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SUPPLIER EMPOWERMENT: MODERATING THE CAUSAL RELATIONSHIP BETWEEN SUPPLIER MODULARITY PRACTICES AND BUILD-TO-ORDER SUPPLY CHAIN CAPABILITIES

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ABSTRACT

Psychological empowerment attracts researchers in theory building, measurements, and applications at the individual and team levels. Based on social dilemma theory and resource dependency theory, this study proposes a research model to explore (1) the relationship between supplier modularity practices and build-to-order supply chain (BOSC) capabilities, (2) the role of supplier empowerment in moderating the relationship between supplier modularity practices and BOSC capabilities, and (3) the direct impact of supplier empowerment on BOSC capabilities in a supply chain context. The model is tested with 208 responses from automotive suppliers in North America and in China.

Key Words: Supplier Empowerment; Build-to-order Supply Chain (BOSC); Supplier Modularity

1. INTRODUCTION

Companies are utilizing build-to-order supply chain (BOSC) practices to deploy their supply chain management strategy and mass customization strategy in order to build up their supply chain's flexibility and responsiveness, which, in turn, enables the companies to deliver products that customers ordered [18][49]. BOSC is viewed as the 21st century supply chain strategy [17]. However, Gunasekaran and Ngai (2005) point out the areas to be further explored in the BOSC literature, including (1) defining and specifying the content domain of the BOSC construct, (2) developing an integrated model for business strategy and operations strategy, economic factors, market factors, and competitive factors, and (3) defining measures [18]. Supplier modularity practice is a major type of build-to-order supply chain practices. This practice views a supply chain from a design architecture perspective. Its impact on the BOSC capability may be limited unless an interaction mechanism between a buyer and its suppliers exists to guide the efforts of all members in the supply chain. However, this interaction mechanism has not been adequately explored nor been empirically tested [16] [35].

This study presents a research model, based on social dilemma theory and resource dependency theory, to explore (1) the relationship between supplier modularity practices and build-to-order supply chain (BOSC) capabilities, (2) the role of supplier empowerment in moderating the

relationship between supplier modularity practices and BOSC capabilities, and (3) the direct impact of supplier empowerment on BOSC capabilities in a supply chain context. The model is tested with 208 responses from automotive suppliers in North America and in China.

2. THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

Supply chain practices are broad and there is no consensus among researchers. A valuable way to define and measure supply chain practices to benefit researchers and practitioners is to define supply chain practices that target on a specific supply chain strategy. Build-to-order supply chain (BOSC) strategy is a state-of-the-art supply chain strategy. It focuses on a supply chain's responsiveness toward customers and its own efficiency and effectiveness. BOSC is a fast, reliable, and low-inventory system. Which practices should be viewed as critical BOSC practices is a valuable question that attracts interests of researchers and supply chain managers. In addition, how to coordinate supply chain members to actively participate into BOSC is also a valuable topic, which deserves to be explored more deeply [18].

Following the above discussion, a research model is built on theories of mass customization, social dilemma, and resource dependency. Then, constructs are defined and hypotheses of relationships between these constructs are proposed through the literature review.

Environmental uncertainty includes two main parts: technology changes and demanding customers. Technology changes result in push strategy of operations or supply chain, while demanding customers result in a pull strategy. Fine (1998) proposes a concept of clockspeed to measure the rate of technology change [15]. A company in an industry with high clockspeed has a high possibility of quickly losing its advantages, resulting in a shorter life for its competitive advantage [14]. A company's real core competence is its ability to design and redesign its value chain in order to continually seek the maximum advantage [14]. They provide 3D concurrent engineering practices to respond to the fast rate of technology change. 3D concurrent engineering is used to simultaneously build supply chain practices in three dimensions: product development, process management, and supply and retail management.

Mass customization is a pull strategy to satisfy demanding customers. It utilizes modular product design. Modularity product design provides more product varieties for customers. In this study of exploring and defining BOSC supply chain practices, both technology push strategy (e.g., 3D concurrent engineering) and customer pull strategy (e.g., mass customization) are considered. Therefore, based on 3D concurrent engineering (i.e., product development, process, and supply and retail management) and mass customization (e.g., modularity), one type of build-to-order supply chain practices is supplier modularity practices (see Figure 1). By definition, modularity allows many varieties of products while maintaining low cost of manufacturing each module. Modularity allows companies to communicate available permutations of products with customers easily and to fulfill orders quickly.

However, the interaction mechanism, which is between a buyer and its suppliers to pursue this practice, has not been clearly explored nor been empirically tested [16][35]. Previous studies of supply chain practices are mainly from the buyer (i.e. manufacturer) perspective [21][30][39]. This is a study to include a model of supply chain practices from the supplier perspective. The

model is based on social dilemma theory from economics and resource dependency theory from management.

When applying social dilemma theory in an alliance context (i.e., a group of several members pursuing common goals and then sharing benefits according to some rules), Zeng and Chen (2003) use a simple decision model to support that a member in an alliance has a tendency to choose defecting to get higher self-interest rather than to choose cooperation to get higher interest for the whole alliance [51]. Social dilemma theory describes the potential short-term decision of a member in an alliance, which will lead to a long-term failure of the whole alliance and thus the failure of the member. In contrast to the social dilemma theory, resource dependency theory focuses on the long-term view of members in an alliance to emphasize the importance of cooperation in an alliance [3][41]. Therefore, members in a successful supply chain should have a long-term view to choose cooperation instead of competition.

Researchers have been finding different ways to enable members in an alliance to have a long-term and cooperation view rather than a short-term and competition view. Motivational solutions the social dilemmas focus on increasing self efficacy of members and include two approaches, enhancing communications [4][6][51] and establishing long-term goals [1][19][38][51]. This study adapts motivational solutions to social dilemmas into supply chain management to facilitate cooperation within a supply chain.

A research model (see Figure 1) is built on theories of mass customization, social dilemma, and resource dependency. The supplier empowerment mainly focuses on increasing a supplier's task motivation.

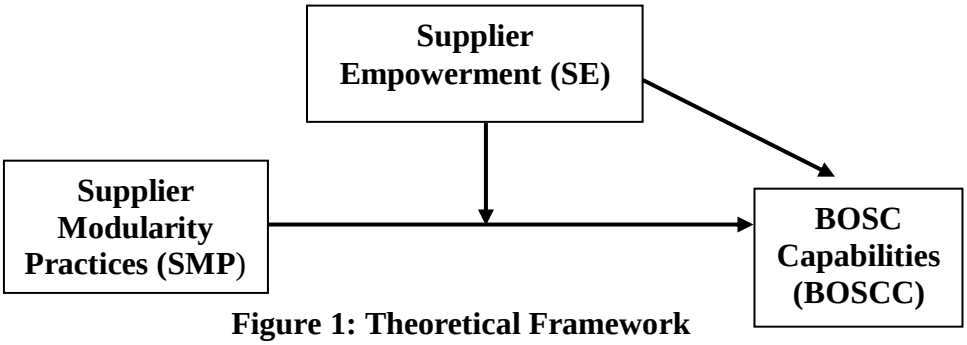

Figure 1: Theoretical Framework

Table 1 presents the constructs, their definitions, major dimensions of each construct, and the relevant literature of these constructs.

Tu et al. (2004) show that high modularity-based manufacturing practices (i.e., modularity product design, modularity process, and dynamic teaming) increase mass customization capability (i.e., cost effectiveness, volume effectiveness, and responsiveness), which is a key part of build-to-order capability [49]. In supplier modularity practices, the fourth dimension is strategic supplier segmentation. It allows the manufacturer to save a lot of time in managing the supply base through managing modules of suppliers based on the product modules, and to save on the cost of managing suppliers and to respond to changing demands quickly. Therefore, this study proposes the following hypothesis:

Hypothesis 1: Supplier modularity practices have a positive impact on BOSC capabilities.

Table 1: The Definitions, Dimensions, and the Related Literatures of the Constructs

Construct	Definition	Dimensions
Supplier Empowerment	Task motivation of a supplier through its assessment of the potential value of proactively participating in supply chain practices.	• Meaningfulness • Potency • Autonomy • Impact
Supplier Modularity Practices	Practices of applying modularity in product, process, supply base, and teaming in the supply chain context.	• Product modularity • Process modularity • Dynamic teaming • Strategic supplier segmentation
Build-to-Order Supply Chain Capabilities	Ability of a firm to produce varieties of customized products on a large scale to fulfill customer orders efficiently at a reasonable cost through technical and managerial innovations.	• Mass customization • Order fulfillment • Inventory

Empowered suppliers, like empowered individuals, are proactive in the alliance with the buyer on supplier modularity practices in product design, process operation, manufacturing team, and supply base management. In product design, empowered suppliers are willing to share their expertise to design modules for the final products. In this way, the introduction period of new product becomes shorter.

In the manufacturing process, empowered suppliers are willing to adapt to the market change of the final products and thus invest more in modular manufacturing processes to respond to the fast changed products, which demand flexible manufacturing requirements for suppliers. Similar to the effect of supplier alignment, flexible manufacturing systems call for flexible manufacturing teams of suppliers to adapt to the fast changing manufacturing projects and their schedules.

Changing demands of the buyer push back the uncertainty to the supplier's supply base management. Empowered suppliers are more likely to utilize the method of modular supply base management (i.e., strategic supplier segmentation) to maximize the utilization of resources in supply base management. Therefore, this study proposes the following two hypotheses:

Hypothesis 2: Supplier empowerment has a positive impact on BOSC capabilities.

Hypothesis 3: Supplier empowerment moderates the relationship between supplier

modularity practices and BOSC capabilities.

3. RESEARCH METHODOLOGY

Supplier empowerment is measured with items adapted from Kirkman and Rosen (1999) [27]. **Supplier modularity practices** are measured with the items adapted from Tu et al. (2004) and through the review of literature in the supply chain context [12][13][31][40][42][49]. **BOSC Capabilities** are measured with the items adapted from Tu et al., (2004) and Gunasekaran and Ngai (2005) [18][49]. All measurement items use a five-point scale ranging from 1 = "strongly disagree" to 5 = "strongly agree". The data were collected in the U.S. and China through a survey questionnaire. Of 480 mailed or emailed questionnaires, 24 did not reach the targeted respondents because of wrong addresses or names. The number of people who received the questionnaire is 456. There are 160 responses from the first wave and 48 responses from the second one. The number of respondents who completed and provided usable responses was 208. After all, our response rate is 45.6%.

4. INTRUMENT DEVELOPMENT

After the large-scale survey is conducted, a sample of data is ready for the instrument validation and the hypothesis testing. Due to the limit of the paper size, the large-scale instrument validation is not reported here. Each of the three constructs in this study has good reliability and validity including content validity, convergent validity, discriminant validity, and validation of the second-order construct.

5. HYPOTHESIS TESTING

ANOVA is used to test the hypotheses. Results are listed in Table 2. All three hypotheses are supported at the significance level of 0.001.

The regression analysis is conducted at two levels: low supplier empowerment and high supplier empowerment. Modality-based supplier practices have a significantly positive impact on BOSC capability at each level.

Table 2: Hypothesis Testing using ANOVA Approach
Dependent Variable: BOSC Capabilities

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	3169.611(a)	200	15.848	1078.276	.000
ModularityPractices	9.752	54	.181	12.288	.000
SupplierEmpowerment	9.568	58	.165	11.224	.001
ModularityPractices * SupplierEmpowerment	1.115	6	.186	12.648	.001
Error	.118	8	.015		
Total	3169.728	208			

a R Squared = 1.000 (Adjusted R Squared = .999)

We compare the means of BOSC capabilities for four groups (Supplier Empowerment: High vs. Low; Modularity: High vs. Low). The results are described as follows:

- The means of BOSC capabilities at the high empowerment level (3.90 and 4.27) are higher than that at the low empowerment level (3.48 and 3.81), respectively.
- At the low modularity level, the mean of BOSC capabilities at the high empowerment level (3.90) is significantly ($p < 0.001$) higher than that at the low empowerment level (3.48).
- At the high modularity level, the mean of BOSC capabilities at the high empowerment level (4.27) is significantly ($p < 0.001$) higher than that at the low empowerment level (3.81).

6. CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

This study provides some preliminary empirical evidences that support (1) supplier modularity practices have a significant positive relationship with build-to-order supply chain (BOSC) capabilities, (2) supplier empowerment moderates the relationship between supplier modularity practices and BOSC capabilities, and (3) supplier empowerment has a significant positive relationship with BOSC capabilities in a supply chain context. The proposed measurement model of supplier empowerment has been empirically tested with good reliability and validity.

Future studies will focus on the relationships between supplier empowerment and other supplier and/or supply chain practices, which increase performances of supplier and the whole supply chain.

References available upon request from Kun Liao at LiaoK@cwu.edu