Modelling of complex globalized supply chains: Synergy between economic, social and environmental performance metrics

EURO/Informs 2013
Rome, 3rd July 2013

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OUTLINE OF PRESENTATION

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INTRODUCTION

- EU funded project: DISRUPT: “Quantitative modelling of sustainable supply chains under major disruptions”
  [http://lubswww.leeds.ac.uk/disrupt/](http://lubswww.leeds.ac.uk/disrupt/)

- Started 25th March 2013 for two years: PI Dr Luisa Huatuco and Marie Curie International Incoming Fellow Dr Jairo Montoya Torres.

- The purpose of this project: to advance knowledge and management practice on SC approaches to managing sustainability and responding to natural disruption.

PROJECT OBJECTIVES

1. To model conceptually complex globalised SCs in order to measure the synergy between a set of sustainability metrics.

2. To propose efficient and effective solution procedures based on mathematical modelling approaches and heuristic procedures in order to quantify the causal relationships between the different elements of a sustainable SC.

3. To carry out a set of computer experiments so as to validate the proposed modelling and solution approaches in order to analyse how major disruptions may (or may not) cause changes in the environmental performance of the SC.
Objective 1

Developing the Framework: Major external disruptions

- Severely affect the distribution channels.
- Time-to-recovery is unpredictable.
- Damages and Losses are hard to estimate quickly after the major disruption.
Developing the Framework: Organisations’ characteristics

- Individual firm’s characteristics that may affect how they react to major disruptions.
- E.g.: BCM, i.e. preparedness to deal with major disruptions.

Developing the Framework: Supply Chain Characteristics

- Combined effects of the organisations within the affected supply chain.
- Philosophy or Paradigm, e.g. Lean vs. Agile.
- Performance measures, e.g. Cost vs. Dependability.
Developing the Framework: Sustainability in Supply Chains

- Sustainability in SC as a performance measurement system.
- Evolving/emerging factors.
- Triple bottom line.

Proposed hypotheses

H1 – the more severe the disruption, the greater its impact on sustainability in the supply chain

H2 – the greater the proportion of affected nodes in the supply chain, the greater the impact on sustainability in the supply chain

H3 – the more closely-coupled the supply chain nodes, the greater the impact on sustainability in the supply chain
**METHODOLOGIES**

**Computer simulations**

- Preliminary simulation of an automotive SC prone to two disruptions.

![Diagram](https://example.com/diagram.png)

*Source reference [4]*

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**Preliminary computer simulations**

- “After” scenario shows a detrimental effect on both environmental and social metrics.

![Graphs](https://example.com/graphs.png)

*Figure 3: Results for environmental and social dimensions*
METHODOLOGIES

Case studies

- Call for companies.
- Selected companies within the same supply chain with “before” and “after” data.
- Semi-structured interviews with key members of staff involved in the SC process (voice recorded).
- Document review: historical and current.
- Observations of practice.
- Presentations of preliminary results to participating companies for feedback.

Survey questionnaire

- Retrospective view by managers of companies (not necessarily from the same supply chain) who have suffered from major disruptions.
- Design of survey questionnaire.
- Pilot application.
- Web-based application.
- Larger sample of manufacturing organisations.
- Analysis using statistical techniques.
- Generalisation of results.
Forthcoming IJPPM Special Issue

“Performance measurement of sustainable supply chains”

• Tatitchi et al. (2013) literature review paper: reference [8]
  ➢ Exponential growth of publications since 2000.
  ➢ North America and Europe lead the debate.
  ➢ Very few publications that truly cover the Triple Bottom Line.
  ➢ Social dimension needs to be addressed.

  ➢ Balanced Scorecard adapted to sustainable SCs.
  ➢ Alignment of SC strategy, objectives, applicability and relevance to selected performance measures.

• Okongwu et al. (2013) research paper: reference [5]
  ➢ Levels of disclosure related to sustainability initiatives from a continuous improvement perspective.
  ➢ Disclosure: “self-reported firm’s information in excess of those required by law, accounting standards or stock-exchange listing requests”.
  ➢ Propose an overarching framework for improving the maturity of disclosure.

• Bocken et al. (2013) research paper: reference [1]
  ➢ Quantify size of environmental performance variation: between factory sites in multi-national companies.
  ➢ Environmental performance: energy use, carbon emissions and waste generation.
  ➢ Report a large level of variation between ‘best’ and ‘worst’ factory.
Forthcoming IJPPM Special Issue

“Performance measurement of sustainable supply chains”

  ➢ Does it pay-off to be sustainable?
  ➢ Large publically available dataset for US-based companies.
  ➢ For positive effects on corporate financial performance: companies need to engage in both environmental and socially responsible supply chain practices.

  ➢ Effects of greening transport operations and greening transport procurements on: logistics efficiency and logistics effectiveness.
  ➢ Web-based survey to Swedish companies and SEM for analysis.
  ➢ Greening transport procurement achieves improvement in the two chosen performance indicators.

CONCLUSIONS

• Hot research topic
• Evolving/emerging measures
• A novel, holistic and integrated framework:
  ➢ dynamic interaction driven by formal policy and informal norms
  ➢ measurement of sustainability in SC as a key lever for improvement
• Question for future research: What set of performance measures could capture the effect of major disruptions in sustainable supply chains?
REFERENCES


Questions or Comments?