Establishing a Transport Operation Focussed Uncertainty Model for the Supply Chain

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Research Problem Proposition

SC uncertainty frameworks are mainly focused on:

- Manufacturing, logistics is implicit
- Transport a marginal SC activity (Stank & Goldsby, 2000)
- Transport a necessary evil, loose contract, lack of joint thinking, many externalities need to be internalised (Boughton, 2003)
Literature Review

Number of Researchers have developed Uncertainty models with a manufacturing focus, e.g. Uncertainty Circles (Mason-Jones and Towill 1999)
Some authors have extended the Uncertainty Circles Model:

- Van der Vorst and Beulens (2002)- Adding 3 dimensions to the model- quantity, quality and time.
- Geary et al (2003)- Adding to the model examples of causes and effect of uncertainty in the Automotive industry.
- Peck et al (2003)- Adding to the literature the dimension of exogenous events.
The logistics triad

(adapted from Bask, 2001)

Carrier

Shipper

Customer

Physical Flow

Information Flow

Relationships
Conceptual Model Development

- Initially, key words were identified...

Block A: **Uncertainty** as the main key word, but...
Conceptual Model Development

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Block A: Uncertainty as the main key word, but...

Confusion about this term in literature, other uncertainty-related key words:

- Risk and flexibility
Conceptual Model Development

- Other key words were identified...

Block B: Transport, logistics, supply chain and manufacturing.
Conceptual Model Development

- Literature sources.

Academic databases, key academic journals, most regarded trade magazines and logistics trade reports
Conceptual Model Development

- Analysis and synthesis...

(a) All the information was captured using 2-way tables in Excel spreadsheets.
Conceptual Model Development

- Analysis and synthesis…

(a) All the information was captured using 2-way tables in Excel spreadsheets.

(b) Individual uncertainties were clustered in two ways...
- Uncertainty source (shipper, customer, carrier, control systems, external uncertainty)
- Uncertainty sub-categories at uncertainty-source level
The logistics triad uncertainty model

(Extension of Mason-Jones & Towill 1998, Bask 2001)
The logistics triad uncertainty model

Control Systems

Carrier

Shipper

Customer

External Uncertainty

(Extension of Mason-Jones & Towill 1998, Bask 2001)
Shipper - Sources of Uncertainty

**Purchasing**
- JIT Single sourcing
- Problems with supplier capacity

**Logistics**
- Delays in the shipping process
- Variability between shipment and delivery time
- Lack of warehouse capacity

**Commercial**
- Lack of integration in Promotions/PCL
- Unnecessary demand volatility
The logistics triad uncertainty model

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Customer- Sources of Uncertainty

DC and store management
- Excessive time-to-market
- Ineffective labelling at DC
- Lack of shelf capacity

Order and Inventory
- Variations in customer demand for transport
- Difficult and non-standard orders
- Isolated inventory reduction programmes

Unloading
- Excessive queuing time
- Unsynchronised transport
- Rigid delivery windows

SC Management
- Insufficient integration within the triad
- Lack of flexibility in the distribution network

Green Logistics
The logistics triad uncertainty model

Control Systems

Carrier

Shipper

Customer

External Uncertainty

(Extension of Mason-Jones & Towill 1998, Bask 2001)
Carrier- Sources of Uncertainty

**Fleet and Infrastructure**
- Insufficient fleet capacity
- Risk involved in inter-modal rail operations
- Lack of carrier flexibility- e.g. location and vehicle configuration

**Scheduling and Routing**
- Lack of flexibility in shipment and transport schedule
- Rigid routing plan- excess capacity

**Logistic Network Management**
- Integration of transport flows in series
- Lack of integration between transport modes and providers

**Physical Process**
- Double handling in inter-modal terminals
- Delays due to defective vehicles or lack of driver
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Control Systems - Sources of Uncertainty

**Information**
- Lack of visibility of information, e.g. inventory and orders
- Demand forecast inaccuracy
- Lack of routing information visibility from carrier

**ICT Systems Management**
- Information is not updated while the journey happens
- ICT Systems do not allow horizontal collaboration between 3PLs
- Sub-optimisation between transport and inventory

**Physical Process**
- Poor stock auditing
- Poor quality control systems
The logistics triad uncertainty model

(Extension of Mason-Jones & Towill 1998, Bask 2001)
External Uncertainty Sources

**Transport Macroeconomics**
- Fuel price variation
- HGV drivers shortages/availability
- Potential future introduction of pollution taxes

**Modelling**
- Accuracy at the disaggregated level
- Need for detail

**Chaotic uncertainty**
- Political problems
- Disruptions caused by the weather
- Natural disasters

**Congestion**
- Unpredictability caused by road accidents
- Unpredictability caused by unexpected road repairs
Discussion and Conclusions

- Our model integrates all the uncertainty frameworks available, focusing primarily on logistics

- 5 sources of uncertainty - shipper, customer, carrier, control systems and external uncertainty

- The model can be used to diagnose supply chain operations within logistics triads
Limitations and Further Research

- The model is purely conceptual, so further empirical and/or analytical research is needed:
  - The model needs to be validated through broader cross-sectional studies- e.g. focus groups or/ and survey
  - The model needs to be verified through the application of case studies
  - However, the model does not take account of the association between root causes and effects of uncertainty, so analytical research is needed to quantitatively verify those causal relationships
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Thank you for your attention

Any questions?