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Technical Paper

Impact of the integration of tactical supply chain planning determinants on performance

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ABSTRACT

In fulfilling customers' orders, one of the goals of tactical supply chain planning is to satisfy the customers in terms of delivery efficiency, delivery quantity accuracy and on-time delivery. These performance objectives can be impacted by the way firms plan each of the three phases of the supply chain: procurement, production and distribution. Though the link between each of these phases and supply chain performance has been studied in extant literature, very few authors have considered all three phases at the same time. By adopting an integrated approach, this paper therefore aims to study the manner in which, taken together in one model, the planning determinants of the different phases impact on supply chain performance. It is important for managers to understand, from a holistic and integrated perspective, how a given combination of the planning determinants of the supply chain functions impacts positively or negatively on the performance of the supply chain. To carry out this study, this paper starts by proposing an integrated framework that is based on the SCOR model and the customer order decoupling point (CODP), followed by a five-step methodology for tactical supply chain planning. Then, using an analytical model and simulations, and based on a numerical example, it shows how the proposed methodology can be applied in a given decision-making situation. Our results enabled to identify the worst and the best combinations of planning determinants.

1. Introduction

In the globalised and highly competitive world of today, companies aim to achieve high performance through an effective and efficient management of their supply chains (SC). The Global Supply Chain Forum defined supply chain management (SCM) as "the integration of key business processes from end users through original suppliers who provide products, services, and information that create value for customers and other stakeholders" [1]. This definition allows us to state that the performance of a SC can be leveraged through the effective and efficient design, integration, planning and control of the key business processes. The Supply Chain Operations Reference (SCOR) model provides a process-based framework, which incorporates five main process areas – plan, source, make, deliver and return – that constitute a SC [2]. The SCOR model is considered to be a powerful tool that can be used to study and understand how performance variables inter-relate and how to manage the trade-offs resulting from these relationships [3]. Apart from the return process area (which is an aftermarket process), the determinants of each of these process areas (or functions) can impact on the performance of the SC. The source, make and deliver process areas correspond respectively to the procurement, production and distribution functions. Ref. [4] studied and confirmed a positive relationship between supply chain performance and each of the five process areas, but did not investigate the individual or combined impact (on performance) of the determinants of these process areas.

Many researchers have studied the relationship between the determinants of three of these process areas (source, make and deliver) and supply chain performance [5,6]. But, despite the fact that academics and professionals have always thought that significant capacity adjustment expenditures and storage costs might be avoided by better planning [7], the impact of the planning process on performance has not been sufficiently explored [8]. The few studies that have been done on this topic are generally limited only to the manufacturing or production function [9,10]. Moreover, most

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of the studies are based on one-to-one or one-to-few relationships. In other words, the authors study the impact of just one or two planning determinants on a few (or a single) performance measures. For example, Ref. [11] looked at the impact of lot sizing and sequencing on manufacturing performance; Refs. [12,13] studied the effect of capacity and sequencing rules; Ref. [14] studied capacity strategies with respect to total profit; Ref. [15] simulated performance differences between fixed and rolling horizon environments; Ref. [16] analysed the effect of forecast accuracy; Ref. [17] modelled the setting of planned windows and lead times; while Ref. [18] studied the improvement of on-time delivery. These authors report the impact of one or two determinants of a given supply chain function (source, make or deliver) on one or two performance measures. Given that other authors have reported possible trade-offs between different performance measures such as quality consistency, lead time, delivery reliability, cost, and flexibility [19], our postulate is that a given combination of planning determinants from two or more supply chain functions would impact positively or negatively on various SC performance measures, thereby creating a trade-off situation. Ref. [20] noted that, in material requirements planning systems, much was still left to the planner's intuition and experience in selecting appropriate capacity levels and lot sizes for components. Managers therefore need a decision-making support system that would enable them to make the most optimal trade-off decision from an integrated perspective. In a nut shell, this paper aims to study how the integration of supply chain planning determinants impact positively or negatively on supply chain performance objectives.

In the same way that the management of companies involves decisions at the strategic, tactical and operational levels, supply chain planning also involves decisions at these three levels according to the time horizon – long term for strategic planning, medium term for tactical planning and short term for operational planning. However, only the tactical level planning will be studied in this paper for the following reasons: (1) Although Ref. [21] argues that it is crucial for supply chain planning to integrate strategic, tactical and operational decision-making, the huge differences in planning horizons, as well as the difficulty of modelling make the integration (of the three planning levels) to be unrealistic; (2) In recent years, the significance of planning and optimisation at the tactical level has been recognised by academics and practitioners as a competitive advantage for growing production-distribution firms [22]; (3) Dealing with mid-range horizon, the tactical level forms a bridge between the strategic and operational levels [23]; (4) Tactical decisions concern issues surrounding the definition of the more-or-less generic rules for guiding daily operations [24, cited in 25] and these rules tend to satisfy the strategic objectives while respecting the capacities of the supply chain [25]; (5) The tactical level deals with measuring performance against targets to be met in order to achieve results specified at the strategic level [26].

Today, it is commonly admitted that operations planning and control enable firms to be more competitive in many areas, such as quality, delivery, cost efficiency, and flexibility [27]. Moreover, given that this modern world competition is no longer between individual firms, but among supply chains [28], supply chain planning can be considered to be more effective than individual firm operations planning in securing a competitive advantage and improving organisational performance. Therefore, by combining the SCOR model and the customer order decoupling point concept, this paper aims to develop an integrated framework and a five-step methodology that is used to study the positive, negative and conflicting relationships between tactical supply chain planning determinants and supply chain performance. The paper is organised as follows. Firstly, by reviewing the extant literature, we will clarify the notion of tactical supply chain planning determinants and performance measures. Secondly, by discussing the manner in which the former impacts on the latter, we will formulate our research question. Finally, we will develop and present the integrated framework and the five-step methodology, and then apply them to a numerical example.

2. Definitions, literature review and research question

Given that many concepts and terminologies are defined in different ways by different authors, we will in this section state the definitions that we have adopted from extant literature. We will first define supply chain planning and tactical supply chain planning determinants (TSCPDs), then the notion of performance measure (PM), before finally discussing the impact of TSCPDs on PMs.

2.1. Tactical supply chain planning determinants

Planning in any business setup is done at three levels according to the time horizon: the strategic level for long-term planning, the tactical level for medium-term planning and the operational level for short-term planning [29]. Depending on the complexity and life cycle of a product, planning time horizons vary considerably from one business sector to another. For example, in the automotive industry, the strategic planning time horizon is about 5–7 years while the tactical planning time horizon is generally one year [30]. In the forest products industry, the horizon of strategic planning is expressed in decades while that of tactical planning is about five years for a forest management problem [21] and varies between six to twelve months for the production scheduling of pulp mills [31]. Operational planning further details the tactical plan and generally focuses on activities on a day-to-day basis [32]. Though the planning decisions at the three levels (strategic, tactical and operational) have been conventionally considered in isolation from the other levels, the interrelation between them is very important in practice [32] and combining aspects of the strategic and tactical levels can make each far more valuable than either would be alone [33]. However, the big difference in time horizons and the dispersed nature of supply chain configuration make this combination more complex and difficult to model. We have therefore chosen in this paper to consider only tactical supply chain planning determinants.

While strategic supply chain planning concerns capacity investments and facility locations [34], tactical supply chain planning addresses allocation rules for resources, as well as usage rules that define production, distribution lead times, lot sizing and inventory policies [21]. It also deals with demand forecasting, production planning, supply planning, replenishment planning and transport planning [32]. According to Ref. [2], the SCOR Plan processes describe the planning activities associated with operating a supply chain. This includes gathering customer requirements, collecting information on available resources, and balancing requirements and resources to determine planned capabilities and resource gaps. It also includes identifying the actions required to correct any gaps. In line with these statements, other authors define tactical supply chain planning as the process that captures information on market demand and inventories, and combines it with supply capabilities and constraints to develop a plan for future volumes [35]. This includes all the parameters associated with demand forecast, procurement of materials, transformation (making), and delivery of finished products to the customer. We refer to these parameters as tactical supply chain planning determinants (TSCPDs).

A review of the contributions of many other authors [5,9,16,35–42] enabled us to identify 12 generic TSCPD. These are planning horizon, frozen time fence, time bucket, cycle time, non-frozen interval, capacity management policy, lot sizing, inventory management policy, Lead time, scheduling, sequencing, and