Operational planning solutions for non-hierarchical networked SMEs

Beatriz Andrés, Raúl Poler
Research Centre on Production Management and Engineering (CIGIP)

Jorge E. Hernández
Management School, University of Liverpool
OUTLINE

1. Introduction
2. Objective
3. Collaborative Processes Problems
4. Operational Planning Problem
   4.1. Operational Planning Solutions
   4.2. Application of SCAMM-CPA to NHN
5. Conclusions
6. References
Introduction

ICT Advances
Market and society needs
Research progress
Enterprise collaboration issues
Increasing Competition
Customer Requirements
Dispersed Knowledge

Organizational Forms in COLLABORATIVE NETWORKS

Competitiveness
Growth
Dynamic
Today’s Global Market

Highly Innovative Industrial Systems

As a result

Non-Hierarchical manufacturing Networks (NHN)

Industries rely largely on the movement towards

Agile Networked Enterprises

CREATION
CONSOLIDATION
Introduction

Centralised decision-making process
A node of a network makes the decision trying to optimize the objectives of the entire network.

The “central” node can have its own IS to keep the information of all networked nodes in order to make the decision. That does not mean that all the nodes use that “central” IS, each node can have its own.

Decentralised decision-making process
Individually independent entities make its own decisions trying to optimize their own objectives.

Depending on the degree of collaboration the nodes will take into account (to a lesser or larger extent) the opinions of other nodes regarding their decisions:

- Define mechanisms to
  - coordinate the decisions of the networked partners
  - exchange information

(Alemany et al., 2011) (Hong et al, 2008) (Schneeweiss, 2003)
Introduction

Hierarchical Networks (HN)
Centralised models

Non-Hierarchical Networks (NHN)
Decentralised models

- All the partners are involved in the business process management in a collaborative way.
- Improves each network node commitment as regards to the overall goal of the network.
- Improves communication, collaboration and flows among nodes.
- Considers equally all network partners.
- Helps SMEs to position in the global market.
- Complementary → Jointly Activities.
Objective

OVERVIEW → SME’s needs Collaborative Non-Hierarchical Networks (NHN) to support DDM (Andrés and Poler, 2011)

Problems affecting collaborative business processes in networks

Operational Planning Problem

Analysis of Solutions, Adaptation in NON-HIERARCHICAL NETWORKS
Collaborative Processes Problems

Literature Review

Problems derived from inter-enterprise collaboration

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
<th>MODELS</th>
<th>GUIDELINES</th>
<th>TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STRATEGIC</td>
<td>MO_s</td>
<td>GUI_s</td>
<td>TO_s</td>
<td></td>
</tr>
<tr>
<td>TATICAL</td>
<td>MO_T</td>
<td>GUI_T</td>
<td>TO_T</td>
<td></td>
</tr>
<tr>
<td>OPERATIONAL</td>
<td>MO_o</td>
<td>GUI_o</td>
<td>TO_o</td>
<td></td>
</tr>
</tbody>
</table>

The extent to which the provided solution can be implemented in NHN

- Poor: The solution can’t be implemented in NHN
- Unsatisfactory: Concept or idea can be implemented in NHN
- Acceptable: Some solution lines can be implemented in NHN
- Satisfactory: The majority of the solutions are defined for NHN
- Excellent: Solution specifically designed for NHN

(Andrés and Poler, 2011)
Collaborative Processes Problems

RELEVANT PROBLEMS associated with COLLABORATIVE PROCESSES

General classification for network collaborative problems according to the decision making level

<table>
<thead>
<tr>
<th>Level</th>
<th>Strategic</th>
<th>Tactical</th>
<th>Operational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative Problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>Network Design</td>
<td>(1)</td>
<td>Forecast Demand</td>
</tr>
<tr>
<td>(2)</td>
<td>Decision System Design</td>
<td>(2)</td>
<td>Operation Planning</td>
</tr>
<tr>
<td>(3)</td>
<td>Partners Selection</td>
<td>(3)</td>
<td>Replenishment</td>
</tr>
<tr>
<td>(4)</td>
<td>Strategy Alignment</td>
<td>(4)</td>
<td>Performance Management</td>
</tr>
<tr>
<td>(5)</td>
<td>Partners Coordination</td>
<td>(5)</td>
<td>Knowledge Management.</td>
</tr>
<tr>
<td>(6)</td>
<td>Product Design</td>
<td>(6)</td>
<td>Uncertainty Management.</td>
</tr>
<tr>
<td>(7)</td>
<td>PMS Design</td>
<td>(7)</td>
<td>Negotiation Contracts among partners</td>
</tr>
<tr>
<td>(8)</td>
<td>Coordination Mechanisms Design</td>
<td>(8)</td>
<td>Share costs/profits</td>
</tr>
<tr>
<td>(9)</td>
<td></td>
<td>(9)</td>
<td>Coordination Mechanisms Management</td>
</tr>
</tbody>
</table>

Degree of Coverage: poor ☓ unsatisfactory ☐ acceptable ☐ satisfactory ☐ excellent ☦

(Andrés and Poler, 2011)
Operational Planning Problem

Given the complex management of collaborative NHN and different goal-based objectives among partners, it is desirable to develop scenarios to integrate all the nodes through the network planning.

(Andrés and Poler, 2011)
Operational Planning Problem

Non-Hierarchical manufacturing Networks (NHN)

Collaborative planning is defined as a joint decision making process to align individual plans of SC members to jointly plan their activities in order to achieve coordination in a state of asymmetric information (Stadtler, 2009)

- Each node is responsible for exchanging its own information
- Taking their own decisions
- Need coordination mechanisms
- Need pre-agreed business rules

Decision-making Mechanisms From a decentralised perspective
Operational Planning Problem

Classification scheme from the literature review on operational planning solutions

**MODELS:** planning domains, decentralised planning, Partially centralised SCMP, SC Planning matrix, APS, e-constraint method, planning models under uncertainty, network decentralised planning, Fuzzy Goal Programming, conceptual modelling of planning processes

**GUIDELINES:** iterative collaborative planning, non-hierarchical negotiations based on compensation schemes, ADSCP, Decentralised supply chain planning framework, interoperability, OPS

**TOOLS:** ACI, **SCAMM-CPA**, MASCOPP, MASCOT, eXPlanTech, ProPlanT, DGRAI, COC PLAN TOOL

---

SCAMM-CPA → Supply Chain Agent-based Modelling Methodology that supports a Collaborative Planning Approach

↓

Synchronise decentralised production plans

(Hernández, 2011) (Hernández et al., 2009)
Operational Planning Problem

SCAMM-CPA
(Hernández, 2011)
(Hernández et al., 2009)

Oriented to support the design and implementation of the most important **collaborative supply chain processes** - forecasting, order management, production planning, replenishment and product-distribution - by considering a novel implementation of collaborative mechanisms among companies based on distributed MAS tool.

- Architecture structured over the standard perspectives → **Zachman Framework**
- Validated by applying it to an automotive SC
- Generated to be as generic as possible to make it adaptable to any kind of network typology.
- MAS-based tool to support any kind of supply chain typology.

NHN context, the tool is to be installed in each network partner in order to provide an automated system to negotiate demand plans between any pair of network nodes and consider the restrictions in all the nodes involved.
Operational Planning Problem

Interoperable enterprise architecture supported by REA enterprise ontology

(Helloández et al., 2009)
### Operational Planning Problem

#### SCAMM-CPA LAYERS | NHN - Solution
--- | ---
1. Physical Layer | Consider any kind of network configuration.
2. Data Layer | Define the main data structure.
3. Information Layer | Collects, manage and structure all the necessary information to support collaborative processes.
5. Agent Communication Layer | Implementation of the mechanism for the decentralised decision-making.
6. Behaviour Layer | Collect the basic structure of the network.

NHN context, the tool is to be installed in each network partner in order to provide an automated system to negotiate demand plans between any pair of network nodes and consider the restrictions in all the nodes involved.
Conclusions

- **PROBLEMS** affecting **INTER-ENTERPRISE COLLABORATION** (Andrés and Poler, 2011)
  - Relates relevant problems in the collaboration context and propose associated solutions
  - Most problems are discussed in **HN context**.

**DEGREE OF COVERAGE**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
<th>MODELS</th>
<th>GUIDELINES</th>
<th>TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STRATEGIC</td>
<td>MOₜ</td>
<td>GUIₜ</td>
<td>TOₜ</td>
<td></td>
</tr>
<tr>
<td>TACTICAL</td>
<td>MO₀</td>
<td>GUI₀</td>
<td>TO₀</td>
<td></td>
</tr>
<tr>
<td>OPERATIONAL</td>
<td>MO₀</td>
<td>GUI₀</td>
<td>TO₀</td>
<td></td>
</tr>
</tbody>
</table>

**OPERATIONAL PLANNING PROBLEM**

NHN are to be implemented by considering own behaviours and decision-making mechanisms in collaborative and decentralised perspective, which can be considered as novel research solution.

To deal with the operational planning problem a solution based on the SCAMM-CPA is analysed to determine the applicability at NHN.
Conclusions

Problems with unsatisfactory solutions

Solutions to unsatisfactory problems in NHN

Collaborative Framework for Non-Hierarchical Manufacturing Networks

Network Design
Decision System Design
Partners Selection
Strategy Alignment

Partners Coordination
Product Design
PMS Design
Coordination Mechanisms Design

Forecast Demand
Operations Planning
Replenishment
Performance Management
Knowledge Management
Uncertainty Management

Negotiation Contracts among partners
Share costs/profits
Coordination Mechanisms Management

Scheduling
Order Promising Process
Lotsizing Negotiation
Inventory Management
Information Exchange
Process Connection
Interoperability
References


Operational planning solutions for non-hierarchical networked SMEs

Thanks!

Beatriz Andrés, Raúl Poler
Research Centre on Production Management and Engineering (CIGIP),

Jorge E. Hernández
Management School, University of Liverpool