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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; Maestrini *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, transshipment, 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 & Gaeckler, 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

Table 1 (con`t) Theoretical models with moderator designs and tests

2015	Chen *et al.*	Environmental management strategy	Environmental collaboration in supply chains	Environment-performance relationship	Regression	Taiwan manufacturing firms
2016	Mariadoss *et al.*	Sustainable purchasing practices	Firm business type	Sustainable supply practices	SEM	USA manufacturing and service industries
2016	Yoon *et al.*	Innovation leadership	Hospital size	SC efficiency	SEM	South Korea medical service facilities
2016	Chang *et al.*	Internal integration	Time; Relationship quality; National culture	Financial performance	SEM	SCIE journal sample meta data
2016	Liu *et al.*	supply chain technology utilization	Information sharing; Logistics integration	Delivery performance	SEM	USA firms
2016	Flynn *et al.*	Supply chain integration	Centralization; Formalization	Uncertainty	Hierarchical regression	339 globally distributed manufacturing plants
2016	Mokadem	Customer priorities	ISO 9000	Supply chain alignment	Moderated regression	Egypt manufacturing firms
2016	Lee *et al.*	Supply chain integration	Supply chain dynamism	Logistics performance	Moderated hierarchical regression	South Korean manufacturers
2016	Kim *et al.*	Supply chain information sharing	Supply chain culture of competitiveness	Supply chain performance	Regression	South Korean manufacturers
2017	Agrawal *et al.*	Interdependence	Penalties; production costs; Interdependence costs	Quality performance	Regression	USA OEM manufactures
2017	Sreedevi & Saranga	Environmental uncertainty	Supply chain flexibility	Supply chain risk	SEM	India manufacturing firms
2017	Kabra *et al.*	Performance expectancy	Personal innovation	Effort expectancy	PLS/SEM	India disaster relief respondents
2017	Li & Huang	Green supply chain practices	Relational bonding	Green innovation performance	ANOVA	Taiwan manufacturing firms
2017	Liu *et al.*	External integration capability	Environmental proactivity	Supplier appraisal capability	Hierarchical linear regression	International logistics managers
2017	Nejati *et al.*	Green human resource management	Employees' resistance to change	Green supply chain management	(PLS-SEM)	Iran manufacturing industries
2017	Gligor	Supply chain fit	Environmental uncertainty	Financial performance	Hierarchical moderated regression	USA 17 industries
2018	Schniederjans	Social quality management	Business process innovation	Supply chain performance	Hierarchical moderated regression	USA manufacturing firms
2018	Mandal	Big data analytics management capabilities	Technology orientation	Sustainable tourism supply chain performance	PLS	India hotels and restaurants
2018	El-Kassar & Singh	Green innovation; Big Data Adoption	HR practices, training/Management commitment	Organizational performance	(PLS-SEM)	United Arab green firms
2018	Xu *et al.*	Knowledge sharing	Participation in standards consortia	Process integration	PLS	China RosettaNet firms

Table 1 (con`t) Theoretical models with moderator designs and tests

2018	Ledwoch *et al.*	Effectiveness	Supply network topology	Risk management strategies	Simple exponential smoothing forecasting method	UK OEM agents, supplier agents, logistics providers
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 chains performance	SEM	India businesses

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 meditational 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 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 casual 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	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 performance	SEM	South Korean manufacturers
2014	Liao & Kuo	Supply chain collaboration	Supply chain capabilities	Firm performance	SEM	Taiwan TFT-LCD industry
2015	Gómez-Cedeño et et.	Human resource management	Customer satisfaction; Organizational performance	SCM outcomes	SEM	Spain manufacturers
2015	Huo *et al.*	Relationship commitment	Supply chain coordination	Supply chain performance	SEM	China manufacturing firms
2015	Luo *et al.*	Asset specificity; Volume uncertainty; Environmental competition	Guanxi	Green supply chain collaboration	PLS/SEM	Chinese manufacturing organizations
2015	Busse	Sustainability-related conditions	Purchasing costs; Supply chain sustainability risk costs; Cooperation benefits; Benefits stemming	Economic performance	SEM	Swiss manufacturing firms
2015	Wichmann *et al.*	Commitment	Championing behavior	Network centrality	SEM	U.S. technology firms
2015	Ambulkar *et al.*	Supply chain disruption orientation	Resource reconfiguration	Firm resilience	SEM	USA manufacturing firms
2015	Shi & Liao	Inter-firm dependence; Inter-firm trust	E-business integration	Operational performance	SEM	China manufacturing firms
2016	Singh & Teng	Trust	Relational governance	Supply chain performance	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 culture	Relationship strength	Supply chain performance	PLS/ SEM	India manufacturing firms
2016	Bode & Macdonald	Disruption	Disruption recognition; disruption diagnosis; response development; response implementation	Supply chain complexity	OLS regression	Europe manufacturing sectors and firms
2016	Pradhan & Routroy	Risk management	Contract management	SM performance	SEM	India manufacturing firms
2016	Peng *et al.*	Information technology	Internal and External processes	Firm performance	SEM	China IT firms
2017	Liao *et al.*	Supply chain collaboration value innovation	Supply chain capability	Competitive advantage	SEM	Taiwan networking communication industry

Table 2 (con`t) Theoretical models with mediator designs and tests

2017	Durach *et al.*	Risk management	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-Bliech *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 Wisner	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), 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 inference 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 patriating 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

Table 3 (con`t) Theoretical models with moderated mediation designs and tests

2018	Zhang *et al.*	IOS appropriation	Collaborative culture/ Inter-organizational systems	supply chain collaboration	SEM	USA manufacturing firms
2018	Ojha *et al.*	Transformational leadership	Supply chain organizational learning/ Uncertainty	Supply chain ambidexterity	SEM	USA manufacturing and service subjects
2019	Song and Yang	Food traceability-core capabilities	Environmental dynamism/ Operating and marketing capabilities	Food traceability-performance	SEM	China food manufacturing firms
2019	Amoako-Gyampah *et al.*	Supplier relationship management	Flexibility capability/ Ownership structure	Firm performance	Regression	Ghana firms

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 moderator 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 researchers depending on theoretical model differences (Holbert, 2005). Based on research findings, few mediated moderation models have been published in academic journals because of difficulties not only in sample analysis and testing, but also in hypotheses and theoretical model development for specific problem domains and subjects.

Table 4 shows three articles concerning behavior studies of Internet users with mediated moderation using hierarchical multiple regression and SEM analyses. USA information technology firms, Taiwanese industrial buyers and North American firms were research subjects. Mediated moderator variables included governance–knowledge fit/IT governance, attribution/industrial brand equity and forecast accuracy/internal integration, forecasting process quality, effective use of advanced systems, valuation of forecasting, etc.

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 metric is measured by all the goods, services, and intangibles that the company provides. 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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