

Optimal investment decisions for recovery from disruptions in the decentralized supply chains

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Abstract

In this paper, we investigate the optimal supplier's and buyer's reactions to supply disruption. Upon disruption, the supplier loses the supply during the recovery period. Given a delivery time contract between the supplier and buyer, the supplier can make an investment to decrease the recovery time to benefit both parties. If the supplier's capacity is recovered after the delivery time, the supplier should pay a penalty cost to the buyer for each unit of lost sale demand and for the amount of time that the supply is delayed. Also, similar to the supplier situation, the buyer incurs a penalty cost for each unit of lost sale demand and for the amount of the waiting time.

Because the supplier can decrease the recovery completion time, the buyer may offer a financial subsidy incentive to the supplier (sole sourcing with a financial subsidy incentive strategy) or source from two suppliers (dual sourcing strategy). In this study, we present two Stackelberg game models to highlight optimal buyer's and supplier's decisions under the mentioned strategies. We also find the financial incentives levels that would coordinate the two-party supply chain. Finally, we compare the two strategies and characterize the buyer's preference as a function of the model parameters.

Our work complements literature papers where they analyzed similar problems in the context of improving the suppliers' reliability so as to reduce their chances of being disrupted. In contrast, we focus on the analysis of disruption recovery strategies. In particular, we investigate the role of building long term supplier relationships, through joint investment programs, in mitigating the impact of supply disruptions.

Keywords

Supply disruptions, Decentralized supply chain, Recovery strategies, Stackelberg game model.

Biographies

Nader Azad is an Assistant Professor of Management Science in the Sobey School of Business at the Saint Mary's University, Canada. He joined Saint Mary's University from McMaster University in Ontario, Canada where he was a Postdoctoral Research Fellow of Operations Management in the DeGroote School of Business. He has a PhD in Industrial Engineering from the Amirkabir University of Technology. His main research area is in the supply chain management optimization, in particular developing models and solution algorithms for designing and operating of supply chains under disruption risks and/or other types of uncertainty. His research works have appeared in refereed journals such as *Transportation Research Part B: Methodological*, *Transportation Research Part E: Logistics and Transportation Review* and *Annals of Operations Research* amongst others. His research has been funded by the Natural Sciences and Engineering Research Council of Canada (NSERC).

Elkafi Hassini is a Professor of Operations Management in the DeGroote School of Business at the McMaster University, Canada. He specializes in data-driven optimization with applications in supply chain management. His current research interests include big data optimization, supply chain analytics, supply chain risk management, sustainability performance measurement and strategic procurement. His research has been funded by several funding agencies including CFI, MRI ORF-RI, NSERC and SSHRC in Canada. His research has also been recognized through best paper awards and the faculty researcher of the year award. He teaches supply chain management, procurement operations management and applied optimization. His work has appeared in several refereed journals. He is currently a co-editor in chief of the Information Systems and Operational Research (INFOR) journal. He has chaired the Canadian Operational Research Society Conference and the International Symposium on Supply Chain Management. He is the past president of the Canadian Operational Research Society.

Manish Verma is an Associate Professor of Operations Management in the DeGroote School of Business at the McMaster University, Canada. He joined DeGroote from Memorial University in St. John's, Newfoundland where he was an Associate Professor of Operations Management in the Faculty of Business Administration. He has a PhD from McGill University, Canada in Operations Management/Management Science. His current research interests are multimodal transportation of dangerous goods, risk assessment and management, network design and planning issues in transportation, global logistics, and green supply chain management. His research works have appeared in refereed journals such as OMEGA, Transportation Science, Risk Analysis, European Journal of Operational Research, Transportation Research Parts B, C, D and E and Computers and Operations Research amongst others. His research is supported by NSERC and SSHRC grants in Canada.