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Supply Chain Intelligence and Its Impact on Business Performance

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ABSTRACT

Intense global competition has greatly influenced how organisations strive for survival and business success. The emergence of competitive intelligence (CI) and supply chain management (SCM) in dealing with such circumstances has resulted in the need to study further their subsequent impact on business performance. This study examined the use of intelligence in supply chain activities. It attempts to fill the gap in current research by investigating the role of supply chain intelligence (SCI) as a factor influencing a firm's competitiveness that is crucial for future business performance. Based on responses received from 174 firms, confirmatory factor and multiple regression analyses were used to test the research hypotheses. Results suggest that there are significant positive relationships between SCI and business performance. Thus, it validates SCI's contribution and emphasises its potential, if managed efficiently, to boost performance. This study has provided new empirical evidence concerning this. It is suggested that SCI should subsequently be adopted by business organisations as one of the measures to handle the increasingly competitive business environment.

Keywords: Competitive intelligence, supply chain intelligence, supply chain performance

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Any remaining errors or omissions rest solely with the author(s) of this paper.

INTRODUCTION

Historically, much of the focus of integration and knowledge sharing in Supply Chain Management (SCM) has been technology driven, which involves the technical aspects of delivering information between supply chain partners. Discussion on information is more prominent in the technical field dealing with data warehousing systems, servers and other hardware to store and exchange information across the value chain, to assist huge numbers of employees become more productive and efficient, and to result in better business decisions (Stefanovic et al., 2007; 2009). In other words, software and machines play an important role in filtering a tremendous amount of data and information. Having arrived at a point where many of the technical challenges and tradeoffs are at least well understood, attention has shifted toward expanding the ways in which human potential should be emphasised in managing information effectively for both organisational and supply chain decisions in order to boost performance (Raisinghani & Meade, 2005; Hughes, 2005; Wilkins, 2007). In this dimension, data warehousing and information technology form the central repository and thus are a tool to assist intelligence personnel since their inherent capabilities to perform analysis and decision-making are still critical components for delivering business value in supply chain activities (Colakoglu, 2011; Stefanikova & Masarova, 2014). Intelligence requires a process that involves people reviewing and making sense of information. This is where the concept of competitive intelligence (CI) as a systematic process of planning, collecting, analysing and disseminating strategic information on external environments by a specific person/unit for strategic decisions comes into play (Academy of Competitive Intelligence, 2014). Based on these arguments, this study emphasises intelligence information in the strategic management dimension as the integrative approach to supply chain management are bring forward, and known as supply chain intelligence (SCI).

While previous research has been conducted on intelligence, much of it was centred on the process of its acquisition and employment by organizations (Cartwright et al., 1995; Rouach and Santi, 2001; Wright et al, 2002; Wright and Calof, 2006). The specific components of information which are unique to a firm, industry, and nature of business are rarely discussed and remain the exclusive property of the firm in question. By identifying and constructing the kinds of specific information collected by firms, a comprehensive measure of SCI components and their patterns, if any, that are critical and applicable for businesses might be analysed. Furthermore, based on the assumption that different industries gather different information, the SCI components that are being employed by the manufacturing industry might offer an interesting approach as a starting point in this study since that industry has a more extensive global supply chain network than other industries.

The increasing focus on intelligence in studies has further heightened arguments relating to its importance and value to a company's performance. The media have reported various estimates as to the size of the intelligence market and the amount which companies are willing to spend on it due to its perceived contribution to business performance. For example, Market Wire (2007) predicted that the market for SCI would be worth US$10 billion in 2012, up from a spend of about US$1 billion in 2007. However, most studies have focused primarily on the extent to which intelligence has been adopted by organisations as an activity rather than investigating the consequences of its adoption on performance (Wright et al 1999, 2002; Badr, 2003; Stefanikova & Masarova, 2014). One particular challenge for researchers is to develop new performance measures due to intelligence activities that would be stimulants to improved business performance. Gaining this insight shows the critical need for SCI by businesses in order to stay ahead of competition. In summary, there is a gap in the existing literature and there is a real need for more research to be conducted to facilitate the understanding and development of SCI regarding the supply chain performance of businesses. The objective of this study therefore is to identify the dimensions of SCI components. Hence, the relationship between supply chain intelligence and performance in Malaysia's manufacturing firms will be further examined.

The study contributes to uncovering the underlying dimensions of SCI since there is a lack of previous study on the dimensions of SCI components. Further, this study examines the role of SCI and its impact on firms' performance because most of the previous investigation of integration and knowledge sharing in SCM has been IT driven. Specifically, this study brings a new perspective about SCI that will enable companies to have a 360-degree view of their businesses for new opportunities to increase revenue, cut costs and enhance customer satisfaction (Haydock, 2003; Viswanathan and Sadlovska, 2010).

LITERATURE REVIEW

Supply Chain Intelligence (SCI)

Competing in today's business environment precipitates the need for successful integration and collaboration strategies among supply chain partners. The global environment is influenced by increased globalisation and outsourcing, mergers, new technologies, and e-business, forcing organisations to adopt new ways of doing business. SCI provides a broader view of CI on the dynamic relationship of supply chain integration for facilitating better business decisions. It reaches beyond an organisation's internal processes and external environment to include supply chain

partners. Wilkins (2007) defines SCI as the art of acquiring, presenting, analysing, and refining knowledge about the competition's supply chains and then reaching actionable conclusions about potential improvements the organization. Based on the various definitions of CI (Calof and Skinner, 1999; Wright and Calof, 2006; Adidam et al., 2012) and SCM (Chopra and Meindl, 2001), the term SCI in this study is best described as "a set of systematic intelligence processes concerning opportunities or developments that have the potential to affect individual firms and their supply chain networks as a whole towards improving long-term performance."

There is a difference between Competitive Intelligence (CI) and SCI. Even though CI takes a comprehensive view of the internal and external environment (Academy of Competitive Intelligence, 2014), it is limited to operational aspects of SCM. It can be seen that CI is centred on evaluating information about individual stakeholders and internal operations without emphasising the links and interaction (the harmony of the relationship) between supply chain parties (i.e. open communication, knowledge sharing, participation, trust, mutual goals, commitment, integration, etc.). According to Wilding and Humphries (2006), collaboration by working together in the supply chain is essential to achieve effective operations in harmony with the strategies and objectives of all the parties involved, thus resulting in mutual benefit. Though CI is acceptable for the analysis of the competitive position of a firm, it needs suitable adaptation to address the growing phenomenon of supply chains. Therefore, SCI in this study is considered to be a "sub-set" of CI. It covers both the CI and SCM concepts together. It can be seen that SCI perspectives are highly valuable in analysing not only affected stakeholders in isolation, but also the harmony of the relationship between supply chain partners and networks. The volume of data that SCI analysts must utilise means they must have good CI and SCM systems. Thus, SCI is more humanised because it is a unique systematic process that involves people's capability in transforming raw data into actionable intelligence which focuses on the integration of the supply chain between partners, yet also creates value and provides a sustainable competitive advantage for the firm (Porter, 1980; Kahaner, 1997; Wilkins, 2007; Stefanovic *et al*., 2009).

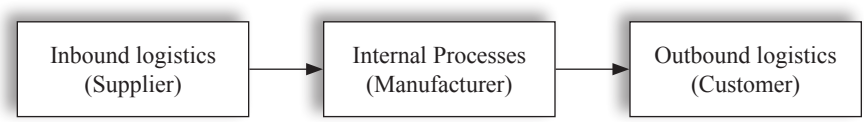

Figure 1 Supple chain elements (Adopted from Mentzer *et al*., 2001)

Subsequently, the supply chain is the network of organisation which is also known as the 'supply chain elements.' It consists of supplier, manufacturer, and customers that are involved through upstream and downstream linkages (Figure 1), which produce value in the form of products and services delivered to the ultimate consumer (Christopher, 1992; Mentzer et al., 2001). Based on these assumptions, SCI components are constructed based on both components of CI and of SCM. These components are focused on the interaction between supply chain elements or partners. In this study, the SCI of supply chain elements (supplier, internal process, and customer) includes any competitors. These SCI components are illustrated in Table 1.

Business Performance

As SCI becomes more established as an important discipline, the need grows to devise ways of measuring and quantifying the results of intelligence gathering operations (Solomon, 1996; GIA, 2004b; Hughes, 2005). Although the value of intelligence appears self-evident to practitioners, the use of performance measures will be further discussed.

Organisational performance is the most widely researched but least understood and most contentious area in strategic management (Neely, 1999; 2005). The problem of conceptualising, operating, and measuring organisational performance often leads to inconsistent and conflicting results. Traditional financial performance measures are at best too summarised, lack strategic focus, and often provide a limited and misleading picture of an organization's performance (Gunasekaran *et al*., 2001; Bourne, 2000, 2005). Thus, a meaningful way to understand the abstract idea of effectiveness is to consider how researchers have conceptualised and measured the construct in their work. Wright and Calof (2006) posit that the adoption of organisational performance measurements will be different depending on the field of study and the research questions. Similarly, many studies have reported that those firms placing a premium on intelligence are outperforming their peers on sustained revenue growth, gross margins, and a number of other key performance measures (Reuters, 2001; Market Wire, 2007; Johns and Van Doren, 2010; Gilad; 2011). However, there is a high degree of scepticism amongst academics and practitioners regarding intelligence's ability to effectively or directly support organisational performance (Bernhardt, 1996; GIA, 2004b). There is, therefore, a need to devise ways of measuring and quantifying the results of SCI gathering operations as intelligence becomes more established as a professional discipline.

Table 1 SCI components

SCI Components	SCI Elements	CI Literature	SCM Literature
Uncontrollable environment (External issue)	Global economy, market and industry structure, political, social, and government, and substitute product.	Prescott & Gibbons, (1993); Porter, (1995); Johnson & Scholes, (2002); APQC, (2003); Fleisher, (2004); Priporas et. al. (2005); Pelsmacker et. al. (2005); Badr et. al. (2006); Brouard, (2006); Wright & Calof, (2006); Miree et. al. (2007); Pirttimaki, (2007); Calof & Wright, (2008)	
Competitive activities	Capacity expansion, mergers and acquisitions, potential strategic partners, and benchmarking.	Fleisher (2004); Pelsmacker et al. (2005); Badr et al. (2006); Brouard (2006); Miree et al. (2007); Wilkins (2007); Calof & Wright (2008)	Lamming (1993); Monczka et al. (1998); Chandra and Kumar (2000); Mentzer et al. (2001); Gunasekaran et al. (2001); Tan et al. (2002); Childhouse & Towill (2003); Sambasivan & Jacobs (2008)
SCM activities	Agility, cost efficiency, information sharing, logistics, communication, commitment, response time, and product development.	Wilkins (2007)	Monczka et al. (1998); Chandra and Kumar (2000); Mentzer et al. (2001); Gunasekaran et al. (2001); Tan et al. (2002); Childhouse & Towill (2003); Wilkins (2007); Sambasivan & Jacobs (2008); Stefanovic &Stefanovic (2009)
Customer/ supplier activities	Bargaining power, relationship, delivery flexibility and capability, quantity delivered, product prices, procurement system, technical expertise, and on-time delivery.	Porter (1995); Johnson & Scholes (2002); APQC (2003); Fleisher (2004); Pelsmacker et al. (2005); Brouard (2006); Wright & Calof (2006); Pirttimaki (2007); Miree et al. (2007); Calof & Wright (2008)	Lamming et al. (1996); Monczka et al. (1998); Tan et al. (1998); Narasimhan and Das (2001); Gunasekaran et al. (2001); Tan et al. (2002); Chopra and Meindl (2004); Sambasivan and Jacob (2008)

Table 1 (*Con t'd*)

Research and technology initiatives	Product innovation, RMD planning & investments, technology capability, and expertise.	Teo & Choo (2001); Chen et al. (2002); Fleisher (2004); Thomas & Tryfonas (2005); Priporas et al. (2005); Badr et al. (2006); Brouard (2006); Wright & Calof (2006); Pirttimaki (2007); Calof & Wright (2008); Dishman & Calof (2008)	Stuart and McCutcheon (2000); Kuei & Madu (2001); Kuei et. al. (2002); Min and Zhou (2002); Vickery et.al.(2003); Kemppainen and Vepsalainen (2003); Stefanovic et al. (2007) ; Stefanovic & Stefanovic (2009)
Marketing planning	Product developments & enhancements, pricing strategy, market focus, cost structure, branding and positioning, product quality, customer service and complaints, and substitute product.	Prescott & Gibbons (1993); Porter (1995); Johnson & Scholes (2002); APQC (2003); Fleisher (2004); Badr et al. (2006); Miree et al. (2007); Wilkins (2007)	Slater and Narver (2000); Stuart and McCutcheon (2000); Frohlich and Westbrook (2001); Kuei & Madu (2001); Min and Zhou (2002); Vickery et. al. (2003); Kemppainen and Vepsalainen (2003); Green et al. (2006)
Strategic planning	Organisation and supply chain goal, competitive strategy, and scope of activity.	Calof & Miller (1998); Du Toit (2003); Fleisher (2004); Hodges (2005); Badr et al. (2006); Miree et al. (2007); Wilkins (2007)	Chandra and Kumar (2000); Mentzer et al. (2000); Gunasekaran et al. (2001); Tan et al. (2002); Childhouse & Towill (2003); Sambasivan & Jacobs (2008); Wilkins (2007)
Organizational resources	Culture, reward, structure, policy, top management, financial, employees, training, reputation, trust, communication, knowledge sharing lifelong learning, and lead time.	Prescott & Gibbons (1993); APQC (2003); Thomas & Tryfonas (2005); Proporas et al. (2005); Marson (2006); Miree et al. (2007); Calof & Wright (2008)	Monczka et al. (1998); Chandra and Kumar (2000); Mentzer et al. (2000); Slater and Narver (2000); Gunasekaran et al. (2001); Tan et al. (2002); Childhouse & Towill (2003); Sambasivan & Jacobs (2008)

Meanwhile, *supply chain performance* is very important in helping firms keep track of their combined efforts in the integrated supply chain and to create sustainable competitive positioning (Porter and Millar, 1985; Cooper et al., 1997). Each firm needs to understand its role in the supply chain, the needs of the customer, and how these needs can be translated into internal operations requirements placed on suppliers. While a primary source of intelligence is the internal operational process, SCI extends and integrates data from partners, customers and suppliers (Stefanovic et al., 2007). SCI facilitates the rapid, secure, and free flow of information for better understanding and reacting to the needs of the customer, suppliers and to changes in the market. Each firm must think of itself as a combination of relationships (business process relationships with supply chain integration) because a company no longer depends solely on its own resources for success. Therefore, researchers need to develop new performance measures for the entire supply chain that would act as stimulants to improved supply chain practice.

THEORETICAL AND HYPOTHESES DEVELOPMENT

Figure 2 shows the conceptual framework of the study. The dimension of SCI components and its elements were tested regarding its relationship with business performance.

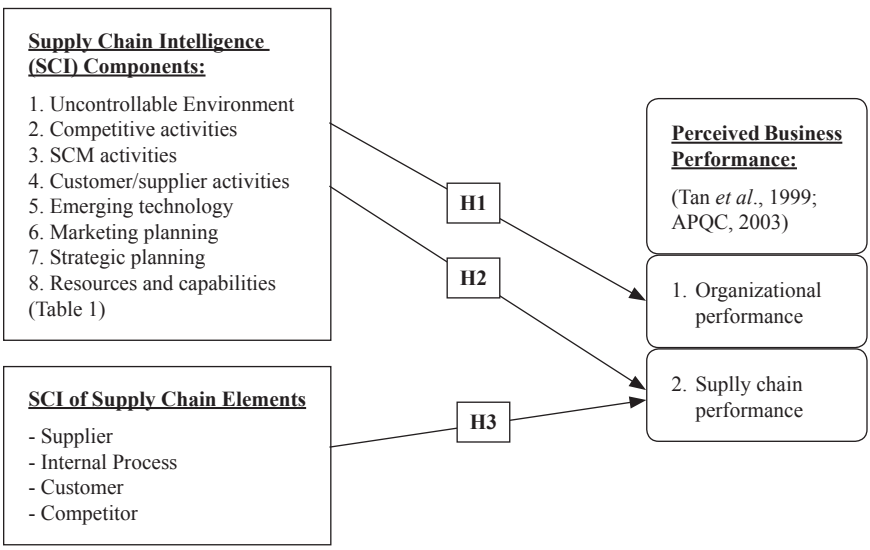

Figure 2 The Conceptual framework concerning the relationship between supply chain intelligence and performance

Theoretical Foundation

SCI is a source of competitive advantage that utilises both CI and SCM views. According to the resource-based view, the existence of the SCI function itself can be argued for its rent generating capabilities (Barney, 1986, 1991; Prahalad & Hamel, 1990). The ongoing dynamic of SCI activities is the learning process that enables firms, through a repetition of routines, to identify new processes for performing functions faster and more effectively. Hence, SCI is the product of business information processed by personnel who possess highly developed critical thinking and problem-solving skills. Thus, SCI develops tacit knowledge of sustainable competitive advantage, which is often difficult for other firms to replicate in order to achieve outstanding performance (Du Toit, 2003; Hughes, 2005; Oubrich, 2011). As for the knowledge-based view, SCI can create a repository of embedded knowledge throughout an organisation by introducing systems and practices of knowledge management into a firm (Nonaka and Takeuchi, 1995; Wisner, 2003; Stefanikova and Masarova, 2014). Since SCI processes involve data gathering, data analysis and data dissemination, the probability of effectively replicating these routines within a short period is slight due to the tacit nature of these processes and so involves an understanding of the multiple linking activities and processes within the supply chain (Porter, 1995; Du Toit, 2003; Hughes, 2005). In other words, tacit knowledge and the concept of SCI are strongly related as a source of competitive advantage for a firm and so provide a useful paradigm in analysing the link with performance.

Hypotheses Development

Undeniably, the primary aim in commissioning intelligence is to help achieve a profit or competitive advantage for the firm (Bernhardt, 1996; Subramaniam & Ishak, 1998; PricewaterhouseCoopers, 2002). According to Stevens (2000), a high performance company is characterised largely by (a) high outputs or productivity, (b) sustained and increasing market share, (c) greater profitability or shareholder value, (d) innovation, and (e) differentiation of service from its competitors. A survey by PricewaterhouseCoopers in 2002 (Global Intelligence Alliance, 2005) reported that companies incorporating intelligence as 'critical knowledge' into their strategic thinking have a 20% faster growth rate than those that do not. However, intelligence activity does not have to be directly linked to business performance indicators because it is extremely difficult to measure and identify the specific intelligence that brought about the particular benefit (Kahaner, 1997; GIA, 2004b). A study on intelligence activities among companies in Singapore also identified a positive relationship between use of SCI and higher organisational effectiveness

(Wee and Leow, 1994). Subramaniam and Ishak's (1998) empirical study of 85 firms revealed that those firms which have advanced intelligence systems to monitor their environment exhibited greater profitability than those firms which did not have such systems. Although some studies reveal the benefits of SCI to firm performance (Jaworski & Wee, 1993; McGonagle and Vella, 1996; GIA, 2004a; Badr et al., 2006), not much has been done to determine the impact of SCI on supply chain performance. Based on the given argument, hypotheses H1 and H2 state that:

H1 : There is a relationship between SCI and supply chain performance.

H2 : There is a relationship between SCI and organisational performance.

According to Mentzer *et al*. (2001) and Chopra and Meindl (2001), supply chain activities consist of strategic integration between the supply chain elements (supplier, internal process, and customers) including competitor. Thus, SCI usage is also examined for each supply chain element, and competitors, as a basis of comparison within the industry (Wright et al., 2006; Wilkins, 2007; Gilad, 2011). Since little has been done by empirical research means to examine the specific impact of SCI on supply chain integration and supply chain performance, hypothesis H3 states that:

H3 : There is a relationship between SCI of supply chain elements and supply chain performance.

METHODOLOGY

There were several stages involved in developing the SCI components and its relationship to performance. Empirical research generally states few important intelligence components of CI and SCM activities. Most of these components are gathered, collated, and consolidated, and their final product is referred to as the SCI components matrix, which is then used to conduct the focus group (see Table 2). The focus group in this study necessitated soliciting feedback from individuals in the field through the use of specially designed survey instruments or questionnaires (Greenbaum, 1993). The questionnaires were distributed to the supply chain, purchasing, marketing and sales managers who are involved in assessing strategic intelligence in the organization.

A sample framework was drawn from the Federation of Malaysian Manufacturers (FMM) book since they are well-recognised in Malaysia (Sambasivan et al., 2013) and represent about 2,135 leading manufacturing and industrial service companies of varying sizes. Only a total of 1435 companies were used following the rejection of several small companies (less than 50 employees). A pilot test was conducted by sending the questionnaire to 25 companies. Minor changes were made to questionnaire items before the final distribution process. A total of 174 companies provided feedback out of the 1435 to which questionnaires sent. Data collection focused on a cross-section sample of two sectors. First sector consists of electrical and electronics manufacturing firms because it represents the supply chain market in which Malaysia is one of the important hubs in Asia. Additionally, the second sector consists of other relevant support firms in manufacturing. The response rate was 10% and was considered low. However, this response rate is ultimately acceptable due to the nature of intelligence, which is a sensitive topic and is considered to be a part of confidential business strategy (Wright et al., 2002). For data collection below 30%, the nonresponsive bias is tested by examining the construct means of early versus late respondents (Armstrong and Overton, 1976).

Measures

The constructs were assessed on a five-point Likert-type scale between 1 (Low) and 5 (High) to assess the level of agreement for each of the items. Most of SCI component items were specifically adapted from the literature (Table 1) and refined further in the focus group. The items on performance were developed by adopting the constructs of organisational performance offered by Porter (1980), whereas the constructs of supply chain performance were developed by modifying and extending from supply chain literature (Table 2). All research questions and objectives were answered by performing appropriate descriptive and inferential statistical analyses, such as hierarchical and multiple linear regressions (MLR).

Table 2 Supply chain components

	Supply chain components	Literature
i.	Strategic partnership/alliances/ collaboration - support rapid product innovation, engage in joint planning, info sharing, reduced order cycle times and inventory.	Spekman (1998); Harland et al. (1999); Cox (1999); Boddy et al. (2000); Lambert and Cooper (2000); Stuart and McCutcheon (2000); Mentzer et al. (2001); Min and Zhou (2002); Simchi-Levi et al. (2003); Kemppainen and Vepsalainen (2003); Green (2006); Schnetzler et al. (2007).

Table 2 (*Con t'd*)

ii.	Outsourcing – cost reduction and capacity reason.	Harland et al. (1999); Cox (1999); McIvor (2000); Bowersox et al. (2000); Stuart and McCutcheon (2000); Mason et. al. (2002); Min and Zhou (2002).
iii.	Horizontal - cross-functional/ business process integration.	Porter (1980, 1985); Tan et al. (1998); Lambert and Cooper (2000); Bowersox et al. (2000); Min and Zhou (2002).
iv.	Vertical - Upstream/supplier/ backward integration.	Porter (1980, 1985); Tan et al. (1998); Harland et al.(1999); Cox (1999); Bowersox et al. (2000); Stuart and McCutcheon (2000); Frohlich and Westbrook (2001); Kuei & Madu (2001); Min and Zhou (2002); Kemppainen and Vepsalainen (2003); Vickery et. al. (2003); Green (2006).
v.	Vertical - Downstream/ customer/forward integration.	Porter (1980, 1985); Tan et al. (1998); Harland et al.(1999); Cox (1999); Bowersox et al. (2000); Stuart and McCutcheon (2000); Frohlich and Westbrook (2001); Kuei & Madu (2001); Min and Zhou (2002); Vickery et. al. (2003); Kemppainen and Vepsalainen (2003); Green (2006).
vi.	Purchasing integration.	Cooper and Ellram (1993); Carr and Smeltzer (1997, 1999); Wisner and Tan (2000); Tan (2001); Kemppainen and Vepsalainen (2003); Trim and Lee (2008).
vii.	Logistic collaboration.	Cooper and Ellram (1993); Harland et al. (1999); Cox (1999); Bowersox et al. (2000); Wisner and Tan (2000); Tan (2001); Kemppainen and Vepsalainen (2003); Schnetzler et al. (2007).
viii.	Lean SC – cost minimization.	Womack and Jones (1996); Harland et al. (1999); Cox (1999); Christopher et al. (2006).
ix.	Agile SC – responsiveness, low cost, high quality, customer specification, short lead times, info sharing.	Mason et. al. (2002); Christopher et al. (2006).
x.	IT Driven Change.	Stuart and McCutcheon (2000); Kuei and Madu (2001); Kuei et. al. (2002); Min and Zhou (2002); Vickery et.al. (2003); Kemppainen and Vepsalainen (2003).

RESULTS AND DISCUSSION

In considering valid and reliable SCI components, an exploratory data analysis (EDA) using principal component analysis (PCA) was performed to identify the underlying dimensions of SCI. A PCA test, known as data reduction, is needed to derive a relatively small number of components that can account for the variability found in a relatively large number of measures (Field, 2005). Table3 shows a total of five factors (dimensions) which have explained about 68% of the total variance.

Table 3 SCI Components after using the PCA

SCI Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
	Sales & mktg	R&D	Org. Resources	Supply chain	External
Customer service	.833				
Price Strategy	.814				
Customer complaints	.793				
Product Quality	.793				
Market Focus	.786				
After Sale Service	.761				
Flexibility customer	.740				
Market strategy	.687				
Product enhancement	.664				
Supply chain goals	.648				
Product price	.646				
New prod develop	.633				
Cost structure	.614				
Quality service	.566				
Tech expertise		.789			
Compatible tech		.741			
R&D Develop.		.682			
Financial stability		.681			
Delivery capacity		.660			
IT Capacity		.649			
Commit. to Cont. imp		.613			
Communication ability		.607			
Comp. strategy		.590			
Orgn goals		.587			

Table 3 (*Con t'd*)

Tech. capacity	.567			
Reward		.779		
Structure		.736		
Staff policies		.735		
Culture		.700		
Training		.698		
Lifelong learning		.671		
Knowledge share		.644		
Communication		.630		
Scope of activity		.617		
Top mgmt.		.609		
Transp. costs		.606		
Internal operations		.598		
Delivery accuracy			.723	
Delivery flexibility			.699	
Supplier forecast			.659	
Shifting needs & prio.			.647	
On time delivery			.609	
Relation supp./buy.			.605	
Barg. power supp/buy			.598	
Cost structure			.576	
Cap. Expansion			.564	
Cust/supp integ.				.719
Substitute products				.619
Market structure				.595
Agility				.590
Benchmarking				.589
Economic cond.				.571
Outsourcing				.569

Reliability Analysis

All calculations of Cronbach's alpha coefficients resulting in alpha coefficients for supply chain components and supply chain elements showed acceptable reliability above 0.7 (Nunnally, 1978; Slater, 1995; Hair et al., 2010) (see Table 4).

Table 4 Reliability analysis

Variables	Cronbach's Alpha	
	Pilot study (n=25)	**Actual study (n=174)**
SCI components		
Uncontrollable Environment	0.874	Original eight dimensions
Competitive Activities	0.855	
SCM Activities	0.944	
Supplier/Buyer Activities	0.957	
Technology Initiatives	0.955	
Marketing Activities	0.979	
Strategic Planning	0.908	
Resources and Capabilities	0.966	
External Environment		0.855
Supply Chain Integration		0.910
Research & Development		0.907
Sales & Marketing		0.946
Organizational Resources		0.922
Supply Chain Elements (supplier, internal process, customer & competitor)	0.757	0.862
Organizational Performance	0.816	0.876
Supply Chain Performance	0.851	0.840

Five dimensions after PCA

Relationship Between SCI and Supply Chain Performance

Table 5 shows that the regression model between SCI (as the independent variable) and supply chain performance (as the dependent variable) has $R^2 = 0.403$, which implies that 40.3% of the variance in supply chain performance has been significantly explained by SCI. This indicates a good fit and a statistically significant relationship with $R^2 = .403$, $F [5, 168] = 22.685$, $p < .05$, and $p = 0.000$. The coefficients indicate that four of the SCI components, namely sales & marketing, organisational resources, research & development, and supply chain integration, are significant with $p < .05$, except for external environment ($p > 0.05$, $p = 0.553$). Overall, the results imply that SCI is positively related to supply chain performance, thus hypothesis H1 is supported.

Table 5 Regression analysis on the relationship between SCI and supply chain performance

Model	R	R^2	Adjusted R^2	F Change			Unstandardised coefficients		Standardised coefficients	t	Sig.
					df1	df2	B	Std. Error	Beta		
(Constant)	0.635[a]	0.403	0.385	22.685	5	168	1.698	0.202		8.404	0.000[a]
Sales Mktg							0.216	0.079	0.275	2.746	0.007*
Organizational resources							0.216	0.078	0.266	2.767	0.006*
RND							0.206	0.066	0.283	3.124	0.002*
S Chain							-0.15	0.074	-0.194	-1.993	0.048*
External							0.05	0.084	0.054	0.594	0.553

a. Predictors: (Constant), Sales Mktg, Organizational Resources, RND, S Chain, External
b. Dependent Variable: Supply Chain Performance
*Significance level - 0.05

Relationship Between SCI and Organisational Performance

Table 6 shows a positive relationship between SCI and organisational performance with $R^2 = 0.644$, which implies that 64.4% of the variance in organisational performance has been significantly explained by SCI. Thus, there is a good fit and a statistically significant relationship with $R^2 = .644$, $F [5, 168] = 60.903$, $p < .05$, and $p = 0.000$. The coefficients indicate that four of the SCI components are significant with $p < .05$; sales & marketing ($p = .000$), organisational resources ($p = .000$), research & development ($p = .018$), and external environment ($p = .035$), while only supply chain integration is insignificant ($p > 0.05$, $p = 0.432$).

Relationship Between Supply Chain Elements and Supply Chain Performance

Table 7 shows that a regression model exists between the SCI of supply chain elements and supply chain performance. R^2 of 0.475 implies that 47.5% of the variance in supply chain performance has been significantly explained by supply chain elements. This indicates a good fit and a statistically significant relationship with $R^2 = .487$, $F [4, 169] = 40.055$, $p < .05$, and $p = 0.000$. The coefficients of internal process, customer, and competitor are significant with $p < .05$, while supplier is insignificant ($p > 0.05$, $p = 0.742$). Therefore, H_3 is supported.

DISCUSSION

Overall, the findings show that SCI is found to be significantly associated with *organisational performance*. Even though the direct causal relationship between revenues and money spent on a specific SCI is hard to measure (Kahaner, 1996; GIA, 2004b), quite a number of previous studies suggest a statistical link between intelligence activities and corporate performance (GIA, 2004b; Hughes, 2005; Wilkins, 2007). For example, an analysis by Price Waterhouse Cooper found that companies incorporating SCI into their strategy formulation had a better growth rate. As for the relationship between SCI and *supply chain performance*, the findings imply that the greater the SCI usage, the greater the supply chain performance. The findings of this study reaffirm past studies by Tan (2002) and Wilkins (2007) who found that customers, suppliers, and service providers in the supply chain can be a valuable source for achieving supply chain performance. Subsequently, *supply chain elements* (internal process, customers) and competitors are found to have significant relationships with performance, thus reaffirmed the results of the study conducted by Supply Chain Foresights (2013) on the South African supply chain

Table 6 Regression analysis on the relationship between SCI and organisational performance

	R	R^2	Adjusted R^2	F Change	df1	df2	Unstandardised coefficients		Standardised coefficients	t	Sig.
							B	Std. Error	Beta		
(Constant)	0.803[a]	0.644	0.634	60.903	5	168	0.727	0.169		4.300	0.000[a]
Sales Mkt							0.237	0.066	0.279	3.609	0.000*
Organizational Resources							0.246	0.065	0.279	3.765	0.000*
RND							0.132	0.055	0.167	2.389	0.018*
S Chain							0.049	0.062	0.059	0.787	0.432
External							0.149	0.07	0.149	2.122	0.035*

a. Predictors: (Constant), Sales Mkt, Organizational Resources, RND, S Chain, External
b. Dependent Variable: Organizational Performance
*Significance level - 0.05

Table 7 Regression analysis on the relationship between supply chain elements and supply chain performance

Model	R	R^2	Adjusted R^2	F Change	df1	df2	Unstandardised coefficients		Standardised coefficients	t	Sig.
							B	Std. Error	Beta		
(Constant)	0.698[a]	0.487	0.475	40.055	4	169	1.435	0.168		8.554	0.000[a]
Supplier							-0.02	0.065	-0.029	-0.33	0.742
Int Process							0.331	0.077	0.411	4.272	0.000*
Customer							0.228	0.07	0.282	3.268	0.001*
Competiton							0.09	0.039	0.151	2.301	0.023*

a. Predictors: (Constant), Supplier, Int Process, Customer, Competitor
b. Dependent Variable: Supply Chain Performance
*Significance level - 0.05

and logistics market. That study reported that 350 respondents, who consisted of senior managers with various job functions, internal operations and customers, were the most used in supply chain activities. Meanwhile, the result that supplier is insignificant is also aligned with the Supply Chain Foresights study (2013) which found SCI of suppliers was less used and seemed to still be in the early stages of development. In line with that, Wilkins (2007) suggests that all relevant divisions must continually discover and share information in order to win market share more regularly and increase performance.

CONCLUSION

The use of SCI is found to be significantly associated with perceived business performance. Even though gathering and analysing data related to SCI is an established practice in large-scale companies in developed countries, it is quite new in Malaysia. The manufacturing companies were found to be somewhat passive in building SCI due to limited access to information from the government and constrained financial resources. The costs to acquire global SCI information are also quite high, especially after considering the foreign exchange rate. This is consistent with the survey by Supply Chain Foresights (2013) reporting that the majority of respondents (80%) ranked the cost of doing business as a major constraint, including with regard to intelligence activities. Even though SCI is still relatively new in Malaysia, it should be subsequently adopted by business organisations as one of the measures for dealing with an increasingly competitive business environment. SCI can greatly contribute to overall industry awareness and to the development of new products and technology. SCI can thus provide faster and more useful information from a global perspective in order to help make strategic decisions, to gain a holistic and accurate view of supply chain activities, and to quickly identify and resolve potential problems.

In this study, the dimensions of SCI components are specifically designed to address the performance of the manufacturing industry and thus some of the components might not be relevant to the service sector. However, future research could further strengthen the SCI components matrix in other sectors because they might have different priorities regarding the SCI components. Since Malaysia is used as a starting point in developing this SCI model, future research could be done to examine the differences between countries so as to enhance the generalisation of findings to other areas of the world (e.g. see Wright and Calof's study on country comparison of intelligence practices (2006) and Fleisher and Wright (2009)). Further, it would be useful for future research to focus on SCI usage in specific business functional areas since this could lead to a more objective assessment on its effectiveness.

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