Co-operation in Networks of Autonomous SME
EP 20723 - PLENT

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Why SME networks?

- **Risk factors for SMEs**
  - limited design and production capabilities
  - limited investment capabilities
  - no time and resources to afford process re-engineering initiatives
  - difficulties in production planning and control

- **Qualities of SMEs**
  - lean structure
  - adaptability of products and resources to market evolution
  - habit to establish sub-contracting relations
  - good technological level of their products
Benefits from co-operative manufacturing

• **Access new markets**
  – by producing more complex and advanced products
  – by reaching higher production volumes

• **Increase (global) reactiveness**
  – by sharing workload peaks and shortages among the nodes

• **Redirect investments**
  – by diverting them from competition with partners to new technologies and process re-engineering

• **Improve (local) management**
  – by sharing planning and control culture
Obstacles to co-operation

• *Individualistic and independent behaviour*
  – many SMEs are family business

• *Redundancy of functions replicated in the network*
  – marketing, purchasing, design, engineering, etc.

• *Historical distrust between enterprises*
  – traditionally in competition

• *Lack of management platforms and tools*
  – for local production planning and control
  – for network management and planning
## Virtual Enterprise vs. SME Network

<table>
<thead>
<tr>
<th>Virtual Enterprise</th>
<th>SME Network</th>
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</thead>
<tbody>
<tr>
<td><strong>Specialisation</strong></td>
<td><strong>Flexibility</strong></td>
</tr>
<tr>
<td>Dedicated nodes</td>
<td>Interchangeable nodes</td>
</tr>
<tr>
<td>Stratified structure</td>
<td>Flat (star-like) structure</td>
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<tr>
<td><strong>Decomposition</strong></td>
<td><strong>Aggregation</strong></td>
</tr>
<tr>
<td>Applied to large company</td>
<td>Applied to SMEs</td>
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<tr>
<td>Shared practice</td>
<td>Individual practice</td>
</tr>
<tr>
<td><strong>Temporary</strong></td>
<td><strong>Steady</strong></td>
</tr>
<tr>
<td>Focus on network creation</td>
<td>Focus on network management</td>
</tr>
<tr>
<td><strong>Local co-ordination</strong></td>
<td><strong>Global co-ordination</strong></td>
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<tr>
<td>Self regulated nodes interaction</td>
<td>Need for a co-ordinating unit</td>
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The PLENT project
*PL*anning small-medium *E*nterprise *N*etworks

- Domain 8 - Integration in Manufacturing
- Started January 1996, duration 30 months, concluded July 1998
- 12 Partners from 3 EU countries (Italy, Spain, Greece) and one from an east Europe country (Hungary)
- Strong participation of end-users: 7 manufacturing SMEs in the consortium

**Objective**

*Develop a set of innovative software tools to support co-operative planning in networks of autonomous SMEs*
The PLENT users

- **The Italian network**
  - was created in 1994 by three SMEs to produce a complex motor-wheel in competition with Japanese industries

- **The Spanish network**
  - a large firm and some subcontracting SMEs producing FMSs

- **The Greek network**
  - works in the textile and garment sector

- **The Hungarian network**
  - made of small producers and dealers working in the food industry
The PLENT model

- A network of operational nodes with equal rights
  - nodes are (possibly competing) SMEs

- An independent co-ordinating unit is created
  - to interact with customers and assign tasks to selected nodes

- Each node is free to decide its involvement
  - by declaring the available manufacturing capacity

- The co-ordinating unit assigns tasks by applying prefixed rules
  - based on node productive capacity, status and reliability
  - supported by proper planning and evaluation software tools
The PLENT architecture

- Local DB
- N
- WFM
- CU
- Log
- NOS phases product nodes
- NOS management
- WorkLoad Distribution
- Performance Evaluation
- Re-planning (RRP, MDLY, SDLY)
Node detail (N)

- Local Planner
- Node Mngr
- Node Ni
- Rest of the Network
- to WFM

Rest of the Network
Network preparation

Network topology
Network Operational Scheme

Product design

CU

Capacity declarations

node_i
node_k
node_n

Network Operational Scheme
Manufacturing phases at the node level
Transport phases between nodes

Capacity declarations
Which phases
Which capacity for phase
Network planning and negotiation

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**Co-ordinating Unit planning**

- Splits the order into tasks
- Distribute tasks to the nodes

**Negotiation**

- A node can reject a task
- CU computes a new task distribution
Network execution

Exceptions

Delays and wastes

Re-planning

Task re-assigned and delay notified to customer
Network performance evaluation

Historical Data Processing

Performance indicators

Bonus / malus factors

Malus
- Delay caused
- Materials wasted
- Other perturbations

Bonus
- Delay recovered
- Materials recovered
- Additional capacity
Concluding remarks

• **Project status**
  - software installation in progress
  - on field validation from December 1997 to May 1998

• **Project impact on SMEs**
  - promotes the idea of co-operative production
  - forces establishing rules for disciplined collaboration
  - introduces the use of advanced IT network support tools
  - induces enhancing the local existing IT applications
  - ultimately, creates a state-of-the-art IT culture in SMEs