A Supply Chain Management Study: A Review of Theoretical Models from 2014 to 2019

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ABSTRACT

Supply Chain Management (SCM) refers to suppliers, manufacturers, warehouses, distribution centers, and distributors who attempt to minimize the cost of the entire supply chain system while meeting certain customer service levels. This study examines supply chain management by reviewing the development of theoretical models of supply chain management. In regard to the development of these models, this study used “supply chain management” as the keywords/article title and searched for matching articles on the following databases from 2014 to 2019: ScienceDirect, Wiley Online Library, Sage Online Journals, Taylor & Francis Online, Springer Link, Emerald Insight and OSCM FORUM. The various types of independent variables, dependent variables, moderators, mediators, moderated mediation and mediated moderation for the research model that were designed and tested in the articles are considered as theoretical models of supply chain management. In addition, this study found supply chain management is a cross-category study issue. Ninety-seven articles are cited from forty-eight journals with twenty-five categories. This research is the first article in terms of investigating supply chain management studies using a theoretical model review based on a qualitative review research in supply chain issues. In reviewing these articles, this study categorizes past studies of supply chain management, identifies differences and indicates possible future developments in the study of SCM.

Keywords: Supply chain; Supply chain management; Supply chain management study; Theoretical model review; Literature review

1. INTRODUCTION

A supply chain refers to the network structure composed of raw material suppliers, producers, distributors, retailers and final consumers involved in the production and distribution of products through the connection with upstream and downstream members (Christopher, 1998). It is also a network of enterprises and enterprise departments involved in the process of material acquisition, material processing, and delivery of finished products to users (Kache & Seuring, 2014). A supply chain can be portrayed as a leafy tree: the production company constitutes the root, the exclusive agent is the main pole, the distributor is the branches and treetops, and the green leaf safflower is the end user. With the nodes of the pole, there is a circulation of time and the context of communication is the information management system (Khalid et al., 2015). Therefore, the relationship between companies in the supply chain is similar to a food chain in biology. It can be seen from the structural model of the supply chain that the supply chain is a network chain structure, and the relationship between the node enterprises is a demand and supply relationship (Gonzalez-Loureiro et al., 2015). A supply chain has the following main characteristics: (I) Complexity: Because the spans (hierarchies) of supply chain nodes are different, a supply chain is often composed of multiple, multi-type or even multi-national enterprises, so the supply chain structure model is more complicated than the structural model of a single enterprise. (II) Dynamics: Supply chain management needs to be dynamically updated due to changes in corporate strategy and adapt to market demands, which gives supply chains obvious dynamics. (III) Responsiveness: The formation, existence and reconstruction of a supply chain are all based on certain market demands. In the operation of a supply chain, the demand of users is the flow of information. Products and services in the supply chain are the driving source of the flow and capital flow operations. (IV) Intersection: A node enterprise can be the node enterprise of one supply chain, and at the same time be the node enterprise of another supply chain. Many supply chains form a cross structure, which increases the difficulty of coordination management. Therefore, a supply chain can extend from the supplier side to the customer side, forming the process and activity of supply chain management (Kembro et al., 2014; Basnet & Seuring, 2016; Maestrimi et al., 2017; Lu et al., 2018).

Supply Chain Management (SCM) refers to suppliers, manufacturers, warehouses, distribution centers, and distributors who attempt to minimize the cost of the entire supply chain system while meeting certain customer service levels. Management methods for product manufacturing, transportation, distribution, and sales are effectively organized together. Supply chain management includes five basic elements: planning, procurement, manufacturing, distribution, and return (Giunipero et al., 2008). Supply chain management and traditional logistics management have significant differences in inventory management methods, goods flow,
cost, information flow, risk, planning and organizational relationships. These differences make supply chain management more advantageous than traditional logistics management (Ntabe et al., 2015). Supply chain management is implemented because it is more dynamic than traditional logistics management and can bring substantial benefits to supply chain members (Wen et al., 2018). However, in order to successfully implement supply chain management, each supply chain member must have good information sharing, and be open and honest. Information sharing is not an easy task for companies pursuing different goals. When a company cooperates with its many competitors, it is especially difficult to achieve information sharing. Therefore, successful supply chain integration requires first-hand enterprise companies to agree on the following aspects: jointly recognize the service level of the final customer, jointly determine the location of the inventory in the supply chain, and the inventory level of each inventory point, and jointly promote policies and procedures that manage the supply chain as an entity (Ding et al., 2018). The background of economic globalization has expanded the content and scope of supply chain management: Global Logistics, Outsourcing, Strategic Sourcing, and Supply Chain Collaboration (CPFR, S&OP) have been greatly developed (Jasti & Kodali, 2015). Supply chain management is no longer only focused on the internal operations of an enterprise, but the operation of the entire industry and value chain in the global market, along with related risk management (Sustainability) and sustainability (Sustainability) (Batista et al., 2018; Mujkic et al., 2018). Thus, supply chain management methods have been developed to provide solutions and alternatives not only for academic research but also for practical application to investigate and solve specific problems in supply chains.

Why have we done this review article on the supply chain management? This is a very important question. A literature review can be a condensed summary of the source of the data and articles (Yalcin et al., 2020). Literature review can reinterpret old data or integrate new and old interpretations, and it can also trace back the development of knowledge in the academic field, which contains major development and controversies (Acerbi & Taisch, 2020). Depending on the situation, the literature review may examine the source of the data and provide readers with relevant or most appropriate suggestions (Asghari & Al-e-hashem, 2020). Understanding the necessity of literature review helps to understand whether researches have done is meaningful, and to know that articles can contribute to the academic field (Al Humdan et al., 2020). On the other hand, a literature review provides a reasonable explanation for past, present and future research (Treiblmaier et al., 2020). However, a little supply chain management review which focus on the issue of theoretical model review in terms of investigating different roles on statistical variables, such as independent variables, dependent variables, moderators, mediators, moderated mediators and mediated moderators. Thus, a strong reason and motivation for this article to construct a historical background and suggestion for future works might be a contribution to the study of supply chain management.

2. METHOD

Regarding to statistical approach on supply chain management research, a theoretical model develops, describes and clarifies a situation related to a problem, and through the data collection or literature, the relationships between variables are examined. A good theoretical model defines the important changes in the context related to the problem and theory and explains the interactive relationship between the variables (Sharma & Nandi, 2018; González-Teruel & Pérez-Pulido, 2020). This study examines supply chain management by reviewing the development of theoretical models of supply chain management. In regard to the development of these models, this study used “supply chain management” as the keywords/article title and searched for matching articles on the following databases from 2014 to 2019: ScienceDirect, Wiley Online Library, Sage Online Journals, Taylor & Francis Online, Springer Link, Emerald Insight and OSCM FORUM. The various types of independent variables, dependent variables, moderators, mediators, moderated mediation and mediated moderation for the research model that were designed and tested in the articles are considered as theoretical models of supply chain management. In reviewing these articles, this study categorizes past studies of supply chain management, identifies differences and indicates possible future developments in the study of SCM.

It is found that supply chain management is a cross-category research issue. Ninety-seven articles from forty-eight journals in twenty-five categories are used, including BUSINESS; BUSINESS, FINANCE; COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE; COMPUTER SCIENCE, INFORMATION SYSTEMS; HOSPITALITY, LEISURE, SPORT & TOURISM; INFORMATION SYSTEMS; COMPUTER SCIENCE, INTERDISCIPLINARY APPLICATIONS; ECONOMICS; ENGINEERING, INDUSTRIAL; ENGINEERING; ELECTRICAL & ELECTRONIC; ENGINEERING, ENVIRONMENTAL; ENGINEERING, MANUFACTURING; ENVIRONMENTAL SCIENCES; ETHICS; GREEN & SUSTAINABLE SCIENCE & TECHNOLOGY; FOOD SCIENCE & TECHNOLOGY; INFORMATION SCIENCE & LIBRARY SCIENCE; MANAGEMENT; MATHEMATICS, APPLIED; OPERATIONS RESEARCH & MANAGEMENT SCIENCE; PLANNING & DEVELOPMENT; SOCIOLOGY; PSYCHOLOGY, EXPERIMENTAL; PSYCHOLOGY, MULTIDISCIPLINARY; and TRANSPORTATION (2019 in Web of Science). Thus, supply chain management issues related to management, business, information systems, operational research, management science, decision science, computer sciences, social sciences, behavioral sciences and other interdisciplinary applications are a valuable research topic for reviewing theoretical models of supply chain management.

3. THEORETICAL MODELS WITH MODERATOR DESIGNS AND TESTS

Moderation refers to a change in the relationship between an independent variable and a dependent variable, depending on the level of a third variable, called the moderator variable. Moderating effects are also referred to as interaction
and conditioning effects in terms of continuous and categorical variables (Edwards, 2002). A moderator variable, commonly denoted as just M, is a third variable affecting the strength of the relationship between a dependent and independent variable. In correlation, a moderator is a third variable affecting the correlation of two variables. In a causal relationship, if x is the predictor variable and y is an outcome variable, then z is the moderator variable affecting the casual relationship of x and y. Most moderator variables measure causal relationships using a regression coefficient. The moderator variable, if it found to be significant, that can cause an amplifying or weakening effect between x and y. In ANOVA, the moderator variable effect is represented by the interaction effect between the dependent variable and the factor variable. On the other hand, in a regression equation, when the relationship between the dependent variable and the independent variable is linear, then the dependent variable may change when the value of the moderator variable changes. In a linear relationship, the relationship represents the interaction effect of the moderator and the independent variable. When the relationship is non-linear, a significant moderator variable value does not prove to be a true moderator effect, unless the moderator is a manipulated variable (Kenny et al., 2006).

In Table 1, moderator variables are designed and tested on theoretical models for different consumer subject backgrounds and variables such as continuous and categorical moderator variables. In terms of continuous moderator variables, regression and latent change modeling with SEM, PLS, Regressions, and ANOVA are commonly used to examine a SCM theoretical model (Kaufmann & Gaeccker, 2015). In terms of subject background, we selected and tested the following subjects: Spanish logistics firms, the UK logistics sectors, UK manufacturing plants, Hong Kong wholesale trade companies, USA consumers, international firms, German firms, Taiwanese manufacturing firms, USA manufacturing and service industries, South Korean medical service facilities, globally distributed manufacturing plants, Egyptian manufacturing firms, South Korean manufacturers, USA OEM manufacturers, India manufacturing firms, India disaster relief respondents, international logistics managers, Iranian manufacturing industries, 17 USA industries, Indian hotels and restaurants, United Arab green firms, China RosettaNet firms, UK OEM agents, supplier agents, logistics providers, Australian retail firms, Sweden SMEs and Taiwan businesses. In terms of moderators on theoretical models, we tested the following designs: logistical capabilities, firm size, supply base complexity, slack/visibility, market complexity, trust, product complexity, environmental collaboration in supply chains, firm business type, hospital size, time/relationship quality/national culture, information sharing/logistics integration, centralization/formalization, ISO 9000, supply chain dynamism, supply chain culture of competitiveness, penalties/production costs/interdependence costs, supply chain flexibility, personal innovation, relational bonding, environmental proactivity, employees’ resistance to change, environmental uncertainty, business process innovation, technology orientation, HR practices/training/management commitment, participation in standards consortia, supply network topology, legal enforceability/guanxi importance, supplier integration and top management, network capability and process innovation and uncertainty.

As we can see, supply chain integration and information sharing are popular independent variables of theoretical designs. Performance plays a main dependent variable role for the consideration of theoretical models. In addition, environmental factors, TQM, supply chain scale/type/complexity/flexibility/innovation/culture and manpower are diversity developments among the moderators in the designing and testing of theoretical models. Manufacturing, logistics, service and green firms are popular industry types from the subject sources.

Table 1 Theoretical models with moderator designs and tests

| Year | Author(s) | Independent variable | Moderator | Dependent variable | Method | Subjects |
|------|-----------|----------------------|-----------|--------------------|--------|----------|
| 2014 | Wiengarten et al. | Supply chain integration | Logistical capabilities | Performance | Regression | Spain logistics firms |
| 2014 | Ramanathan et al. | Barcode experience | Firm size | Government support | ANOVA | UK logistics sectors |
| 2014 | Brandon-Jones et al. | Supply chain connectivity/ Information sharing resources | Supply base complexity | Enhances resilience/ Robustness | Regression | UK manufacturing plants |
| 2014 | Brandon-Jones et al. | Supply base complexity | Slack; Visibility | Disruptions and performance | Regression | UK manufacturing firms |
| 2015 | Wong et al. | Supply chain information integration | Market complexity | Performance | Chi-square test | Hong Kong wholesale trade companies |
| 2015 | Bonn et al. | Consumer perceptions of sustainable practices | Trust | Behavioral intentions | Hierarchical Multiple Regression | USA consumers |
| 2015 | Caniato & Größler | New product development | Product complexity | Supply chain management integration | Multivariate linear regression | International firms |
| 2015 | Eckstein et al. | Supply chain adaptability | Product complexity | Cost/operational performance | Hierarchical regression | Germany firms |
| Year | Authors | Theoretical models with moderator designs and tests |
|------|---------|--------------------------------------------------|
| 2015 | Chen et al. | Environmental management strategy; Environmental collaboration in supply chains |
| 2016 | Mariadoss et al. | Sustainable purchasing practices; Firm business type |
| 2016 | Yoon et al. | Innovation leadership; Hospital size |
| 2016 | Chang et al. | Internal integration; Time; Relationship quality; National culture |
| 2016 | Liu et al. | Supply chain technology utilization; Information sharing; Logistics integration |
| 2015 | Chen et al. | Environmental management strategy; Environmental collaboration in supply chains |
| 2016 | Mariadoss et al. | Sustainable purchasing practices; Firm business type |
| 2016 | Yoon et al. | Innovation leadership; Hospital size |
| 2016 | Chang et al. | Internal integration; Time; Relationship quality; National culture |
| 2016 | Liu et al. | Supply chain technology utilization; Information sharing; Logistics integration |
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| 2016 | Chang et al. | Internal integration; Time; Relationship quality; National culture |
| 2016 | Liu et al. | Supply chain technology utilization; Information sharing; Logistics integration |

Table 1 (con’t) Theoretical models with moderator designs and tests
4. THEORETICAL MODELS WITH MEDIATOR DESIGNS AND TEST
Mediation seeks to identify and explain the mechanism or process underlying an observed relationship between an independent variable and a dependent variable via the inclusion of a third hypothetical variable, known as a mediator variable (also a mediating variable, intermediary variable, or intervening variable). A mediator variable is the variable that causes mediation in the dependent and independent variables. In other words, it explains the relationship between the dependent variable and independent variable. The process of complete mediation is defined as the complete intervention caused by the mediator variable. The results in the initial variable no longer affect the outcome variable. The process of partial mediation is defined as partial intervention. The mediation caused by the mediator variable is developed as a mediation model. This model, which develops due to mediation, is a causal model. In other words, this means the mediator variable has been assumed to cause an effect in the outcome variable and not vice versa. Once we find a cause-effect relationship, the next question is related to the mechanisms of change (Baron & Kenny, 1986). On the other hand, mediators play a prominent role in establishing these mechanisms because they are variables that intervene between the cause and its effect. A wide range of designs can focus on mediators. These include both non-experimental designs (i.e., cross-sectional or longitudinal) and experimental designs. The mediation caused by the variable cannot be defined statistically. On the contrary, statistics can be utilized to assess an assumed mediational model developed by the mediator variable. Experimental designs are more appropriate designs for studying mediation but no single study can meet all prescriptive requirements for considering a specific mediator as a causal mechanism. A strong recommendation is that any endeavor to establish mediation should be complemented by a conceptual analysis through the lens of a well-supported and/or well-specified theory (David & Sava, 2015).

Table 1 (con’t) Theoretical models with moderator designs and tests

| Year | Authors | Independent variable | Mediator variable | Dependent variable | Method | Sample |
|------|---------|----------------------|-------------------|-------------------|--------|--------|
| 2018 | Ledwoch et al. | Effectiveness | Supply network topology | Risk management strategies | SEM | China manufacturing firms |
| 2018 | Yang et al. | Exchange hazards | Legal enforceability; Guanxi importance | Opportunism | Regression | China manufacturing firms |
| 2018 | Shou et al. | Supply chain risk management | Supplier integration | Operational performance | SEM | International survey |
| 2018 | Shee et al. | Supplier and internal integration | Top management | Supply chain performance | SEM | Australian retail firms |
| 2019 | Partanen et al. | Supply chain ambidexterity | Network capability | Manufacturing SME performance | SEM | Sweden SMEs |
| 2019 | Chang et al. | Business systems leveraging | Process innovation and uncertainty | Supply chain performance | SEM | Taiwan businesses |
| 2019 | Gokarn and Kuthambalayan | Firms’ capabilities | Fresh produce supply chains | Fresh produce supply chain performance | SEM | India businesses |

Table 2 shows structural equation modeling (SEM) and regression are the most common methods used to examine consumer behavior mediation models. Structural equation modeling is a multivariate statistical analysis technique used to analyze structural relationships. This technique combines factor analysis and multiple regression analysis and is used to analyze the structural relationship between measured variables and latent constructs. This method is preferred by this researcher because it estimates multiple and interrelated dependencies in a single analysis. In this analysis, two types of variables are used: endogenous variables and exogenous variables. Endogenous variables are equivalent to dependent variables and are equal to the independent variable. There are two types of SEM models: a measurement model and a structural model. These are classified in terms of testing the proposed causal relationships (Mueller, 1996). Several software packages can fit structural equation models. LISREL was the first such software. It was initially released in the 1970s. There are also several packages for the R open source statistical environment. The OpenMx R package provides an open source and enhanced version of the Mx application (Mplus) (Kline, 2015).

In terms of subject background, we examine Chinese manufacturers, European companies, South Korean manufacturers, Taiwanese TFT-LCD industry, Spanish manufacturers, Swiss manufacturing firms, US technology firms, US purchasing and supply chain managers, Chinese hotels, Indian manufacturing firms, European manufacturing sectors and firms, Chinese IT firms, Taiwan’s networking communication industry, Australian courier firms, Global oil & gas firms, Malaysia’s manufacturing industry, French sustainability firms, Pakistani manufacturing companies, Australian manufacturing firms, Pakistan public-owned companies and USA supply chain professionals and procurement specialists etc. In terms of the mediator variable, we investigated the following designs and tests: efficiency, project-level factors, supply chain integration, supply chain capabilities, customer satisfaction/organizational performance, supply chain coordination, Guanxi, purchasing costs/supply chain sustainability.
risk costs/cooperation benefits/benefits stemming, championing behavior, resource reconfiguration, E-business integration, relational governance, supply chain quality, relationship strength, contract management, internal and external processes, supply chain capability, knowledge integration, supply chain performance, knowledge sharing, supply chain uncertainty and risk, supply chain agility, top management commitment, collaborative supply chain capabilities, supplier development and internal impetus Supply chain agility, and Organizational culture. This study found that supply chain collaboration, trust and innovation are popular independent variables in theoretical designs. Performance plays a main dependent variable role for consideration in theoretical models. In addition, supply chain capability, integration and quality are diversity developments among the design and test moderators in theoretical models. Manufacturing, technology and service firms are popular industry types in the subject sources.

Table 2 Theoretical models with mediator designs and tests

| Year | Author(s)         | Independent variable | Mediator                     | Dependent variable | Method | Subjects                              |
|------|-------------------|----------------------|------------------------------|--------------------|--------|---------------------------------------|
| 2014 | Yang et al.       | Agility              | Cost efficiency              | Performance        | SEM    | China manufacturers                    |
| 2014 | Brinkhoff et al.  | Trust                | Project-level factors        | Project success    | PLS/SEM| European companies                    |
| 2014 | Seo et al.        | Innovativeness       | Supply chain integration     | Supply chain       | SEM    | South Korean manufacturers             |
| 2014 | Liao & Kuo        | Supply chain collab. | Supply chain capabilities    | Firm performance   | SEM    | Taiwan TFT-LCD industry               |
| 2015 | Gómez-Cedeño et al.| Human resource      | Customer satisfaction;      | SCM outcomes       | SEM    | Spain manufacturers                    |
| 2015 | Huo et al.        | Relationship commit- | Supply chain coordination   | Supply chain       | SEM    | China manufacturing firms              |
| 2015 | Luo et al.        | Asset specificity;   | Guanxi                       | Green supply chain | PLS/SEM| Chinese manufacturing organizations   |
| 2015 | Busse             | Sustainability-rel.  | Purchasing costs; Supply    | Economic perfor-   | SEM    | Swiss manufacturing firms              |
| 2015 | Wichmann et al.   | Commitment           | Championing behavior        | Network centrality | SEM    | U.S. technology firms                  |
| 2015 | Ambulkar et al.   | Supply chain disrupt-| Resource reconfiguration    | Firm resilience    | SEM    | USA manufacturing firms                |
| 2015 | Shi & Liao        | Inter-firm depend-   | E-business integration      | Operational perfor-| SEM    | China manufacturing firms              |
| 2016 | Singh & Teng      | Trust                | Relational governance       | Supply chain       | SEM    | USA purchasing and supply chain managers|
| 2016 | Zhong et al.      | Quality management   | Supply chain quality        | Hotel performance  | SEM    | China hotels                           |
| 2016 | Kumar et al.      | Collaborative cul.   | Relationship strength       | Supply chain       | PLS/SEM| India manufacturing firms              |
| 2016 | Bode & Macdonald  | Disruption           | Disruption recognition;    | Supply chain com-  | OLS re-| Europe manufacturing sectors and firms|
| 2016 | Pradhan & Routroy | Risk management      | Contract management         | SM performance     | SEM    | India manufacturing firms              |
| 2016 | Peng et al.       | Information technol- | Internal and External       | Firm performance   | SEM    | China IT firms                         |
| 2017 | Liao et al.       | Supply chain collab. | Supply chain capability     | Competitive advan- | SEM    | Taiwan networking communication indus-|

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Table 2 (cont) Theoretical models with mediator designs and tests

| Year | Authors       | Risk Management | Guanxi     | Supplier relationships | SEM      | China suppliers |
|------|---------------|-----------------|------------|------------------------|----------|-----------------|
| 2017 | Durach et al. | Market risk     | Guanxi     | Supplier relationships | SEM      | China suppliers |
| 2017 | Li et al.     | Market-oriented environmental sustainability | Knowledge integration | Performance | SEM      | Chinese exporters |
| 2017 | Gandhi et al. | Supply chain management practices | Supply chain performance | Firm performance | Multiple regression | India firms |
| 2017 | Wang & Hu     | Collaborative innovation activities | Knowledge sharing | Innovation performance | Hierarchical Multiple Regression | China manufacturers |
| 2017 | Chan et al.   | Strategic flexibility | Supply chain agility | Manufacturing flexibility | SEM      | China garment manufacturers |
| 2018 | Ebrahimi et al. | Supply chain integration | Internal, customer; Supplier integration | Operational performance | SEM      | Global oil & gas firms |
| 2018 | Sundram et al. | Supply chain information management | Supply chain integration | Manufacturing performance | Mediated multiple regression | Malaysia manufacturing industry |
| 2018 | Saeed et al.  | Product modularity | Supply chain agility | Responsiveness; Cost reduction | SEM      | USA manufacturing firms |
| 2018 | Dubey et al.  | External pressures | Top management commitment | Supplier relationship management | Hierarchical regression | France sustainability firms |
| 2018 | Sadiq Jajja et al. | Supply chain risk | Supply chain integration | Agility performance | SEM      | Pakistan manufacturing companies |
| 2018 | Levi-Bleich et al. | Mobile technology | Collaborative supply chain capabilities | Business process performance | SEM      | Six European country managers |
| 2018 | Wang et al.   | Logistics capability | Supply chain uncertainty and risk | Logistics performance | PLS-SEM | Australian courier firms |
| 2018 | Jadhav et al. | Supply chain orientation | Organization’s internal supply chain sustainability practices | Supply chain environmental sustainability performance | SEM | Australian manufacturing firms |
| 2018 | Lo et al.     | Top management support | Supplier development | Upstream green supply chain integration | SEM | International firms |
| 2018 | Agarwal et al. | Market pressures | Internal impetus | Green Supply Chain Management adoption | Partial Least Squares (PLS) | USA manufacturing companies |
| 2019 | Khan and Wissner | Supply chain integration | Supply chain agility | Firm performance | SEM | Pakistan public-owned companies |
| 2019 | Porter        | Supply chain integration | Organizational culture | Firm performance | Multiple regression | USA supply chain professionals and procurement specialists |

5. THEORETICAL MODELS WITH MODERATED MEDIATION DESIGNS AND TESTS

Moderated mediation, also known as conditional indirect effects, occurs when the treatment effect of an independent variable A on an outcome variable C via a mediator variable B differs depending on the levels of a moderator variable D. Specifically, either the effect of A on B, and/or the effect of B on C depends on the level of D (Preacher et al., 2007). To test for moderated mediation, some recommend examining a series of models, sometimes called a piecemeal approach, and looking at the overall pattern of results (Muller et al., 2005). This approach is similar to the previously mentioned Baron and Kenny method for testing mediation by analyzing a series of three regressions (Baron & Kenny, 1986). They suggest a single overall test would be insufficient to analyze the complex processes at play in moderated mediation, and would not allow one to differentiate between moderated mediation and mediated moderation. In terms of the method of the moderated mediation model, bootstrapping has also been suggested as a method of estimating the sampling distributions of a moderated mediation model to generate confidence intervals (Preacher et al., 2007). This method has the advantage of not requiring any assumptions be made about the shape of the sampling distribution. Preacher et al. (2007)
created an SPSS macro that provides bootstrapping estimations as well as Johnson–Neyman results. Their macro was made obsolete with the release of PROCESS for SPSS and SAS.

PROCESS is an observed variable ordinary least squares (OLS) and logistic regression path analysis modeling tool. It is widely used in social, business, and health sciences for estimating direct and indirect effects in single and multiple mediator models (parallel and serial), and two and three way interactions in moderation models along with simple slopes and regions of significance for probing interactions, and conditional indirect effects in moderated mediation models with a single or multiple mediators or moderators (Hayes, 2013a). PROCESS generates direct and indirect effects in mediation and mediated moderation models, conditional effects in moderation models, and conditional indirect effects in moderated mediation models with a single or multiple mediator. PROCESS offers various tools for probing 2 and 3 way interactions and can construct percentile based bootstrap confidence intervals for conditional and unconditional indirect effects. In mediation models, multiple mediator variables can be specified to operate in parallel or in sequence. Heteroscedasticity-consistent standard errors are available for probing about paths coefficients, in the Sobel test for indirect effects, and when probing interactions in moderation analysis. Various measures of effect size for indirect effects are generated in mediation models, along with bootstrap confidence intervals for effect size inference. An option is available for patiating out contextual level variation when individual data are nested under a higher-level organizational structure. Individual paths in moderated mediation models can be estimated as moderated by one or two variables either additively or multiplicatively (Hayes, 2013b). Recently, it was found that either the effect of the independent variable on the mediator variable, and/or the effect of the mediator variable on the outcome variable depends on the level of the moderator variable (Drummond et al., 2016). In addition, Cheung and Lau (2017) extended the latent moderated structural equations (LMS) method—which corrects for measurement errors when estimating latent interaction effects—to the study of the moderated mediation of latent variables. Simulations were conducted to compare the regression approach and the LMS approach. On the other hand, moderated mediation analyses using Bayesian methods are alternatives to investigating theoretical models of moderated mediation (Wang & Preacher, 2015).

Table 3 shows regression analyses and SEM using PROCESS version 3 are the main methods used to examine a moderated mediation model for Internet user behavior. In terms of subject background, we examined international manufacturing companies, global firms, USA sellers, Chinese manufacturing firms, USA soft drink industry firms, USA manufacturing and service subjects, China food manufacturing firms and Ghana firms etc. In terms of moderated mediator variables, we found the following designs and tests: global sourcing/sustainable supply chain management, supply chain planning/capabilities, trade offers expected by the sellers/aggregation of seller’s cost information, knowledge acquisition, knowledge combination/servitisation, forecast bias/vertical integration, operational integration/upstream and downstream partners, collaborative culture/inter-organizational systems, supply chain organizational learning/uncertainty, Environmental dynamism/ Operating and marketing capabilities and Flexibility capability/ Ownership structure etc.. Supply chain integration, collaboration and performance are main considerations in terms of the designs and tests of theoretical models of moderated mediation.

Table 3 Theoretical models with moderated mediation designs and tests

| Year | Author(s) | Independent variable | Moderated mediation | Dependent variable | Method | Subjects |
|------|-----------|----------------------|---------------------|-------------------|--------|----------|
| 2014 | Gualandris et al. | Social responsibility | Global sourcing/ Sustainable supply chain management | Ecological efficiency | SEM | International manufacturing companies |
| 2015 | Srinivasan & Swink | Supply chain integration activities | Supply chain planning/ Capabilities | Operational performance | SEM | Global firms |
| 2016 | Miller & Drake | Information asymmetry | Trade offers expected by the sellers/ Aggregation of seller’s cost information | Relation-specific investment | SEM | USA sellers |
| 2017 | Zhang et al. | Social capital effects | Knowledge acquisition; Knowledge combination/Servitisation | Operational performance | SEM | China manufacturing firms |
| 2017 | Wan et al. | Product variety | Forecast bias/ Vertical integration | Inventory level | Generalized estimating equation | USA soft drink industry firms |
| 2017 | Vanpoucke et al. | Information exchange | Operational integration/ Upstream and downstream partners | Cost-efficiency; Delivery performance; Process flexibility | Constrained non-linear regression (CNLR) | International manufacturing survey |
6. THEORETICAL MODELS WITH MEDIATED MODERATION DESIGNS AND TESTS

In mediated moderation, the main difference between the moderated mediation and mediated moderation processes is whether there is overall moderation of the treatment effect of A on outcome variable C. If there is, then there is mediated moderation. If there is no overall moderation of A on C, then there is moderated mediation (Muller et al., 2005). Bucy and Tao (2007) propose a mediated moderation model and maintain that interactivity, serving as a media stimulus, should be defined in terms of intrinsic media attributes. They point out that interactivity in a mediated moderation model, which resides in media technology, serves as the manipulated independent variable, while perceived interactivity, which consists of user perceptions, functions to transform the impact of interactivity. Importantly, the objective existence of interactive attributes does not guarantee the subjective experience of interactivity—but actual technology use may. Both interactivity and perceived interactivity thus play an important role in theorizing the effects of information technology yet represent disparate constructs and should be treated as having independent influences. Thus, in the mediated moderation model, the interaction effects of the independent and moderating variables on the dependent variable are transmitted through the mediator variable. A prerequisite of mediated moderation is the occurrence of overall moderation between the independent and dependent variables (Baron & Kenny, 1986). The effect of the independent variable on the dependent variable must depend on the moderator variable. There are at least three different types of mediated moderation: between the independent and mediator variables, between the mediator and dependent variables, or both (Muller et al., 2005). Mediated moderation can be used to explain the causal relationship between four variables. Therefore, the mediated moderation model should occur between interactivity and perceived interactivity. The model accommodates the possibility that the same interactive features may produce different levels of interactivity design among different research contexts.

### Table 3 (con’t) Theoretical models with moderated mediation designs and tests

| Year | Author(s)          | Theoretical model | Method        | Subjects               |
|------|--------------------|-------------------|---------------|------------------------|
| 2018 | Zhang et al.       | IOS appropriation | supply chain collaboration | USA manufacturing firms |
| 2018 | Ojha et al.        | Transformational leadership | Supply chain organizational learning/ Uncertainty | USA manufacturing and service subjects |
| 2019 | Song and Yang      | Food traceability-core capabilities | Environmental dynamism/ Operating and marketing capabilities | China food manufacturing firms |
| 2019 | Amoako-Gyampah et al. | Supplier relationship management | Flexibility capability/ Ownership structure | Ghana firms |

### Table 4 Theoretical models with mediated moderation designs and tests

| Year | Author(s)          | Independent variable | Mediated moderation | Dependent variable | Method        | Subjects               |
|------|--------------------|----------------------|---------------------|-------------------|---------------|------------------------|
| 2014 | Xue                | Strategic risk taking | Governance–knowledge fit/IT governance | Supply chain digitization | SEM | USA information technology firms |
| 2015 | Pai et al.         | Corporate Social Responsibility | Attribution/ Industrial brand equity | Brand Advocacy | Hierarchical multiple regression | Taiwan industrial buyers |
| 2016 | Doering & Suresh   | Cost reduction; Delivery performance | Forecast accuracy/ Internal integration; Forecasting process quality; Effective use of advanced systems; Evaluation of forecasting | Forecasting management competence | PLS-SEM | North America firms |

Accordingly, the theoretical models with moderators, mediators, moderated mediation and mediated moderation described in the above context provide examples not only in their academic theory but also in the development of the study of supply chain management study. In doing so, this study offers deductive and inductive reviews of relevant supply...
chain management research issues to readers for future studies. In addition, this study proposes some theoretical discussions on in next section.

7. DISCUSSIONS

7.1 Supply Chain Management Research Development

The research development of SCM has mainly gone through four phases of history. The first phase was the independent logistics distribution and logistics cost management phase, which mainly studied physical distribution and distribution systems to downstream manufacturers. In this phase, supply chain management was inseparable from the development of manufacturing automation, the evolution of business management and the evolution of enterprise information systems. In the 1950s and 1960s, manufacturers emphasized large-scale production to reduce unit production costs, that is, operational strategies for mass production. At that time, the production of enterprises considered market factors less. This phase was also characterized by a lack of flexibility in production and manufacturing, the slow development of new products, and the almost total reliance on the internal technology and capabilities of the enterprise. Therefore, the operational bottleneck of the enterprise was solved by increasing the inventory, and the cooperation and development between enterprises were rarely considered. Purchasing at the time was only considered a support activity for production, and managers were less concerned with procurement activities. In the 1970s, a manufacturing resource plan was introduced, and managers realized that the amount of inventory had a significant impact on manufacturing costs, new product development, and production lead times. Thus, business performance was improvement by shifting to new material management.

The second phase was the integrated logistics management phase, focusing on the integration of intra-enterprise logistics and external logistics, and researching inter-enterprise procurement and supply strategies, emphasizing the strengthening of cooperation. After the 1980s, global competition intensified. Some large multinational companies faced market competition and maintained their leading position by providing low-cost, high-quality, reliable products and more flexible designs. Manufacturing companies began to introduce JIT productivity concepts, and Japanese companies implemented JIT to improve manufacturing efficiency, shorten production cycles and reduce inventory. Manufacturers were aware of the importance of strategic partnerships as JIT mitigated production and scheduling problems through a fast-paced manufacturing environment and low inventory. Therefore, when manufacturers and suppliers began to develop strategic supply relationships, the concept of supply chain management emerged. In this phase, the specialization of procurement, logistics and transportation processes promoted the further development of material management concepts. Manufacturing Resource Planning (MRP II) emphasizes the integration of functions and resources within an enterprise, and the integration of internal resource planning requires the cooperation of external suppliers and distributors. Manufacturing companies integrated internal and external logistics systems, which leads to the concept of integrated logistics.

The third phase was the integration of the supply chain management phase, which focused on the overall supply chain research from the supplier's supplier to the customer's customer, focusing on the overall value chain efficiency and value added. After the 1990s, supply chain management continued to grow and the supply chain expanded into an overall value chain of suppliers, manufacturers, distributors and customers. The efficiency of procurement and supply required more consideration of coordination between cost and quality. Manufacturers eliminated non-value-added activities by purchasing raw materials from selected suppliers or certified suppliers, such as raw material quality inspections, warehousing inspections, etc. Many manufacturers and retailers worked closely together to increase the efficiency of cross-enterprise value chains. For example, in the development of new products, manufacturers' integrated suppliers and customers, used the research and development capabilities and technology of partners, improved the research and development cycle, and enhanced core competitiveness. Distributors and retailers seamlessly connected their distribution and transportation providers to achieve direct delivery and eliminate value-added activities such as item inspections (Uvet, 2020).

The fourth phase, after the 20th century, was the development of information technology and decision support systems. Information technology is a key factor in enabling effective supply chain management. In this phase, the basic question of supply chain management is what data should be passed and how it is analyzed and utilized in terms of integration and collaboration. The impact of the Internet, the role of e-commerce, information technology and decision support systems have become the main tools for companies to gain market competitive advantage. On the other hand, customer value is a measure of how much a supply chain or firm contributes to its customers in terms of market performance. This indicator has replaced indicators such as quality and customer satisfaction in recent years.

7.2 Trends in Supply Chain Management Research

In regard to time and speed, in this study, the supply chain environment, time and speed have been regarded as the main sources of improving the competitive advantage of enterprises. The drag of one link often affects the operation of the entire supply chain. Each enterprise in the supply chain realizes the close connection between logistics and information flow through various means to achieve the quick response to the final customer requirements, reduce the inventory cost, and improve the overall competition level of the supply chain in electronic commerce (E-commerce) (Das et al., 2020).

In regard to quality and asset productivity, in this study, supply chain management involves many links, and it needs to be closely linked and ensure the quality of each link. Any link, such as the quality of transportation services, will directly affect the quantity of suppliers' stocking and the number of distributors' warehousing, which will ultimately affect users' evaluation of product quality, timeliness and price.
Nowadays, more and more companies believe that logistics quality innovation is evolving into a powerful force to improve supply chain performance. On the other hand, manufacturers are increasingly concerned about asset productivity. Improving asset productivity is not just about reducing inventory within the company, but more importantly, reducing inventory in the supply chain. The trends in supply chain management require companies to collaborate and share data to reduce inventory across the supply chain.

In regard to organizational streamlining, in this study, the type and number of members in the supply chain are the direct cause of the complexity of supply chain management. Under the current supply chain development trend, more and more companies are beginning to consider reducing the number of logistics providers, and this trend is very obvious and rapid. For example, multinational clients are more willing to outsource their global logistics supply chain to a few partners, ideally logistics providers. This is not only beneficial to management, but also helps to provide uniform standard services on a global scale, and better demonstrates the overall advantages of global supply chain management.

In regard to customer service, in this study, more and more supply chain members are beginning to value customer service and customer satisfaction. Supply chain management needs to pay more attention to customers’ feelings about the service level, and the measurement of service level is also based on customer satisfaction. The result of the shift in the focus of customer service is to attach importance to the relationship with logistics firms, and regard logistics firms as partners in providing a high level of service.

### 7.3 Development of Theoretical Models of Supply Chain Management

A theoretical model is a representation of a problem domain using general rules and concepts; also it is a simplified and idealized understanding of solution alternatives (Wieteska, 2020). This study examines the supply chain management research issue by reviewing the development SCM theoretical models and illustrating theoretical model types with moderators, mediators, moderated mediation and mediated moderation variables. The ninety-seven articles reviewed here compiled the variables, research methods, and research subjects theoretical models of supply chain management research from 2014-2019. The theoretical models with moderators and mediators are mature theoretical models in SCM research. In recent years, theoretical models with moderated mediation have been an emerging development, applied in the study of this research issue. In addition, with the rapid development of statistical and mathematical analysis tools and the pursuit of excellence in science and social science theories, theoretical models with mediated moderation are destined develop further in the future of SCM research.

### 8. CONCLUSION

This research is the first article in terms of investigating supply chain management studies using a theoretical model review based on a qualitative historical review research in supply chain issue. This survey only provides a static picture of a very dynamic area, but several implications can be drawn from the supply chain management literature. Different reviews and survey methods must be implemented to broaden the knowledge base. This study also contributes to the field by providing past, current and future research directions with potential understandings and matters of significance. Finally, even if the which articles related to theoretical models of supply chain management published in various journals have captured the attention of several research communities and categories, very few multidisciplinary studies seem to have been conducted on the subject. Therefore, this study provides a valuable reference for future studies of supply chain management.

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