THE ANALYTIC NETWORK PROCESS IN MODELING AND COORDINATION OF DYNAMIC SUPPLY NETWORKS

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ABSTRACT

Supply chain management is more and more affected by network and dynamic business environment. Inefficiencies exist in supply network behavior. Coordination and cooperation can significantly improve the efficiency of supply networks. The Analytic Network Process (ANP) approach is appropriate for modeling network environment. The proposed version of dynamic ANP is able to model and analyze the supply dynamics. Dynamic ANP is a hybrid procedure that combines the benefits of long-term forecasting of pairwise comparison functions and short-term weight predictions using exponential smoothing compositional data. Analysis and modeling of dynamic supply networks goes through the following phases: designing, managing, performance measurement and improvement. Important features of this environment are established in the proposed approach, which can be a powerful instrument for modeling and coordination of dynamic supply networks.

Keywords: supply chain management, ANP, networks, dynamics, compositional data

1. Introduction

Supply chain management is a philosophy that provides the tools and techniques enabling organizations to develop strategic focus and achieve sustainable competitive advantage. It presents management with a new focus and way of thinking about how their organization exists and operates within the wider business environment. The globalization and technological improvement has changed the business environment. It has become more complex and dynamic (Fiala, 2006); one consequence is that organizations are making efforts to deal with the increasing challenges and keep competitive. The paper uses the Analytic Network Process (ANP) for modeling and managing supply networks.

2. Literature Review

Supply networks are dynamic multilevel systems with sets of suppliers, manufacturers, distributors, retailers and customers. The multiple decision-makers are interconnected with dynamic structures and dynamic linkages by material, financial, information and decision flows. Each unit will attempt to optimize its own preference. Behavior that is locally efficient can be inefficient from a global point of view. Once traditionally driven by pure competition, supply networks for many successful firms have matured from an adversarial relationship to one of supply network partnership (Tayur et al., 1999, Snyder and Shen, 2011). The Analytic Network Process (ANP) approach (Saaty, 2001) seems to be very appropriate for networks. The ANP makes it possible to deal systematically with all kinds of dependencies and feedback in a system. Dynamic analysis of systems uses time-dependent priorities that can be expressed by a combination of forecasting using

pairwise comparison functions (Saaty, 2007) and predictions based on use of compositional data exponential smoothing (Raharjo et al., 2009).

3. Objectives

The main objective is development of a general approach for analysis and modeling of dynamic supply networks through the basic phases: designing, managing, performance measurement, and performance improvement. Designing of supply networks involves establishing the most appropriate system elements and their relationships in time, dynamic setting for the needs of end users and other requirements for functioning of dynamic systems according to multiple criteria. The managing phase covers the entire hierarchy of management activities, from planning to production scheduling and distribution of products to real-time control. The most important part is the coordination of individual activities to be optimal in terms of the whole system. Phases of performance measurement and improvement focus on assessing the current state of the system according to multiple criteria and propose best approaches to improve its performance.

4. Research Design/Methodology

The basic ANP model constructs the structure of supply networks. The clusters in modeling of supply networks can be economic agents, activities, products, items, evaluating criteria, etc. The connections among members of supply networks are material, financial and information flows. The basic ANP model is completed by specific sub-networks. The sub-networks are used to model important features of dynamic supply networks. The most important features in our ANP-based framework for dynamic supply networks are captured in the following sub-networks: dynamic flow of activities, and time-dependent resources.

5. Data/Model Analysis

Dynamics is an important characteristic of supply networks. Time dependent priorities play an increasingly important role in a rapidly changing environment of network systems. Long-term priorities can be based on time dependent comparisons of system elements. Short-term predictions can use compositional data exponential smoothing. A hybrid procedure that combines the advantages of both approaches is proposed. The procedure can be combined with the Aspiration Level Oriented Procedure (ALOP). The ALOP is based on a goal-programming approach. A combination of the dynamic ANP and ALOP seems to be the appropriate method for the analysis of the specific features in dynamic supply networks.

6. Limitations

The proposed model and solving procedure is general. The approach must be tested under different conditions. The experimental results will affect the specification, completing and extending the model. The modified approach can be then applied to real supply networks.

7. Conclusions

The very important new features in supply systems are dynamics and network structure. Coordination of decisions in supply networks is a key issue. The combination of network

structure modeling and simulation of dynamic behavior of agents in supply networks can be a powerful instrument of coordination in dynamic supply networks. The proposed approach combines advantages of the traditional methods with new procedures. There is a combination of system dynamics modeling and the Dynamic Analytic Network Process. The aim is coordination of units and management of supplier-customer relations. The expected result is a mutually beneficial, win-win partnership that creates a synergistic network in which the entire network is more effective than the sum of its individual agents.

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8. Key References

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