Viability of e-commerce as an alternative distribution channel

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Keywords

Electronic commerce, Distributors, Malaysia, Semiconductors, Technology led strategy

Abstract

This paper proposes a framework for evaluating the impact of e-commerce on the roles of distributors in the semiconductor industry for four different types of products, namely differentiated products, architectural products, technological products, and complex products. Questionnaire and the purposive sampling method were used to collect data from respondents in the distribution industry. The results of the study show that the salience of the roles is increasing. In addition, there is strong likelihood of e-commerce replacing the traditional distributors, more so for less standardized products such as complex, technological, and architectural products.

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Introduction

During the past decade, organizational theorists, telecommunication managers, business consultants, have directed our attention to the strategic role that information technology can play in the competitive strategy of firms. Throughout the 1980s, the use of telecommunication networks linking firms to their suppliers and distribution chains conveyed important first mover advantages were discussed. The Internet business-to-business (B2B) space is gaining much attention, with valuation for publicly traded B2B companies escalating rapidly. Estimates for the size of this burgeoning space vary widely from Gartner Group's prediction of $7.29 trillion by 2004 to Goldman Sachs" estimation of $1.5 trillion, the future still hold great promise (A.T. Kearney, 2000a, b). Similarly, Arthur Andersen & Co. (2000) indicated that eB2B represents 84 per cent of total
e-business revenue and the growth prospects are substantial with the revenues predicted to be anywhere from $2.7 trillion to over $7 trillion in the next three years.

In the other hand, the existence of distribution channels has helped to make society more efficient in resource allocation. Most producers use intermediaries to bring their products to market. They try to forge distribution channel – a set of interdependent organizations involved in the process of making a product or service available for use or consumption by the consumer or business users (Stern *et al.*, 1996). Bagozzi *et al.* (1998) asserted that intermediary creates economics savings for the system and the savings become more dramatic as the number of producer-consumers increases. Armstrong and Kotler (2000) argued that intermediaries play an important role in matching supply and demand. Waxman (2000a, b) argued that by servicing the thousands of indirect partners who are the customers, midrange distribution adds true value.

However, one of the constantly raised questions with the emergence of e-commerce is whether the functions of traditional distribution channel will remain. Will dis-intermediation happen with the increasing popularity of e-commerce? Will distributors be able to secure their position as the channel of promoting products to users? Or how can middlemen survive when the world is

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becoming more and more reliant on information technology, especially e-business oriented technologies? The purpose of the study therefore, is to unveil and generate discussion of the impact of e-commerce on the roles of traditional distribution channel. Thus, it evaluates if e-commerce can be substitute to existing distribution channel for semiconductor industry, and stretches the understanding of the likelihood of market characteristics and technology novelty in impacting distribution channel's roles with the emergence of e-commerce.

Literature

The distribution industry can be considered as one of the fragmented industries whereby no firm has a significant market share and can strongly influence the industry outcome. Porter (1980) wrote that industries are fragmented for a wide variety of reasons with greatly differing implications for competing in them. Some of the underlying economic causes of fragmentation are, low overall entry barrier, absence of economies of scale or experience curve, high transportation costs, high inventory costs or erratic sales fluctuation, etc. Consequently, the industry is usually populated by a large number of small and medium-size firms. Yet, marketing channel decision is one of the critical decisions for an organization because it will intimately affect all other marketing and overall strategic decisions on how a product is to be offered in the marketplace. Stern and El-Ansary (1988) see distribution channel as a set of independent organizations involved in the process of making a product or service available for use. In most contemporary markets, mass production and consumption have lured intermediaries into the junction between buyer and seller. Alderson (1958) wrote that the goal of marketing is the matching of segments of supply and demand. Alderson argued that intermediaries provide economies of distribution by increasing the efficiency of the process.

Porter's (1985) value chain model describes primary activities such as inbound logistics, operations, outbound logistics, marketing and sales, service, etc., and distribution channel clearly plays an important role in these (safe for operations) where they also could gain competitive advantage. Researchers have credited distribution channels with the following roles: information gathering and distribution of marketing research and intelligence information (Sawhney, 2000; Sarkar *et al.*, 1995; Stern and El-Ansary, 1988); promotion (Sarkar *et al.*, 1995; Stern and El-Ansary, 1988); contact or prospecting (Sawhney, 2000; Shapiro, 1997; Sarkar *et al.*, 1995); matching (A.T. Kearney, 2000a, b; Shapiro, 1997; Bagozzi *et al.*, 1998; Stern and El-Ansary, 1988; Reibstein, 1985); negotiation (Shapiro, 1997); physical distribution (Sawhney, 2000; A.T. Kearney, 2000a, b; Shapiro, 1997; Sarkar *et al.*, 1995; Reibstein, 1985); financing (Shapiro, 1997; Stern and El-Ansary, 1988); and risk-taking (Kearney, 2000a, b; Sarkar *et al.*, 1995; Stern and El-Ansary, 1988).

Bagozzi *et al.* (1998) categorized the distribution functions into three: functions for customers; functions for producers; and functions for both customers and producers. Two forces underlie the need for intermediaries: the discrepancy of quantity (i.e. difference between the quantity typically demanded by customers and the quantity that can be produced economically by manufacturers) and the discrepancy of assortment (difference between the varieties of products typically demanded and economically produce-able varieties (Bagozzi *et al.*, 1998). Middlemen fill these needs by carrying out what Reibstein called transactional activities, physical activities, and facilitating activities (for a review, see Reibstein, 1985).

E-commerce (particularly B2B) has revolutionized and fundamentally reshaped business relationships and has caused dramatic shifts in channel power as information and communication imbalances disappear. Online exchanges are infiltrating distribution channels at an outstanding rate. As growth in the use of Internet accelerates, distributors have been warned repeatedly that they risk being cut out of the channel by aggressive Web-savvy, and purely virtual competitors. Gates (in Adelaar, 2000) opined that in recent years, it has been widely accepted that e-commerce signifies the dawn of a friction-free market; structural changes in markets, such as dis-intermediation, would occur due to the impact of electronic trade and electronic information age, albeit, Sarkar *et al.* (1995) disagrees, stating it is

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exaggeration because different outcomes are possible such as, cyber-mediation and re-intermediation. Moreover, the high fragmentation of the distribution industry, and the nature of the product sold which differs with respect to need for inspection, personal assistance needed from the expert, etc. has been challenging the view traditional channel replacement by the Internet. Instead, distributors will compete and collaborate with a new type of Internet-based company – the online exchange (OLE). Online exchanges, which are being created in almost every vertical supply chain, bring together buyers and sellers in ways that were not possible before the advent of Internet. It is believed by many that online exchanges (of the many variations of e-commerce) pose the most important strategic challenges to the traditional intermediary, whereas Fein *et al.* (1999) believe that distributors can retain an important, and enhanced place in the channel as these exchanges mature.

The issue of place retention by traditional channels or its replacement by e-commerce will depend on a number of factors chief among them being the value-added and the cost of each channel. The transaction cost theory by Coase (in Sarkar *et al.*, 1995) is an often-employed framework in the intermediaries context since it focuses on a firm's choice between internalized, vertically integrated structures, and the use of external market agents for carrying out activities that constitute its value system. In the context of channel decisions, it can be used to articulate process whereby firms either "make or buy" an intermediary function; that is, whether the firm decides to internalize the channel activity within its organizational boundaries, or whether it chooses to rely on the market (Sarkar *et al.*, 1995). In the milieu of choice between traditional channels or e-commerce, decision makers have employed the transaction cost perspective. Wigand and Benjamin (1995) examined electronic markets and the industry value chain from a transaction and transaction cost perspective. They argued that transaction cost theory helps to understand how markets and hierarchies are chosen. In free market economies, one can observe two basic mechanisms for coordinating the flow of materials and services through adjacent steps in the value chain: markets and hierarchies. Williamson (1981) further classified transactions into those that support coordination between multiple buyers and sellers (i.e. market transactions), and those supporting coordination within the firm as well as industry value chain (i.e. hierarchy transactions). Hence, the price a product is sold consists of three elements: production costs, coordination costs, and profit margin. Wigand and Benjamin (1995) suggest that the chain of market hierarchies, which bypasses the distributor, will result in a lower purchase price for the customer. Recent research by A.T. Kearney (2000a, b) showed that production costs seem to be under control, but Web-based processes can:

- save another 10-30 per cent from operating costs;
- cut cycle times by anything up to 90 per cent; and
- virtually eliminate the supply and demand mismatches that cause inventory build-ups and stock-outs.

Porter (1985) viewed value chain as a collection of activities that add value to the product or service provided. For instance, value is added when the production process takes raw materials, transforms them into finished or semi-finished products, and distributes them to customers. At each stage, a company makes profit if the price customers are willing to pay for (value-added to) the product exceeds the cost of creating the value. It has been noted that intermediaries add significant costs to the value chain, which are reflected in a higher final price of goods and services (Sarkar *et al.*, 1995). As illustrated in Benjamin and Wigand (1995), in the high quality shirts market, it would be possible to reduce the retail price by almost 62 per cent if wholesalers and retailers could be eliminated from the traditional value chain. If intermediaries will be eliminated at all, the "also runs" or "me too" intermediaries, who neither innovate nor add any tangible value are more prone to catch pneumonia when traditional channels are threatened by cold. Moreover, since the cost of creating value is a function of how well the activities in the value chain are coordinated, and integrated (Delphi Group, 2000), intermediaries who are unable to coordinate and integrate activities at reduced cost will suffer market loss to this newer marketing arrangement – the e-commerce.

Schmitz (2000) commented that the effects of e-commerce on intermediation depend on

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the characteristics of the goods under consideration. Schmitz (2000) considers high degrees of standardization, a low complexity of valuation, and ease of description as prerequisites to distribute goods via e-commerce. King and Kang (2000) indicated that product complexity is positively correlated to an e-shopper's propensity to use a vehicle other than the Internet to close a transaction. In other words, the more complex the product is, the more likely the customer is to seek information or make the purchase using a more interactive method of communication. Connors (2000) asserted that technological advances are producing many products more complex than what came before, so it is essential to get active guidance from technicians for customizing, integrating, installing, documenting, and maintaining these systems. As new technologies create new markets and opportunities, new technologies will replace older ones (Armstrong and Kotler, 2000), just as more efficient processes will take the baton from the exhausted ones. There is no gainsaying that the cycle rate of new technologies allows the distributors to bring, newer, less matured, and often more complex product lines into the mix, nonetheless, Waxman (2000a, b) holds the view that relationship with customer (common in relationship marketing) is still required even though the Internet may migrate to an order fulfillment vehicle. Manufacturers of many types of industrial goods tend to be more engineering than marketing-oriented, therefore, it is not surprising (given this orientation) that they frequently turn marketing problems to distribution specialists. This is one of the reasons why industrial products, more so than consumer products has been a particularly viable sector of wholesaling over the years (Stern and El-Ansary, 1988). Also, distribution goals depend in part on other product characteristics namely, unit value, standardization, bulkiness, complexity, stage of product life cycle (Pelton *et al.*, 1997), which affect decision about whether intermediaries should be used or which distribution channel to use. Industrial products more so than other product categories tend to be more complex, and the relevant properties are more technical in nature, which plausibly explains why "the same man who as a customer settles for plain shaving cream if he cannot find a lemon lime, will be unwilling as an industrial buyer to accept a bolt with 30 threads to the inch when his specification calls for 28 inches" (Webster, 1984).

Whilst some researchers have argued in favour of traditional channel based intermediation, others have feared its overthrow (dis-intermediation) by e-commerce. Wigand (1996) has defined dis-intermediation as the displacement of market intermediaries, enabling direct trade between sellers and buyers without agents. Schmitz (2000) wrote that the notion that e-commerce will lead to dis-intermediation seems to be widely accepted in the scientific community and well established in the popular debates. Schmitz further argued that elimination of intermediaries will have one of two causes: there is no longer a demand for the services provided by the intermediary; or the provider of these services is integrated into another company at a different step in the value chain and the service will be produced internally. According to Benjamin and Wigand (1995) when appropriate information technology can reach the consumer directly – the manufacturer can use the national information infrastructure to leap over all intermediaries. In turn, Picot *et al.* (1997) argued that with the support of information and communication technology, principals could acquire the agent's superior problem solving capabilities, thus enabling them to fulfill the originally delegated tasks on their own. In line with above argument, Pitt *et al.* (1999) reasoned that many intermediaries will die out, while new channels and new intermediaries will take their places as a result of the emergence of Internet, and the World Wide Web will change distribution like no other environmental force since the industrial revolution. Other works (e.g. Sawhney, 2000) have studied the channel impact of e-commerce and categorized richness of physical interactions in the buying process and the intensity of information in the buying process as two main factors influencing whether a company should disintermediate its channel partners.

The synthesis of these divergent views is the form of collaboration between producers and channels partners with the help of advancement in information technology. Partner Relationship Management, (PRM) focuses on information that enables channels partners to quickly act on the product and

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customer data they receive from vendors (Connors, 2000). The PRM utilizes specialized extranets (password protected Web sites) that enable producers and their channels partners to share and jointly manage business processes to facilitate sales management and product information sharing, offering secure Web sites that afford partners access to all a producer's data – leads, profiles, and sales support documents (Connors, 2000). Survey conducted by Johnson (1999) on industrial equipment distributors unveiled that dependence, flexibility, continuity expectations, and relationship age, encouraged the distributor's strategic integration of its supplier relationship. These new intermediaries or e-marketplaces in some cases are threatening existing intermediaries, and in many other cases, they are establishing partnerships with traditional intermediaries (Weller, 2000).

In sum, some developments (e.g. increased efficiency and availability of truck transportation, increased availability and access to electronic data interchange via WWW, growth of larger retailers) threaten the overall viability of distributors, or at least limit their ability to perform certain functions profitably, whereas others create new opportunities for distributors growth and expansion, and new ways of doing business (Bagozzi *et al.*, 1998). Schmitz (2000) submits that the effects of the diffusion of e-commerce would not reduce the functions of distributors in gathering, organizing, and evaluating information, instead the informational efficiency of intermediation will prevail. Moreover, there is no indication that e-commerce would reduce the marginal efficiency gains from engaging in a principal agent relation nor increase its marginal costs to the principal. Corroborating, Amor's (2000) summation posits that the Internet has become the fourth channel for trade, after face-to-face, mail, and telephone.

Research framework and method

This study attempted to investigate the likelihood of market characteristics and technology novelty in impacting the roles of industrial distributors in the e-commerce world (see Figure 1). Based on Tidd *et al.* (1997) and Bagozzi *et al.* (1998) the research model was developed. Bagozzi *et al.*"s (1998) model of distribution functions was adapted to categorize distribution functions into three major groups – functions for customers, functions for producers, and functions for both customers and producers. Tidd *et al.* (1997) developed the two-by-two matrix of technological and market novelties presented in Figure 2. Market innovation includes the identification of market trends and opportunities, the translation of these requirements into new products and services, and the promotion and diffusion of these products. Clearly, understanding the maturity of the technologies and markets will provide organizations an insight of strategic or tactical marketing that the firm might adopt.

Since a number of studies (e.g. King and Kang, 2000; Schmitz, 2000) have shown that the nature of the product is important factor in determining whether or not transaction will be done online, an investigation of different product categories in the semiconductor industry is needful as there is currently no known study focusing on this sector.

For complex products, both the technologies and markets are novel, and co-evolve. In this case there is no clearly defined use of a new technology, but over time

Figure 1 Schema of the study model

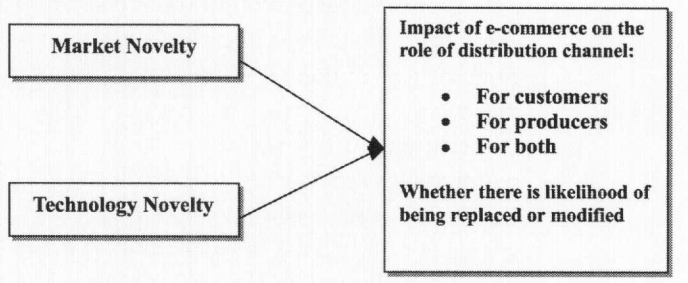
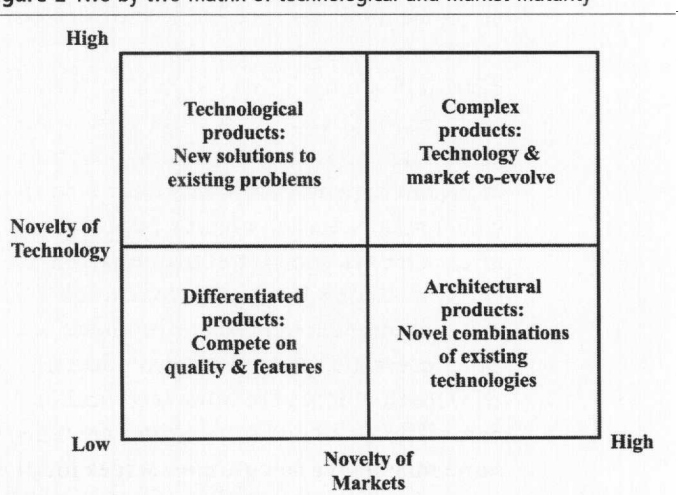


Figure 2 Two-by-two matrix of technological and market maturity



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developers work with lead users to create new applications. The development of multimedia products and services is a recent example of such a co-evolution of technologies and markets.

Technological products are novel technologies developed to satisfy known customer needs. Such products and services compete on the basis of performance, rather than price or quality. Here, innovation is mainly driven by developers.

Architectural products are existing technologies applied or combined to create novel products or services, or new applications. Competition is based on serving specific market niches and on close relations with customers. Innovation typically originates or is in collaboration with potential users.

Differentiated products are those in which both the technologies and markets are mature, and most innovations consist of the improved use of existing technologies to meet a known customer need. Products and services are differentiated on the basis of packaging, pricing and support.

Verification of the impact of e-commerce on the roles of physical distributors (for customers, producers, and for both) of four different types of products is important as product nature may have different implications for this industry. Hence, the following hypotheses were verified:

H1. The change in importance of functions for customers is higher for differentiated products, architectural products, technological products, and then complex products.

H2. The change in importance for functions for producers is higher for differentiated products, architectural products, technological products, and complex products.

H3. The change in importance for functions for both customers and producers is higher for differentiated products, architectural products, technological products, and complex products.

H4. The likelihood of functions for producers being replaced is higher for differentiated products, architectural products, technological products, and then complex products.

H5. The likelihood of functions for customers being replaced is higher for differentiated products, architectural products, technological products, and then complex products

H6. The likelihood of functions for both being replaced is higher for differentiated products, architectural products, technological products, and then complex products.

Method

The population of study includes all multi-national industrial distributors in the semiconductor industry in Penang, Malaysia. It is important to mention that Penang is the seat of semiconductor business in Malaysia and East-Asia by extension. A total of 63 distributors of different countries of origin (as shown in Table I) were identified, and respondents were selected based on purposive sampling (non-probabilistic) method targeted at decision makers. Out of this, 54 usable responses were received. All the firms included in this study have a Web site where products are exhibited. They also have portals where customers as well as producers logon to access and give information regarding products, order placement and payment, etc. The distributors have ample experience with both on-line and off-line transactions. Thus, respondents are aware of the changes in importance of e-commerce having experienced the two worlds.

The questionnaire was adapted from Tidd *et al.* (1997) and Bagozzi *et al.* (1998). All questions were rated using five-point Likert-like scale. Questions relating to change in importance were measured from greatly decreased (point 1) to greatly increased (point 5), while those relating to likelihood of distributors functions being replaced or modified were measured from highly unlikely (point 1) to highly likely (point 5).

Results and discussion

The internal consistency of the measures was ascertained via reliability analysis. The Cronbach's Alpha coefficients for all dimensions show values higher than 0.60 except for likelihood of distributors (for differentiated products) function for producers being replaced, which is 0.50. As observed from Table II, the construct measures are reliable.

Table I Responding organizations by country of origin

Country	America	Asia	AME	Europe	Oceania	Total
Australia					2	2
Belgium				1		1
Finland				1		1
France				2		2
Germany				3		3
Greece				1		1
Hong Kong		6				6
Israel			1			1
Italy				2		2
Japan		5				5
Malaysia		1				1
The Netherlands				2		2
Rep. of Korea		2				2
Singapore		3				3
South Africa			2			2
Spain				2		2
Sweden				1		1
Taiwan		5				5
Turkey				1		1
UAE			1			1
UK				3		3
USA	7					7
Total	7	22	4	19	2	54

Notes: AME = Africa and Middle East; UAE = United Arab Emirate

Table II Cronbach's alpha values

	Change in Importance				Likelihood of being replaced or modified			
Role of distributors	S1	S2	S3	S4	S1	S2	S3	S4
Functions for customers	0.88	0.88	0.77	0.80	0.83	0.90	0.89	0.80
Functions for producers	0.74	0.73	0.73	0.72	0.50	0.80	0.81	0.71
Functions for both	0.62	0.73	0.75	0.74	0.65	0.81	0.80	0.83

Notes: S1 = differentiated products; S2 = architectural products; S3 = technological products; S4 = complex products

E-commerce and change in importance of distributors roles

Table III shows the mean and standard deviation for the change in importance of distributors functions for all product categories.

E-commerce has convincing impact on the importance of distributors functions with mean values ranging from 3.06 to 3.96 across product categories. The perceived impact of e-commerce on the importance of distributors" functions for customers, producers and for both respectively range from 3.60 to 3.74, 3.52 to 3.69, and 3.44 to 3.56 across product categories. The impact of e-commerce on the overall functions of distributors (a combination of functions for customers, producer, and both) is increasing for all categories. Mean and standard deviation of perceived impact on the importance of overall distributors" functions based on product categories are as follows: differentiated products (3.54; 0.62), architectural products (3.62; 0.58), technical products (3.59; 0.58), and complex products (3.50; 0.64). In all, the results show a strong impact of e-commerce on perceived importance of the roles of distributors in the semiconductor industry.

The three most important impact of e-commerce on the roles of distributors of complex products going by their mean value is in the area information gathering (3.91), promoting and highlighting new products

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Table III Change in importance of distributors" roles

Role of distributors	Mean				SD			
	S1	S2	S3	S4	S1	S2	S3	S4
Functions for customers	3.61	3.74	3.73	3.60	1.10	0.84	0.85	0.95
Right attribute	3.61	3.83	3.94	3.74	1.23	0.91	0.98	1.08
Right quantity	3.61	3.65	3.52	3.46	1.09	0.87	0.91	1.00
Functions for producers	3.69	3.66	3.60	3.52	0.81	0.70	0.73	0.73
Storing	3.59	3.30	3.24	3.06	0.92	0.79	0.75	0.81
Financing	3.64	3.76	3.75	3.59	1.09	0.83	0.85	0.96
Information gathering	3.85	3.93	3.81	3.91	0.98	0.97	1.10	0.96
Functions for both	3.44	3.56	3.53	3.45	0.58	0.55	0.58	0.64
Risk reduction	3.13	3.11	3.26	3.07	0.75	0.77	0.71	0.93
Educating customers and representing producer	3.20	3.76	3.57	3.76	1.14	1.08	1.11	1.16
Transport safely	3.35	3.31	3.30	3.19	0.85	0.58	0.69	0.73
Transport on time	3.57	3.46	3.39	3.20	0.94	0.77	0.74	0.81
Promote/highlight new products	3.74	3.85	3.91	3.89	1.07	0.94	1.00	1.02
Promo. programs for sales force	3.61	3.83	3.78	3.59	1.09	0.86	0.90	1.09
Overall function	3.54	3.62	3.59	3.50	0.62	0.58	0.58	0.64

Notes: S1 = differentiated products; S2 = architectural products; S3 = technological products; S4 = complex products

(3.89), and educating customers and representing producers (3.76). For architectural products, the three most salient functions are information gathering (3.93), promoting and highlighting new products (3.85), and right attribute (3.83), while for technological products, they include providing the right attribute (3.94), promoting and highlighting new products (3.91), and information gathering (3.81). For differentiated products, the most important functions are information gathering (3.85), promoting and highlighting new products (3.74), and financing (3.64). Clearly, e-commerce has strongly impacted the informational roles of distributors in the semiconductor industry positively as demonstrated in the above results. In all product categories in the industry, perceived impact of e-commerce on the distributors roles is very robust in the area of information gathering and disseminating. One plausible explanation for this finding is found in the very nature of the industry and its products. In the semiconductor industry, adequate product information is vital in order to overcome problems emanating from wrong orders and delivery of incorrect specifications, as it is very common for each spec to have a definite size and use, which cannot be modified or exchanged. The richness and timeliness of product information available on the Internet makes this mode very useful.

Table IV presents the ranking in the perceived change in importance for the four product categories using the Friedman two-way ANOVA. The results indicate that there is no definite ranking in the perception of change of importance for the three main functions measured in this study. Nonetheless, mean rank for differentiated products is generally highest (2.17-2.94), followed by architectural products (2.46-2.71), technological products (2.35-2.71), and complex products (2.14-2.65). This signifies that decrease of change in importance is seen more with complex products as compared to technological, architectural, and differentiated products. Further scrutiny of the data indicates that three functions have definite ranking, namely storing, educating customer and representing producer, and transport on time with Kendall test of concordance at 0.111, 0.055, and 0.049 respectively.

Likelihood of distributors roles being replaced

Table V presents the means and standard deviations for likelihood of traditional distributors being replaced. Mean and standard deviation of likelihood of using the Internet instead of traditional distributors to provide overall distributors functions based on product category are, differentiated products (3.41; 0.59), architectural products (3.24; 0.75), technological products (3.24; 0.71), and complex products (3.09; 0.78). The results show that the likelihood of the

Table IV Friedman two-way ANOVA by rank (change in importance)

Role of distributors	Mean rank				Test statistics		
	S1	S2	S3	S4	Chi-sq.	Sig.	W[a]
Functions for customers	2.43	2.70	2.49	2.38	2.679	0.444	0.017
Right attribute	2.35	2.53	2.71	2.41	3.933	0.269	0.024
Right quantity	2.66	2.62	2.36	2.36	3.994	0.262	0.025
Functions for producers	2.71	2.66	2.35	2.28	5.380	0.146	0.033
Storing	2.94	2.52	2.41	2.14	17.972	0.000**	0.111
Financing	2.46	2.71	2.50	2.32	3.441	0.329	0.021
Information gathering	2.52	2.56	2.41	2.51	0.702	0.873	0.004
Functions for both	2.25	2.68	2.59	2.48	3.860	0.277	0.024
Risk reduction	2.43	2.46	2.68	2.44	3.210	0.360	0.020
Educating customers and representing producer	2.17	2.67	2.52	2.65	7.966	0.047*	0.049
Transport safely	2.61	2.56	2.50	2.33	3.743	0.291	0.023
Transport on time	2.69	2.62	2.48	2.20	8.935	0.030*	0.055
Promote/highlight new products	2.39	2.49	2.56	2.56	1.015	0.798	0.006
Promo. programs for sales force	2.43	2.59	2.56	2.42	1.455	0.693	0.009

Notes: S1=differentiated products; S2 = architectural products; S3 = technological products; S4 = complex products.
* $p < 0.05$; ** $p < 0.001$. [a] Kendall's coefficient of concordance

Table V Likelihood of distributor's roles being replaced

Role of distributors	Mean				SD			
	S1	S2	S3	S4	S1	S2	S3	S4
Functions for customers	3.62	3.24	3.28	3.12	1.02	1.05	1.05	1.06
Right attribute	3.69	3.30	3.41	3.28	1.10	1.16	1.16	1.23
Right quantity	3.56	3.19	3.15	2.96	1.11	1.05	1.05	1.08
Functions for producers	3.50	3.28	3.27	3.15	0.70	0.92	0.87	0.86
Storing	3.22	2.96	3.07	2.94	1.02	1.03	0.91	0.96
Financing	3.60	3.29	3.28	3.11	1.04	1.08	1.08	1.09
Information gathering	3.69	3.59	3.46	3.41	0.95	1.17	1.08	1.16
Functions for both	3.30	3.22	3.16	3.05	0.59	0.69	0.68	0.77
Risk reduction	2.83	2.94	2.85	2.72	0.88	0.76	0.86	0.90
Educating customers and representing producer	3.31	3.26	3.15	3.19	1.04	1.15	1.09	1.27
Transport safely	3.22	3.09	3.08	2.85	0.92	0.83	0.85	0.83
Transport on time	3.30	3.13	3.09	3.04	1.02	0.91	0.83	0.80
Promote/highlight new products	3.54	3.54	3.50	3.24	0.95	1.04	1.15	1.24
Promo. programs for sales force	3.59	3.35	3.31	3.28	1.02	1.07	0.99	1.11
Overall function	3.41	3.24	3.24	3.09	0.59	0.75	0.71	0.78

Notes: S1 = differentiated products; S2 = architectural products; S3 = technological products; S4 = complex products

brick and mortar distributors roles (for customers, producers, and for both) being replaced by e-commerce is higher for differentiated products and least for complex products. This result is probably accounted for by the low level of technology novelty and market novelty of differentiated products. Since market and technology co-evolve in complex product category, the roles of distributors seemingly become more indispensable as demand for their specialized services increase. This finding corroborates that of Schmitz (2000), which reported that high degrees of standardization and low complexity of valuation are prerequisites to distributing goods via e-commerce.

In Table VI, the summary of Friedman two-way ANOVA and Kendall test of concordance's test results for likelihood of functions being replaced is provided. There is a definite ranking across all product categories for the three main functions. Generally, mean rank is highest for differentiated products (2.53-2.94), followed by architectural products (2.40-2.68), technological products (2.27-2.58), and subsequently complex

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Table VI Friedman two-way ANOVA by rank (likelihood of being replaced)

Role of distributors	Mean rank				Test statistics		
	S1	S2	S3	S4	Chi-sq.	Sig.	W[a]
Functions for customers	2.94	2.42	2.40	2.25	11.544	0.009**	0.071
Right attribute	2.81	2.40	2.49	2.31	6.845	0.077	0.042
Right quantity	2.94	2.47	2.42	2.18	15.233	0.002	0.094
Functions for producers	2.85	2.54	2.32	2.29	7.359	0.061[b]	0.045
Storing	2.69	2.41	2.53	2.37	3.179	0.365	0.020
Financing	2.94	2.47	2.39	2.20	12.541	0.006	0.770
Information gathering	2.65	2.61	2.28	2.46	4.239	0.237	0.026
Functions for both	2.80	2.68	2.27	2.26	8.554	0.036*	0.053
Risk reduction	2.53	2.65	2.53	2.30	4.660	0.198	0.029
Educating customers and representing producer	2.56	2.52	2.42	2.51	0.534	0.911	0.003
Transport safely	2.75	2.56	2.48	2.21	9.505	0.023	0.060
Transport on time	2.69	2.51	2.41	2.40	3.456	0.327	0.021
Promote/highlight new products	2.56	2.55	2.58	2.31	2.669	0.446	0.016
Promo. programs for sales force	2.75	2.50	2.40	2.35	5.058	0.168	0.031

Notes: S1 = differentiated products; S2 = architectural products; S3 = technological products; S4 = complex products. * $p < 0.05$; ** $p < 0.01$. [a] Kendall's coefficient of concordance. [b] Moderate

products (2.18-2.51) for all functions. It is therefore conclusive to state that the likelihood of functions of traditional distributors being replaced is highest for differentiated products, followed by architectural products, technological products, and complex products. Detail check shows that right attribute, right quantity, financing, and transport safely, have definite ranking for likelihood of being replaced. The mean rank for the last three is highest for differentiated products, architectural products, technological products, and complex products in order. As for the right attribute function, the order is similar except that architectural and technological products swapped positions.

The findings of the study show that there is increasing impact of e-commerce on the roles of distributors of all product categories, even though there is no definite ranking of respondents" perceptions on changes in importance across the four types of products. Thus, there is no evidence to support the validity of *H1-3*. However, their perceptions of the likelihood of distributors" functions being replaced show otherwise. As stated in *H4-6* respectively, the likelihood of distributors" functions for producers, customers, and for both, being replaced is higher for differentiated products followed by architectural products, technological products, and lastly complex products. With Chi-square (λ) of 0.009, 0.036 and 0.061 respectively, there is significant evidence supporting *H4* and *H6*, and marginal evidence supporting *H5*. This can possibly be explained from three perspectives. Firstly, the advancement in technology enables the shift in roles from distributors to customers and producers. Customers can now source for the right product and the right quantity utilizing the Internet whereby more products information is posted for customers" reference, moving the business setting to a customer centric environment. This is consistent with Frank Lynn & Associates, Inc. (1997) and Fein (1998). Moreover, as basic competition in the marketplace has enabled more comprehensive information to be posted on the Internet and competitors are relatively flexible in products offering, customers could resort to the Internet for such information, which they previously rely on distributors to provide. Next, the emergence of Internet financiers and lenders, increased lending by financial and other institutions, and decreasing need for storage occasioned by computerized stock management systems and JIT, could have impacted the likelihood of the roles of traditional distributors to producers being replaced. Lastly, availability of truck transportation and increased efficiency may have contributed to the likelihood of traditional distributors being replaced in providing safe and timely transportation. Customers and producers may not need to rely on brick and mortar distributors, but

depend on forwarders or couriers for reliable shipment. This is consistent with Bagozzi *et al.*'s (1998) view.

For undifferentiated products (i.e. architectural, technological, and complex products), it is less likely (compared to differentiated products) that dis-intermediation will occur. The rationale behind this phenomenon could be that the customers and producers are not ready to take over the distributors" roles even though technology advancement is seen from day to day. On the other hand, e-shoppers are less likely to close a transaction using the Internet when the product is somewhat complicated. Thus far, most of the producers are still unprepared, either technologically or from a business process perspective, to pipe a large portion of their B2B transactions over the Internet to promote complex products that are often difficult to describe. The transaction costs involved may be too high to be absorbed by both the customers and producers. From the producers" standpoint, the extra costs incurred may include the need to provide immediacy, flexible pricing structure, advanced customer support, digital signatures or financial clearing for large-sum transactions. From the customers" perspective, sourcing information from multiple Web sites for a single non-standardized product may not be cost effective. This may be a carry over effect of single supplier source era. Also, the effectiveness of distributors in getting critical mass could be apparent to producer and cannot be underestimated. On top of that, the efficiency and value added by performing these functions could be one of their concerns. Unless the producers have resources to internalize the channel activities within its organizational boundaries, it may be deemed more cost effective to leave these functions to the hands of distributors.

Implications of study

Several implications of study are raised based on the findings. The research may provide distributors an idea of which of the functions that can be replaced and which are those that cannot be substituted based on types of products. For those functions that are more likely to be replaced, distributors should collaborate with producers and customers to integrate their operational activities in order to achieve higher efficiency level, which will eventually benefit all parties in the supply chain. For those functions that are less likely to be replaced, distributors may continue to strengthen their competitive edge and further add value to customers and producers, in particular in today's world of solution centric business model. Traditional distributors should deliver solutions instead of just commodities, which is the only way they can retain an important place in the channel. Distributors may need to ensure that massive amount of supply and demand data is well-managed and near-perfect information to buyers and sellers are easily available. The ability of distributors to provide market intelligence to producers will be considered as value added as it is difficult for producers to monitor each and every one of their customers. Furthermore, with the findings, distributors may make some strategic decision as to whether to concentrate on demand fulfillment business or demand creation activities. Apart from the above, it is not likely that Fein *et al.*'s (1999) belief that distributors can retain an important, and enhanced place in the channel will hold. The current study supports the earlier findings of Schmitz (2000) that the effects of e-commerce on intermediation depend on the characteristics of the goods under consideration, as well as the findings of King and Kang (2000) that product complexity is positively correlated to an e-shopper's propensity to use a vehicle other than the Internet to close a transaction. Therefore, since product simplicity (i.e. non-complication) is negatively associated to an e-shippers propensity to use a vehicle other than the Internet to close a transaction, brick and mortar distributors may wish to exploit this opportunity created by the inability of e-commerce to begin and complete delivery of complex products or highly technical products by extension. Besides that, the findings may trigger discussion on the possibility of consortia-like electronic marketplace being the next business model for distribution channel since it may help to achieve to a more efficient market. Distributors need to be ready and prepared for the next possible distribution channel evolution. As much as the functions of distributors of undifferentiated products may be less likely to be replaced in near term, however, the Internet will continue to deliver information and options to customers at an exponentially accelerating rate that may

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change the traditional channel practices in the long run.

Limitations of study

Some limitations and opportunities for additional research can be identified from this research. Firstly, this study is purely on understanding the respondents" perceptions and they are not tracked over time on the change in importance and likelihood of distributors" functions being replaced. Secondly, the sampling of this study is limited to semiconductor industry, hence may not be applicable to other industry sectors. Lastly, this study concentrates only on market and technology novelty as independent variables, which may underestimate the effect of other factors that could potentially influence the changes in importance and likelihood of distributors" functions being replaced.

Suggestions for future research

This study is exploratory in nature and may seem to be oversimplified focusing only on two independent variables. Several recommendations to advance research in this area is put forward. First, the future research should be longitudinal, using actual data of change in importance and likelihood of functions being replaced. This will help to ascertain if the findings based on actual data agree with findings of the current study, which is based on perceptions. Besides, the future research should also cover a wider industry sectors for a more comprehensive findings. Lastly, it is suggested that future research should include other independent factors besides market novelty and technology novelty. The factors suggested are how well verse are customers in using Internet, investment in information technology by producers and customers, readiness of the infrastructure in supporting usage of Internet, and cultural differences in different countries.

Conclusion

This study attempts to provide an understanding of the impact of e-commerce from a very specific perspective, namely the market novelty and technology novelty in the semiconductor industry by examining four product categories such as, differentiated products, architectural products, technological products, and complex products. The findings of the study reveal that e-commerce has important impact on the roles of distributors, albeit there is no definite ranking across the four product categories. Further, findings by comparing among the four different types of products show that the likelihood of distributors' functions (for producers, for customers, and for both) being replaced is higher for differentiated products followed by architectural product, technological products, and subsequently complex products. Hopefully this piece of information will be useful to the distributors in further developing their strategic and realign the business goals in order to compete in the dynamic world of technology.

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