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SURVEY APPROACHES IN GREEN SUPPLY CHAIN MANAGEMENT RESEARCH: AN ANALYSIS

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ABSTRACT

Survey is an approved method that has been used by researchers for many years ago. The effectiveness of the method cannot be denied and until today, it is still the best method to identify a population perspective on the particular thing or anything that related to the purpose of a study. The aim of this paper is to examine the extent of the survey approaches in green supply chain management (GSCM) research. The findings show that GSCM survey-based research is mainly conducted in Asian countries regions which focused on the GSCM practice and performance. Postal survey is the most preferred in data collection as well as survey are also distributed in workshops. Analysis methods such structural equation modeling (SEM), conformity factor analysis (CFA), non-parametric test, correlation test, regression analysis, and ANOVA were selected to test the researches hypotheses while SPSS and AMOS are the favourite software that used for the analysis.

Keyword: Green supply chain management, Survey-based research.

INTRODUCTION

Supply chain management is a close-loop activity that involved suppliers, manufacturers, retailers, and customers. It is a continuous action that required the supplier chain members to develop a strategy to strengthen the business or competitiveness in the market. Green supply chain management (GSCM) is a concept that is gaining popularity and demonstrates a commitment to sustainability (Bacallan, 2000). Besides, it is a new form of integration environment protection idea that considered the environmental problem of each link in the supply chain (Yanmou and Weina, 2009). Hervani et al (2005) believed that by adding the "green" component to supply chain management involves expressing the influence and relationships of supply chain management to the natural environment. Porter and Van der Linde (1995) stated that the basics reasoning of GSCM are resource saving, waste elimination and productivity improvement. Adopting green technology in the whole direction of raw materials

obtaining, processing, packaging, storage, transportation, products dealing with and recycling, can minimize the products' impact on environment, and utilize resources most effectively. Therefore, green initiatives can lower not only the environmental impact of a business but also raise efficiency, possibly creating major competitive advantages in innovation and operations.

GSCM is environmental awareness, resource and energy effective use and each link to supply chain. It considered the effects of products and processes associated with translating raw materials into final products (Beamon, 2008). Ciocci and Pecht (2006) agreed that green engineering involves environmental implication at the design phase of a product that reveals the production's effect to the environment and the resource when they are designed, and optimizes interrelated ingredients in order to minimize the above effect during the whole lifecycle. GSCM practices integrated life-cycle management supply chains flowing from supplier, through to manufacturer, customer, and closing the loop with reverse logistics (Zhu *et al*., 2008a).

This paper is organized as follows. In the next section, a short review on survey approach will be discussed. It followed by the state of the art. Finally, several conclusions are drawn, and spaces for future research.

SURVEY APPROACH

A survey approach is often used to gather information from a large number of respondents that is representative of a population. The results are then used to describe a phenomenon about population. As supported by Walizer and Wienir (1978), in the research process the term surveys refers to "anyway of making examinations where the indicators of variables are the answer to questions presented either verbally or in writing". On the other hand, survey is able to examine complex propositions involving several variables in simultaneous interaction (Babbie, 1990).

There are three types of gathering data in survey approach, which include postal survey or mail questionnaires, personal interviews and telephone interviews. The basic method for the data collection through the mail is the transmission of a questionnaire accompanied by a letter of explanation and a return envelope. The respondent completes the questionnaire and returns it to the research office through the mail, using the envelope provided for that purpose. A postal survey is regarded as an impersonal survey approach (Nachmias and Nachmias, 1992) and considered to be the most economical among methods of data collection (Moser, 1967). In interview surveys, rather than asking respondents to read questionnaires and enter their own answers, interviewers ask the questions verbally and record the respondents' answers. Interviewing is performed either in a face-to-face encounter or over telephone. However, if interviewers are unfamiliar with the questionnaire, the study suffers and an unfair burden is placed on the respondent. In the latter respect, the interview is likely to take more time than necessary and be generally unpleasant.

RESEARCH METHODS

As the purpose of this paper is to review the survey approaches that have been conducted in the previous researches on green supply chain management, the intention of the literature review was to collect information from a representative pool of research articles. Journal articles were sourced from three databases – Elsevier's Science Direct, Emerald, and IEEE research paper. Searches were mainly carried out based on key words – green supply chain management, survey, empirical study, questionnaires-based research etc. In the first instance only articles published from the year 2000 onwards are considered. Besides, to make the review more comprehensive, the authors is only focused on the research interest on GSCM, survey target groups, sample sizes and the sampling techniques, survey instrument design and development, and analytical method that used to conclude the research findings precisely.

STATE OF THE ART

A number of structured literature reviews exist on GSCM, to number a few; Carter and Rogers (2007) focus on the link to performance; Srivastava (2007) focuses on the reverse logistics; Suering and Muller (2008) focus on reverse logistics and purchasing; whilst Walker et al (2008) review the literature on the driver and barrier of GSCM practice. Although the growing literatures on GSCM have increased, it is seen that there are a lot of space to enhance the number of GSCM research via survey approach with the appropriate analytical methods. The section will discuss the research state of the art.

Research interest

Research interest is referred to the key of the empirical studies that influenced the research findings. It indicates that a clear bias towards upstream and downstream research interest on GSCM driver and practice (Zhu and Sarkis, 2004; 2006; Zhu et al, 2007a; Lee, 2008; Holt and Abby, 2009; Hu and Hsu, 2006). The GSCM practices implementation were focused on green purchasing, environmental requirement, investment recovery, eco-design, and internal environmental management while the GSCM drivers are included the regulation, marketing, supplier, competitor and internal factor. However, a trend is emerging of more recent study focusing mostly on GSCM performance that involved environmental initiative, environmental performance, economic performance, competitiveness as well as overall operational performance (Rao, 2002; Vachon and Klassen, 2006a; 2006b; 2008; Zhu and Sarkis, 2004; Zhu et al, 2005; 2007a; 2007b).

Lee (2008) explored the driver for the participation of small and medium-sized supplier in the view of the supplier readiness, buyer practice on GSCM and government involvement to encourage the green activities. Meanwhile, Zhu et al (2008b) conducted an exploratory analysis on the GSCM implication for closing the supply chain loop by adding customer cooperation in GSCM practice. Furthermore, Rao and Holt (2005) investigated the potential

linkages between GSCM as an initiative for environmental enhancement, economic performance and competitiveness in inbound logistics, production, outbound logistics and reverse logistic. Hong et al (2009) performed an empirical study to identify the impact of GSCM on competitive market environment, integrated product development, supply chain coordination, green performance outcome and business unit performance.

On the other hand, Hu and Hsu (2006) categorized the critical factor for GSCM practice; Cheng et al (2008) examined the factor influencing inter-organisational knowledge sharing on GSCM that consist of of share value, participation, communication, learning capacity, opportunity behavior, power, resource fitness and the knowledge sharing behavior; Zhu and Sarkis (2004) discovered the relationship between GSCM practice and environmental and economic performance in the terms of quality management and just-in-time manufacturing; Simpson et al (2007) revealed the customer's environmental performance requirement-supplier environmental commitment relationship condition; Zhu et al (2008c) seek out the GSCM awareness that associated with organizational learning and management support.

Target Group

From the observation, Zhu et al (2005; 2007a; 2007b; 2008a; 2008b; 2008c), and Zhu and Sarkis (2004; 2006) prejudice on the development of GSCM practice in Chinese industry. It was supported that China recently has increased its emphasis on economic development, while seeking to maintain a balance with environmental protection which have made it a struggle for organizations to balance economic benefit and environmental performance (Shultz and Holbrook, 1999). Nevertheless, Cheng et al (2008) is called to conduct a survey on factor influencing inter-organisational sharing on GSCM in Taiwan manufacturing firms. This is because; the Taiwanese information industry has outpaced the majority of its international counterparts, at one time being positioned as the third largest producer of information products globally (Chen, 2004). The common problem of both industries is that they suffer from buyer requests for green products and green manufacturing to comply with emerging environmental Directive (WEEE, RoHS and EuP) and customers.

Conversely, the concept pertaining to greening the supply chain or supply chain environmental management are usually understood by industry as screening suppliers for their environmental performance and then doing business with only those that meet the regulatory standards. Due to the reasons, Lee (2008) was attracted to define the participation of Korean small and medium-sized enterprises (SMEs) suppliers in green supply chain initiatives, Simpson et al (2007) desired to identify customer-supplier relationship in GSCM for automotive Australian firms, Vachon and Kalssen (2006a; 2006b; 2008) obtained to know the impact of GSCM in printing industry among North America manufacturing firms while Hong et al (2009) attained to study the impact of GSCM among manufacturing firms in cross-regions included Asia Pacific, North America and South Africa. Besides, Rao (2002) and Rao and Holt (2005) passionate to study the potential linkages between GSCM practices among ISO

14001 certified manufacturing firms in Philippine, Indonesia, Malaysia, Thailand and Singapore.

Analytical Method

The authors found that analytical method is required in the development of the survey instrument (pilot study) and data analysis. Chi square test and *t*-test were the most preferred analysis tool in the survey instrument development phase for reliability analysis. To perform the analysis, data from pilot study is compulsory. The pilot study is done by distributing the final draft of the questionnaire to a few selected target groups. Then, it was followed up with group discussion, interview and site visit on the particular industry for survey validation which significant with research aims or objectives. In this phase, some questions in the questionnaire will be adjusted or deleted due to unreliable or invalid question. As a result, a set of questionnaire is tangible for actual data collection which involved a large size of sample.

The authors identified that once the data was collected, the researchers will perform the reliability analysis called Cronbach alpha test. The Cronbach alpha is performed to ensure that the answers of the respondent in the survey are invariable and reliable for the further analysis. Next, descriptive statistic will prepare to generalize the data base on the mean and standard deviation.

On the other hand, most researchers performed factor analysis to derive groupings of variable from the survey data. For Zhu and Sarkis (2004), Zhu et al (2005), Vachon and Klassen (2006b), and Hu and Hsu (2008), the factors were extracted using the maximum likelihood method, followed by a varimax rotation. The Kaiser criterion (eigenvalue > 1) was employed in conjunction with an evaluation of scree plots. Cronbach alpha test was performed to ensure that the factors are highly reliable (Zhu and Sarkis, 2004; Zhu et al 2005) while Hu and Hsu (2008) were conducted Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy to test the appropriateness of the data for factor analysis.

In addition, Vachon and Klassen (2006a; 2008), and Zhu et al (2007b; 2008a; 2008b; 2008c) preferred to conduct confirmatory factor analysis (CFA). The CFA is a composite analysis that occupied χ^2 statistic, normed fit index (NFI), Tucker-Lewis (TLI), comparative fit index (CFI), incremental fit index (IFI), goodness-of-fit index (GFI), adjusted goodness of fit (AGFI), and root mean-square error of approximation (RMSEA). Consequently, CFA was use to further evaluate the measurement properties of the construct of GSCM implementation and performance outcomes (Zhu et al (2007b). All of the measurement items also significantly loaded on the constructs on which they were hypothesized to load and provide a confident level that the measures are indeed valid and reliable. In contrast, CFA was used to assess how well the observed variables, i.e., measurement items, reflect unobserved or latent variables in the hypothesized structure (Zhu et al, 2008a). A series of pairwise CFAs was conducted to assess the discriminant validity of the factors using the χ^2 difference test. This step of the analysis was conducted by forcing measurement items of each pair of factors into a single underlying factor. If there is a significant deterioration of model fit relative to a two-factor model, then the result implies

the presence of discriminant validity between the pair of factors. The test was performed on all possible pairs of factors. The result shows that discriminant validity is achieved for all cases. The significant results of the χ^2 difference tests confirm to presence of disriminant validity between any two factors.

Furthermore, Zhu et al (2008b) performed CFA with AMOS to validate the measurement properties. CFA were performed separately with three sets of constructs in the regression model, namely, the independent variables (i.e., management support, organizational learning), the dependent variables (i.e., external GSCM practices, IR, eco-design) and the control variables (i.e., regulation, market pressure, supplier pressure and cost pressure). All the measurement items were forced to load onto and were allowed to correlate to other factors in their corresponding factor in the CFA. The results lend support to the convergent validity and uni-dimensionality of the latent constructs and sustanantiate their measurement properties.

Alternatively, Rao (2002), Rao and Holt (2005), Cheng et al (2008) and Hong et al (2009) preferred to apply the structural equation modeling (SEM) to validate the causal relationship between the different variables. SEM estimates a series of separate but interdependent multiple regression equations simultaneously via LISREL-type measurement model. SEM involves the analysis of two models: a measurement (or factor analysis) model and a structural model. The measurement model specifies the relationship between the observed measures and their underlying constructs, with the constructs allowed to inter-correlate. The structural model specifies the posited causal relationship among the constructs. For analysis, the proposed relationships are then translated into a series of structural equations for each dependent variable (base on research aims and objective). Then, the structural model expresses these relationships among independent and dependent variables. The conceptual model is evaluated by estimating the regression weight of each link (arrow) and the associated significance. This significance was evaluated with the statistic called "critical ratio" associated with the regression weight which helped to test the null hypothesis.

CONCLUSION

As the conclusion, the survey or questionnaire-base research approach had contributed a pool of knowledge on GSCM practices, and sustainability. The result from the survey helped the companies to search the GSCM drivers, practices and performance. Besides, the impact of upstream and downstream integration on GSCM is revealed. Moreover, operational performance on cost, quality, delivery, flexibility, and environment of green project partnerships in the supply chain is identified. In addition, the survey was able to identify potential linkages between GSCM as an initiative for environmental enhancement, economic performance and competitiveness in a few of conditions such as inbound logistic, productions or internal supply chain, outbound logistics and reverse logistic. Although the survey provided a best outlook on the particular researches, the authors found that the participation of the respondent is considerably low. This issue is unsolvable due to lack of special body used to

manage the group of GSCM practitioners. However, to make a superior conclusion of the survey that able to represent a population, some researchers have decided to select the companies who had registered as green manufacturing firms, small medium-sized companies, automotive industry, electrical and electronics manufactures association, and ISO 14001 certified companies. Fortunately, based on the awareness, surveys during conducting workshop is more helpful to increase the number of respondent.

The authors identified that the GSCM survey has been conducted on GSCM practice in Asia-countries regions such as China, Korea, Australia, and Taiwan. However, some preferred multi-regions survey to search wider aspect of GSCM practice. For the survey instrument design and development, the authors found that the number of measurement items in a questionnaire survey in the range of 6 to 70 items. In addition, the measurement items that asked in the survey involved tested measurement item and control variables. The development of the measurement items is based on the hypotheses of the research and considered to be analyzed with statistical analysis. Pilot study is prepared to ensure that the instrument is highly reliable. The researchers used statistical analysis to analyse the collection of the data. SPSS and AMOS are the favourite software that used for the analysis. Reliability and validity test were the crucial test that have been performed by the researchers before conducting particular analysis to test the researches hypotheses such as factor analysis, non-parametric test, correlation test, regression analysis, ANOVA etc.

For further research, the authors will focus on the other research methods that can be used to enhance the GSCM research includes the similarities and differences. In addition, the authors intended to identify the role of advance technology in promoting GSCM. The authors believe that above suggested research focus may provide useful knowledge in helping to strengthen the GSCM and it sustainability.

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