



Cristina de las Nieves Araneda Fuentes

**A contract for coordinating capacities of two
manufacturers in a supply chain**

PhD Thesis

Thesis presented to the Post-graduate Program in Production Engineering of the Industrial Engineering Department, PUC-Rio as partial fulfillment of the requirements for the degree of Doctor in Philosophy in Production Engineering

Adviser : Prof. Leonardo Junqueira Lustosa
Co-Adviser: Prof. Stefan Minner

Rio de Janeiro
March 2008



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Abstract

Araneda Fuentes, Cristina de las Nieves; Lustosa, Leonardo Junqueira; Minner, Stefan. **A contract for coordinating capacities of two manufacturers in a supply chain**. Rio de Janeiro, 2008. 145p. PhD Thesis — Department of Industrial Engineering, Pontifícia Universidade Católica do Rio de Janeiro.

Coordinating-supply-contracts are key to restoring the production-systems efficiency lost with the progressive reduction of vertical integration. The bulk of the literature on this subject focuses on the analysis of a contract between a retailer and a manufacturer, or on contracts that maximize the profit of one of the parties. However, contracts between two manufacturers are more frequent in practice, and harder to analyze because both parties have their actual sales constrained by their medium-term capacity decisions. This research analyzes a capacity-reservation contract with reward-and-penalty designed to coordinate the single-period medium-term capacity decisions of two autonomous manufacturers facing stochastic market demands. Under this contract, the supplier will sell to the buyer, at a discount price, whatever he orders up to a certain previously agreed quantity. If the buyer's order is in excess of this quantity, he will purchase this excess at market price; if it is short, he will pay an agreed per-unit penalty for what he fails to order up to this quantity. The supplier reserves the capacity for producing the agreed quantity until the buyer announces his order, and then uses the remaining capacity for selling to the market. Stochastic optimization models are used to evaluate the improvement the contract can bring to each party's profit, and also how close it can take the dyad's joint profit to an ideal maximum. Numerical analyses carried out in different settings indicate that the contract can achieve full coordination and allows different distributions of the gain between the parties.

Keywords

Coordinating-contracts. Capacity planning. Stochastic optimization. Analysis of contracts. Supply Chain Management.

Resumo

Araneda Fuentes, Cristina de las Nieves; Lustosa, Leonardo Junqueira; Minner, Stefan. **Um contrato para coordenar capacidades de duas manufaturas em uma cadeia de suprimentos.** Rio de Janeiro, 2008. 145p. Tese de Doutorado — Departamento de Industrial Engineering, Pontifícia Universidade Católica do Rio de Janeiro.

Contratos de fornecimento coordenadores são fundamentais para resgatar a eficiência de sistemas de produção prejudicada pela progressiva redução da integração vertical. A maior parte da literatura sobre esse assunto trata da análise contratos entre manufatura e varejista, ou que maximizam o lucro de uma das partes. Entretanto, na prática, contratos entre duas manufaturas são mais frequentes e de análise mais difícil, pois ambas têm suas vendas limitadas pelas capacidades que decidiram no médio-prazo. Esta pesquisa analisa um contrato de reserva de capacidade, envolvendo incentivo e penalidade, concebido para coordenar as decisões de médio-prazo de duas manufaturas autônomas sobre suas capacidades para um único período de planejamento e diante de demandas estocásticas. Sob esse contrato, a fornecedora promete vender para o comprador, a um preço com desconto, tudo o que ele vier a pedir até uma certa quantidade previamente estabelecida. Caso o comprador peça mais do que essa quantidade, pagará o excedente a preço de mercado; se pedir menos do que essa quantidade, ele pagará uma penalidade previamente estabelecida por cada unidade que deixar de pedir. A fornecedora reserva a capacidade necessária para produzir a quantidade estabelecida, até que o comprador faça seu pedido e, depois, usa a sobra de capacidade para vender no mercado. Modelos de otimização estocástica são utilizados para avaliar o aumento que o contrato pode propiciar no lucro de cada parte e, também, quão próximo de um máximo ideal ele pode levar o lucro conjunto da díade. Análises numéricas realizadas em diferentes situações indicam que o contrato pode promover coordenação total e permite diferentes distribuições do ganho.

Palavras-chave

Contratos-coordenadores. Planejamento de capacidade. Otimização estocástica. Análise de contratos. Gestão da cadeia de suprimentos.

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Alis grave nil

PUC-Rio's lemma.