which eight were invalid and 156 were valid. The retrieval rate was 55%. The survey period extended from 13 to 27 April, 2006. Most (66%) survey subjects were lower ranking man-

TABLE 1 The strategies for vertical channel integration

Inbound logistics				
Processing	Azzam and Wellman (1992)	1	Product cutting (level 1 processing)	17, 21, 25, 29
Checking and acceptance	Glenn et al. (2000)	2	Accuracy of product categorization and classification	
		3	Enhanced hygiene and safety inspection	
		4	Product weighing accuracy	
Processing				
Auction	Expert opinion of aquaculture product wholesale markets (2006)	5	Fair and open product auction	18, 22, 26, 30
Package	Azzam and Wellman (1992)	6	Small package treatment	
Processing		7	Product process treatment (level 2 processing)	
Product preservation	Dawson (2003)	8	Enhanced product preservation level	
Logistic shipping				
Distribution accuracy	Stern et al. (1996)	9	Distributing products to accurate locations	19, 23, 27, 31
Reliability		10	Product preservation in distribution process	
Speed		11	Speedy distribution	
On schedule		12	Product distribution on schedule	
Customized service		13	Distributing small packages	
		14	Customized distribution service	
Marketing and after sales service				
Service drawbacks and amendments	Tso (2002)	15	Service drawbacks and amendments (For example: Product decomposed and shortage)	20, 24, 28, 31

Collaboration Marketing		16	Collaboration Marketing promotion	
Emergency treatment ability		17	Management capability of emergency distribution	
Knowing customer's need	Van de ven (1976)	18	Precisely and speedily understanding the market demand	
Reservation	Expert opinion of aquaculture product wholesale markets (2006)	19	Promoting reservation trade	
Development of systematic information interaction	Sharma (1995)	20	Current information of product amount	
		21	Supply chain information of purchasing from buyers to sellers	
		22	Obtaining the collaborate information technology supported by university and software corporation	
Human resource				
Employee training	Heskett et al. (1994)	23	Training employees about auction knowledge and techniques	13–16
		24	Training employees about the knowledge and techniques of product categorization and classification	
Employee welfares		25	Enhanced employees' welfare and salary	1–12
		26	Sharing the profit of corporation with employees	
Employees internal service quality	Rust et al. (1996)	27	Integration and cohesion of opinion within the organization	
		28	Focus on promotion fairness of employees	
		29	Respecting employees	
		30	Providing job security for employees	

agers, and many (41%) interviewees had 15 or more years of working experience.

RELIABILITY AND VALIDITY ANALYSIS

Reliability is the accuracy or precision of a measurement instrument, and the measure consists of stability and consistency. In addition to the literature review, this study compiled comments from managers of aquaculture product wholesale markets and from individual fish farmers. Therefore, the findings of this study are considered reliable. In validity analysis, this study adopts the Cronbach alpha coefficient to determine internal consistency; the validity of the key success factors for vertical integration of the fish farming industry channel was 0.931. Considering the reliability of the vertical channel integration strategies for each aspect, the alpha coefficient was 0.840 for logistic incoming, 0.783 for production, 0.843 for logistic shipping, 0.830 for marketing and after sales service, and 0.947 for human resources. As suggested by Guielford (1965), if the Cronbach alpha coefficient is greater than 0.7, the reliability is high. According to the above calculations, all alpha coefficients were higher than 0.7, indicating high reliability in this questionnaire.

GREY RELATIONAL ANALYSIS

Grey relational analysis was adopted in this study, and option 5 – 'agreed strongly' – in the reference sequence was chosen as the basis for measuring the relationship between success factors and strategies for vertical channel integration. The grey relational method was used to determine the relationship (sequence weight) of each factor. A higher grey relation indicates greater importance, indicating that management level personnel in the fish markets agreed with and valued this particular 'key success factor for vertical channel integration' and 'vertical channel integration strategy.' Tables 2 and 3 present the results of this analysis in order of magnitude.

GRAY RELATIONAL ANALYSIS OF THE KEY SUCCESS FACTORS FOR VERTICAL CHANNEL INTEGRATION

Each question was analyzed using the grey relational method (the maximum of gray relation is 1 and the minimum is 0. After arranging the calculated values in descending order, the greater grey relations were higher in the gray relation sequence, indicating that managers of fish markets

TABLE 2 Key successful factor analyses with grey relational analyses of channel vertical integration

(1)	(2)	(3)	(4)
Internal communication of organization	Communication, integration and cohesion of opinion within the wholesale market	0.6854	1
Government support	Government support and cooperation	0.6827	2
Trust	Mutual trust between members of the vertical integration scheme	0.6618	3
Fairness	Fairness of profit and risk distribution between members of the vertical integration scheme	0.6372	4
Mutual assist in difficulty	Mutual assist in difficulty between members of the vertical integration scheme	0.6310	5
Classification of clear target	Mutual consent of providing healthy and safety food between members of the vertical integration scheme	0.6292	6
Organizing committee of vertical integration	The committee organized by members of the vertical integration scheme promotes vertical integration	0.6235	7
Outside pressure	Influenced and pushed by outside pressure	0.6164	8
Understanding the demand of partners	Understanding the demand of partners in vertical integration	0.6111	9
Relationship commitment	Mutual commitment of relationship	0.6042	10
Expectation of mutual relationship	Expectation of mutual relationship between members of the vertical integration scheme	0.5964	11
Developing systematical information interaction	Mutual cooperation of information system	0.5576	13
Flexibility	Keeping mutual relationship with flexibility	0.5448	14
Inventory management	Stable product supply between members of the vertical integration scheme	0.5430	15

NOTES Column headings are as follows: (1) dimensions, (2) question items, (3) grey relational degree, (4) grey relational rank.

placed more importance on the question and considered it a key success factor for vertical integration of fish farming industry channels.

After calculation, the grey relations were displayed in number lines grouping approximate values together. The lines and grouping are displayed in figure 3. The right-hand-side of lines grouping indicating the grey relations as close to 1 which showed that these factors are more im-

TABLE 3 Grey relational analyses for vertical channel integration strategies

(1)	(2)	(3)
Enhanced hygiene and safety inspection	0.8246	1
Accuracy of product categorization and classification	0.7997	2
Product weighing accuracy	0.7971	3
Enhanced product preservation level	0.7723	4
Providing job security for employees	0.7700	5
Respecting employees	0.7630	6
Product preservation in distribution process	0.7581	7
Comm., int. and cohesion of opinion within the wholesale market	0.7489	8
Speedy distribution	0.7469	9
Fair and open product auction	0.7445	10
Focus on promotion fairness of employees	0.7272	11
Enhanced employees' welfare and salary	0.7218	12
Sharing the profit of corporation with employees	0.7175	13
Product distribution on schedule	0.7015	14
Training employees about the knowledge and techniques of product categorization and classification	0.6991	15
Training employees about auction knowledge and techniques	0.6850	16
Collaboration Marketing promotion	0.6849	17
Current information of product amount	0.6826	18
Distributing products to accurate locations	0.6797	19
Promoting reservation trade	0.6724	20
Precise and speedy understanding of the market demand	0.6710	21
Small package treatment	0.6591	22
Product cutting (level 1 processing)	0.6577	23
Service drawbacks and amendments (For example: Product decomposed and shortage)	0.6512	24
Obtaining the collaborate information technology supported by university and software corporation	0.6493	25
Distributing small packages	0.6415	26
Customized distribution service	0.6327	27
Product process treatment (level 2 processing)	0.6067	28
Supply chain information on purchasing from buyers to sellers	0.6063	29
Management capability of emergency distribution	0.6008	30

NOTES Column headings are as follows: (1) strategies, (2) grey relational degree, (3) grey relational rank.

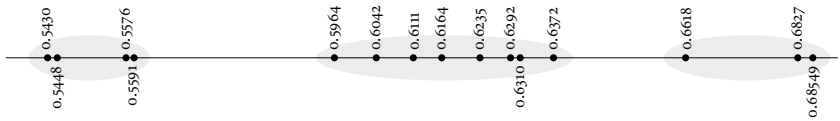

FIGURE 3 Key successful factor analyses with number lines of grey relational degree

portant. The left-hand-side indicating the grey relations as close to 0, which showed that these factors are not so important. This study divided the fifteen aspects of measurement into three groups. From right to left, the grey relation values are 0.6854, 0.6827 and 0.6618 represent 'internal communications of an organization,' 'government support' and 'mutual trust,' respectively.

The sequence of grey relations revealed that the first group, which includes 'internal communication of an organization,' 'government support' and 'mutual trust' are the vertical channel integration success factors most valued by managers of fish markets. This finding indicates that the fish markets must reach a mutual understanding within their organization before participating in the vertical integration system for fish farming industry channels, so that internal management and employees have the same objective in upcoming external integration actions. Due to the limited resources within the fish farming industry, resource input and government support are required for successful establishment and maintenance of a vertical channel integration system. To achieve vertical channel integration, one additional success factor is crucial in the first group: trust. The mutual trust between partners in a channel can only be established under the premise that the members are not opportunistic and will not compromise the benefits of other channel partners to attain short-term profits. Only then can a long-lasting relationship and efficient vertical integration be achieved.

GREY RELATIONAL ANALYSIS FOR VERTICAL CHANNEL INTEGRATION STRATEGIES

After calculation, the grey relations were displayed in number lines grouping approximate values together. Figure 4 depicts the lines and grouping.

Thirty strategies were divided into six groups. For example, from right to left, the grey relations were 0.8246, 0.7997 and 0.7971, representing 'enhanced product hygiene and safety inspection,' 'product categorization and classification accuracy' and 'product weighing accuracy' as the first

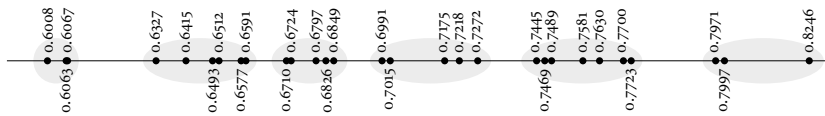

FIGURE 4 Channel vertical integration strategies with number lines of grey relational degree

group. Looking at the sequencing of grey relations, the first group, which includes 'enhanced product hygiene and safety inspection,' 'product categorization and classification accuracy' and 'product weighing accuracy,' were vertical channel integration strategies that fish market managers considered most feasible for achieving vertical channel integration. The three strategies in the first group are all aspects of 'inbound logistics,' indicating that fish market managers considered them important. Categorization and classification of products, hygiene and safety inspections and accuracy of weighing are all front-end tasks in the value chain of aquaculture product wholesale markets. Subsequent operations of vertical channel integration, 'production, logistic shipping, marketing and after sales service' run smoothly if front-end application strategies of the value chain are intensified and most of the efforts are directed towards stabilizing the most important factor of 'fish farming product quality.'

Discussion

This study conducted an interview with the Fish Marketing Organization of Taiwan in cooperation with related fish farmer associations, SMEs, and interviewees with wholesalers firms were conducted to evaluate the suitability of the key factors. The results found that the key factors are driving the improvement needs and the important strategic areas to satisfy with the market demands. First of all, the safety/hygiene as well as the product understanding/ group were the overwhelming factors that had influenced the need to improve the operational performance at the Taiwan Fish Markets. Thus, weight and pricing accuracy also received a considerable amount of attention as the business and transaction were continuous during the operating hours. Some of the key strategic areas to be under consideration included better scheduling and more available pricing information.

To facilitate vertical channel integration, this study investigated the key success factors and feasible strategies for vertical integration. Management level of aquaculture product wholesale markets was selected as the

survey subject. The analytical results indicated that the success factors considered crucial by management-level officers of aquaculture product wholesale markets are: communications, integration and cohesion of opinions within the wholesale markets, the full support from government, and mutual trust between members of the vertical channel. To facilitate vertical integration of the aquaculture industry channel, mutual consent should first be established within an organization so that internal management and employees work cooperatively to achieve external integration. Due to the limited resources available to the fish farming industry, resource input and governmental support are required for successful establishment and maintenance of vertical channel integration systems. To achieve vertical channel integration, one additional key success factor is required in the first group, and that is trust. The mutual trust between each of the partners in a channel can only be established under the premise that the members are not opportunistic and will not compromise the benefits of other channel partners for short-term profits. A long-lasting relationship can then be achieved, and vertical integration of the channel will be realized.

For effective strategies of vertical integration of the fish farming industry, the lines grouping were developed for the grey relations, and approximate values were grouped after calculation by the grey relational method. Thirty strategies for vertical integration of the fish farming industry developed in this study were divided into six groups. The first group consists of strategies that managers of aquaculture product wholesale markets considered most crucial and helpful for vertical integration of the fish farming industry. All strategies in the first group focus on 'inbound logistics' and are the front-end tasks in the value chain of aquaculture product wholesale markets. Consumers can have access to healthy and fresh farming products only if the 'aquaculture product quality' starts at the front end of the value chain and continues at the middle and rear ends of the chain.

From the management points of view, the key success factors from this study can be taking into account for the policy making of Taiwan aquaculture product wholesale markets. The policy makers can be considered as the key success factors for aquaculture wholesale markets, which include the effective communication, government support, and mutual trust between members of the vertical integration scheme. From the results of this empirical study, the policy makers can be more precise, for the suitable vertical integration strategies are an improved safety and hy-

giene inspection of aquaculture products, accuracy of aquaculture product categorization, and precision in product weighing. In addition to the Taiwan aquaculture industry analyzed in this study, the authors hope that the results of this study can serve as a reference for promoting vertical integration in other industries or in other countries.

Conclusion

The study focuses on applying the vertical integration concept to help improve the operational performance in the Taiwan aquaculture industry. This study is derived from the ongoing trends in urbanization and the aging population that have changed food consumption patterns and behaviour, especially higher demands for fresh fish, fruit, and vegetable. Based on a four-by-eight matrix derived from both a value chain and a service profit chain, thirty different strategies are developed. The findings are identified by applying the Grey Relational Analysis (GRA). For this study, the success factors for wholesale aquaculture markets include the communication, integration and cohesion of opinion within the wholesale market; government support; and mutual trust between members of the vertical integration scheme. The suitable vertical integration strategies are an improved safety and hygiene inspection of aquaculture products, accuracy of aquaculture product categorization, and precision in product weighing. Finally, an initial comparison is also made with the report published by Thailand's Fish Marketing Organization, which indicates similar findings.

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