Supply Chain Complexity

[Supply chain] complexity does not mean complicated, but rather it describes a condition of inter-connectedness and inter-dependencies across a network where a change in one element can have an effect on other elements (Christopher).

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Introduction

Supply chains consist of multiple business partners who work together directly or indirectly and collaborate by information, material and financial flows (Isik, 2010). Supply chains are usually faced with a considerable number of exogenous and endogenous drivers of complexity originating from diverse sources which can arise from network, process, range, product, customer, supplier, organisational and information complexities (Blecker et al., 2005; Christopher).

Supply chain complexity is characterised by copiousness, interdependency, variability, variety and uncertainty. These complexity characteristics are interrelated. For example, a high level of variety may lead to variability or high density. Similarly, diversity may cause uncertainty. Reducing the level of these characteristics can help companies reduce supply chain complexity (Isik, 2011).

Supply chain complexity is closely correlated with total supply chain management cost. For example, many of Shell's refineries have their own supply chain planning and operational processes accompanied by a large number of spreadsheets and applications that created complexity and required high support, maintenance and training costs (Aspentech, 2010). In addition, supply chain complexity can lead to high operational costs, customer dissatisfaction, time delay in delivery, excess inventory or inventory shortage, or lack of cooperation, collaboration and integration among supply chain participants (Isik, 2011).

Increased complexity in the supply chain contributes to increases in total cost. Because of the direct link between the efficiency and complexity of a supply chain, complexity management becomes a major task of today's business management (Blecker et al., 2005) and complexity reduction is often recommended as one of the most effective ways to improve agility and reduce cost in the supply chain (Christopher). Isik (2011) suggests a four stage complexity management model as one of the ways to effectively manage complexity in supply chains. The model covers actions aimed at identifying, measuring, analysing and controlling (whether reducing and avoiding) complexity.

Definition

Analysis of supply chain complexity can be achieved by categorising it into three complexity types: decision-making complexity, structural complexity and behavioural complexity (Calinescu et al., 2001).

Successful application

Most of the trade and academic literature on lean production has focused predominantly on how to reduce supply chain complexity. Because complexity implies uncertainty, one powerful way to handle it is through creating a higher level of adaptability in the supply chain. An adaptable supply chain is one that can change its structure in response to fundamental shifts in the business environment (Christopher). The literature on flexibility (Swink et al., 2005; Sethi and Sethi, 1990; Swafford et al., 2006) and operations strategy (Hayes and Wheelwright, 1979; Closs et al., 2008) on the other hand argues the importance of understanding how to accommodate high levels of supply chain complexity when required by the business strategy.

Steps to successful application

1. Identify the level of supply chain complexity.

2. Measure the level of supply chain complexity.
3. Decide on what is the best option for managing complexity or whether there is a need for its reduction.
4. Control supply chain complexity.

Isik (2010)

Hints and tips

- It is not always necessary to reduce complexity as sometimes accommodating high levels of supply chain complexity to company strategy can be preferable (Blecker and Kersten, 2006).
- Supply chain complexity management can require analysis of all supply chain components to identify what kind of strategy needs to be followed (Blecker and Kersten, 2006).
- Consideration over supply chain complexity should be part of the company supply chain and should be treated as an integrated part of supply chain management (Blecker and Kersten, 2006).

Potential advantages

- The complex supply chain is capable of faster adaption to the needs of suppliers and customers (Bozarth et al., 2009).
- Through supply chain complexity companies can differentiates themselves from competitors (Christopher).
- Supply chain complexity can increase the functionality of the supply chain system (Bozarth et al., 2009).

Potential disadvantages

- Supply chain complexity can increase operational costs, customer dissatisfaction, time delays in delivery, excess inventory or inventory shortage (stockouts), and can cause a lack of cooperation, collaboration and integration among supply chain participants (Isik, 2010).
- Supply chain complexity can imply uncertainty (Christopher).
- Complex supply chains are often not cost-competitive (Barton and Thomas, 2009).

Performance monitoring

Calculation of variation: supply chain complexity can be measured by analysing quantitative differences (variations) between actual and scheduled demand values, calculated by subtracting actual values from expected values and seen in variation (Isik, 2011).
State definition: a state refers to what the system is doing and a system can be in one or more states (Isik, 2011).
Probability distribution and data analyses: probability histogram can be created to analyse the measurement results (Isik, 2011).

Case studies

- In the mid-2000s HP began a project to simplify 300 of its supply-chain related applications. Within three years the company's ratio of spend to revenue has been reduced by 19% (HP White paper, 2010).
- To decrease the complexity, Benetton uses a 'double supply chain'. It allows the company to focus on rapid response to the market while looking outside Italy for an optimum combi-

nation of product quality, efficiency, and the necessary cost control. Thus, modern scheduling and planning systems capable of managing complex situations associated with medium and long-term supply allow Benetton's production to quickly and effectively respond to the needs of a market (Benetton Group, 2011).

- Many of Shell's refineries had their own supply chain planning and operational processes accompanied by a large number of spreadsheets and applications that created complexity and required high support, maintenance and training costs. Standardizing IT applications across its refineries would not only reduce operational costs but also respond faster to the changing market. The last tenet of the solution was to optimise profitability across the supply chain (Aspentech, 2010).

Further Resources/Reading

Web

Horsemeat scandal: Food supply chain 'too complex' - Morrisons

Reducing supply chain complexity.

Managing complexity in supply chains.

Supply chain complexity and globalisation.

Case studies on reducing supply chain complexity.

Books

Understanding Supply Chain Complexity: An approach integrating performance measurement and System Dynamics ISBN 978-3639244359

Complexity Management in Supply Chains: Concepts, Tools and Methods ISBN 978-3503097371

Supply Chain Excellence: A Handbook for Dramatic Improvement Using the SCOR Model ISBN 978-0814409268

Planning and Optimisation of Complex Supply Chains: An Integrated Approach for Solving Aggregate Production-Distribution Planning Problems ISBN 978-3844318647

Sourcing of Services: International Aspects and Complex Categories (Einkauf, Logistik und Supply Chain Management) ISBN 978-3834911902

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Video

Phil Greening: Supply chain disruptions and complexity
https://www.youtube.com/watch?v=jgugU8iBKJY

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