Lecture 1

Different perspectives on value chain management

Supply Chain Management

- Top management and strategic decisions
  - More than the individual components
    - Production, purchase, sales, distribution, material control and integrated logistics
  - Links strategic decisions to
    - Tactical and operational decisions
    - Relations upstream and downstream in the chain
  - Operational constraints in the value chain
    - Capacities
    - Distribution
    - Technology
    - Production
  - Business constraints
    - Minimal inventory
    - Supplier preferences
    - Minimal order volumes
    - Contracts and cooperation

- SKS, Chapter 1, Introduction to supply chain management
- Hax, A.C., and Candea, D., Production and inventory management, pages, 2-7

- Case studies:

An analytical framework for literature review (Croom, Romano and Giannakis)

Dimension 1: level of analysis
- Dyadic: single two-party relationship
- Chain level: a set of dyadic relationships (in a chain)
- Network level: concerns a network of operations
- In addition: single company value chain.
- How does this fit with the above?

Lambert & Cooper

Lambert and Cooper

An analytical framework for literature review (Croom, Romano and Giannakis)

Dimension 2: element of exchange
- What is exchanged
  - Material assets
  - Human assets
  - Financial assets
- How is it exchanged
Hierarchical planning

SKS, Hax & Candea, Anthony,

- The Planning Process
- Anthony’s Framework
  - Strategic Planning
  - Tactical Planning (Management Control)
  - Operational Planning
- Implications of the Framework
- Strategic Planning in Supply Chain Management
- Decision-Support Systems
- Summary

What is Planning?

- First statement:
  - Planning is a target-directed decision to take future action, it is therefore a decision process
  - Result of the decision process is a plan
- Second statement:
  - Planning is the activity of establishing goals over some future time period, called the planning horizon
- Third statement:
  - Planning is a complex social activity that cannot be simply structured by rules of thumb or quantitative procedures
  - Essence of planning is to organize, in a disciplined way, the major tasks that the firm has to address to maintain an operational efficiency in its existing businesses and to guide the organization into a new and better future

The Planning Process

The Planning Horizon

- The planning horizon should be adjusted according to the effects of the decisions and the availability of reliable forecasts
- Rolling horizons can be used to incorporate dynamics and the possibility of learning in the decision process
- NB: optimal policies are very likely to turn out to be suboptimal in an ex-post analysis

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Problems of the Deterministic Setting

- Rolling horizons are presented in every textbook on planning, usually in a deterministic setting
- Deterministic setting cannot capture uncertainties in the future: flexible decisions are not made
- Flexibility (and options as well) never shows up in a deterministic solution, unless it comes free
- “You never buy an insurance in a deterministic world!”

Anthony's Framework

- Developed by Robert N. Anthony in 1965
- First framework to classify different planning and decision levels
- Originally, Anthony distinguished between
  - Strategic Planning
  - Management Control
  - Operational Control
- Today known as
  - Strategic Planning
  - Tactical Planning
  - Operational Planning

Strategic Planning I

Definition:
“Strategic Planning is the process of deciding on objectives of the organization, on changes in these objectives, on the resources used to attain these objectives, and on the policies that are to govern the acquisition, use, and disposition of these resources”

Strategic Planning II

- Strategic Decisions have long-lasting effects, they therefore require long planning horizons, usually 2-10 years
- Long planning horizons call for the consideration of uncertainties and risk in the decision-making process
- Decisions are extremely important, they often involve major capital investments and can be decisive for future success or failure of a firm
Strategic Planning III

- Strategic Planning in SCM should
  - develop objectives and policies for the entire supply chain and analyse how these support the needs of a firm
  - determine the shape of the supply chain in terms of design
  - discuss how SCM can enhance the competitiveness of the firm

- In SCM: Quantitative models for strategic planning (operations research perspective) consider the infrastructure of the supply chain
  - Facility Location
  - Location-Allocation

Tactical Planning I

Definition:
“Tactical planning is the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives”

Tactical Planning II

- Decisions over a medium-term time horizon, usually 0.5-2 years

- Local opportunities require planning on a more detailed level within the local domain, decisions are no longer made for the whole company

- Focus on capacity utilization and inventory management

Tactical Planning III

- Tactical Decisions
  - should focus on the implementation of strategic decisions
  - are functional and may only deal with a few players of the supply chain
  - may involve decision-support systems (MRP, DRP, JIT, etc) necessary to manage the supply chain

- Examples in SCM:
  - Aggregated production planning (time and products)
  - Distribution planning
  - Demand forecasting and inventory control
  - Supply chain relations
Operational Planning I

Definition:
"Operational planning is the process of assuring that specific tasks are carried out effectively and efficiently."

Operational Planning II

- Detailed "day-to-day" operational and scheduling decisions based on the decisions made on the other planning levels
- Complete disaggregation of data (marked, product, time, etc.) and decisions
- Thoroughly studied in Operations Research

Operational Planning III

- Decisions on the operational level
  - Concerned with the efficient operation of the company within the supply chain
  - Focus on controls and performance measures
- Typical examples:
  - Production planning and scheduling
  - Inventory management and control
  - Vehicle routing

Operational Control

- Some kind of fourth level within the framework
- Deals with the material flow in the plant, basically no planning horizon
- Focuses basically on "error management", deviation from the plan due to unforeseen events (breakdown of production line, etc)
- Probably best covered by the Norwegian terms "styring" and "drift"
Implications of the Framework

- Decisions on the different levels cannot be made isolated of each other, there is a strong interaction.

- Decisions at one level are linked to the decisions at a higher level. Lower level decisions have to satisfy constraints given from a higher level and allow in turn to evaluate the decisions from a higher level.

- Integrated approach is needed to avoid suboptimal solutions.

- Decomposition (here: in terms of organization) is necessary to perform planning on the different levels, as one global approach will fail due to the complexity.

Comparing the 3 Planning Levels I

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>STRATEGIC PLANNING</th>
<th>TACTICAL PLANNING</th>
<th>OPERATIONAL PLANNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>Management of change, resource acquisition</td>
<td>Resource utilization</td>
<td>Execution, evaluation, and control</td>
</tr>
<tr>
<td>Implementation instruments</td>
<td>Policies, objectives, capital investments</td>
<td>Budgets</td>
<td>Procedures, reports</td>
</tr>
<tr>
<td>Planning horizon</td>
<td>Long</td>
<td>Medium</td>
<td>Short</td>
</tr>
<tr>
<td>Scope</td>
<td>Broad, corporate level</td>
<td>Medium, plant level</td>
<td>Narrow, job shop level</td>
</tr>
<tr>
<td>Level of management involvement</td>
<td>Top</td>
<td>Middle</td>
<td>Low</td>
</tr>
<tr>
<td>Frequency of Replanning</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

Source: Hax/Candea 1984

Comparing the 3 Planning Levels II

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>STRATEGIC PLANNING</th>
<th>TACTICAL PLANNING</th>
<th>OPERATIONAL PLANNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source of information</td>
<td>Largely external</td>
<td>External and internal</td>
<td>Largely internal</td>
</tr>
<tr>
<td>Level of aggregation of information</td>
<td>Highly aggregated</td>
<td>Moderately aggregated</td>
<td>Detailed</td>
</tr>
<tr>
<td>Required accuracy</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Degree of uncertainty</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Degree of risk</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
</tbody>
</table>

Source: Hax/Candea 1984

Supply Chain Coordination and Sales Forecasts

An example of a real world supply chain planning model.
Example

- A supply chain in the meat industry
- Uncertainty
  - Decision flexibility
  - Inventory and capacity sharing
  - Demand distributions
- Planning models
  - Operational planning
    - Inventories
    - Production co-ordination
  - Tactical planning
    - Prices and marketing
    - Inventories

Supply Chain Characteristics

- Customers
  - Very large and few customers in some market segments (Supermarket Chains)
  - Direct distribution
  - manage wholesaler role themselves
- Owners
  - Owned by their suppliers
  - Cannot refuse member farmer’s request to deliver animal
  - Recently restructured from regionally owned profit centres to a unified company
  - Little integration

The Supply Chain

Supply chain for Beef, veal, lamb and pork meat

S - Slaughtering
C - Cutting
P - Processing
D - Distribution centre
I - Inventory

\(S\) \(\rightarrow C\) \(\rightarrow P\) \(\rightarrow D\)

\(I\) Set of processing prescriptions
\(I\) Set of cutting prescriptions

The modules

Strategic
- Supply Chain Design

Tactical
- Supply Chain Coordination
- Market regulation
- National supply forecasts
- Regional supply forecasts

Operational
- Supply Chain Operation
- Prescription Optimization
- ERP

Modules developed by SINTEF NTNU
Existing tools

Region North
Region West
**Time decomposition**

**Tactical horizon 12 months**

- Supply Chain Coordination (Stochastic MIP)
- Marketing
- Prices and targets for inventories (based on market)
- Target price: raw material, proco-ex: econ. considerations
- Regulatory inventory needs
- Export/Import

**Supply Chain Operations (Stochastic Linear Programming)**

**Horizon 7 weeks**

Operational decisions

- Maximize expected profit minus shortfall costs

**Dynamics**

- Stochastic demand
  - Activities timing
  - Effect of activities
  - Weather
  - Other companies activities
  - Seasons
  - Trends
  - Requires co-ordination of
    - inventory
    - production capacity allocation
  - Trade off between
    - production and inventory
    - sales today or tomorrow
    - different recipes

**Handling uncertainty**

- Demands are not perfectly correlated
  - Gives incentives for sharing inventories between regions
  - Sharing safety buffers
  - Portfolio thinking!
- Demand distributions are not symmetric
- Dynamics and decision flexibility
  - As time passes you get more information
  - You are free to change decisions
  - You should recognize this already when making your first decisions

**Demand scenarios**

- SCENARIO 1
  - High demand in North-west (Nice weather + barbecue season)
  - Moderate demand in east
- SCENARIO 2
  - Low demand in North-west (rainy weather)
  - High demand in east
Inventory sharing

- Correlations are easy to forget in practice
- They are important when deciding inventory levels

Demand scenarios

<table>
<thead>
<tr>
<th>Demand</th>
<th>Region A</th>
<th>Region B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

Region A
Region B

Scenario analysis

- Eignproduksjon
- Outsourcing

Flexibility

- Low (liten)
- Normal (middles)
- High (stor)

Supply Chain Operation

- Decision variables
- Which product produced where
- Prescription choices
- Timing
- Transportation and exchange
- Inventory
  - Whole
  - Cut
  - Finished
- Sales
- 17 variable classes
- 12 constraint types
- Non-anticipativity
- Uncertainty influences
  - Inventory diversification (uncorrelated demand)
  - Capacity co-ordination (uncorrelated demand)
  - Recipe/cutting pattern choices
  - Under supplying/over supplying policy
Modelling the market (short term)

- income from sales
- production costs
- transportation costs

\[
p = 0.8 \delta_{st} \quad 0.8 \delta_{st} \quad 1.2 \delta_{st}
\]

\[
0.8c_\delta \quad \delta_{st} \quad p+c
\]

Supply Chain Tactical Planning

- Which product produced where
- Recipe choices for different seasons
- Inventory build-up
  - whole
  - cut
  - finished
- Transportation and exchange agreements
- Marketing
- Prices
- Uncertainty influences
  - inventory diversification
  - seasonal smoothing
  - at company level
  - dynamic planning
  - capacity allocation
  - at company level
  - price policy

We hope to achieve

- Prescription choices matching national raw material needs, not regional
- Alternative value of inputs with global focus, not local
  - Better capacity utilization
  - Larger series, more flexibility
- Quantification of value of exchange
- identify bottlenecks
- optimal trade off between profit and wreckage
- optimal short term inventory size

Challenges

- Change business processes to a global supply chain philosophy from today's regional business centres
  - Get a focus on the alternative values of the inputs
- Translating the plans from Supply Chain Operations and Co-ordination into signals that the production units can relate to (transfer prices versus centralised planning)
- Correlations (time, products, scenarios)
Key Issues in supply chain management

- SKS
- Lambert and Coper
- Seal et. Al.

Key Issues in supply chain management (SKS)

Distribution network configuration
- Link between demand patterns and value chain flow pattern affects the requirements for the distribution network
- Centralized or decentralized distribution network?
- Central issues are warehouse location, sizes, production levels, transportation patterns (inbound and outbound)
- Focus in this course is both from an optimization perspective and from an economics perspective. We investigate how incentives and transfer prices can be used in configuration of the value chain.

Key Issues in supply chain management

Inventory control
- Demand prediction from historical data
- Order management
- How to manage uncertainty
- Focus in this course is both from contract economics and from an optimization perspective

Key Issues in supply chain management

Supply contracts
- Focus on the supply chain profit, not the individual profit
- How should profit be shared?
- How to specify the relationships, the prices and measure performance
- Incentives?
- Focus in this course is mainly from an economics perspective
### Key Issues in supply chain management

#### Distribution strategies
- Cross-docking (central warehouses without inventories)
- Traditional with inventories at warehouses
- Direct shipping

- Not focused on in this course

#### Supply chain integration and strategic partnering
- Dynamics and conflicting interests complicate alliances
- Information sharing enhances performance
- Collaborative planning
- Other co-ordination mechanisms
- How to share the profit from co-operation
- What level of integration is needed, and what kind of partnership should be chosen

- Focus in this course is from an economics perspective

### Key Issues in supply chain management

#### Outsourcing and procurement strategies
- What to make internally and what to make externally
- Risks and uncertainties
- Relations to product design and architecture

- Not focused in this course

#### Product design
- Effective design plays critical roles in the supply chain
- Affects costs on inventory and transportation
- Lead time
- Demand uncertainty and postponement of design
- Mass customization

- No focus in this course
Key Issues in supply chain management

Information technology and decision support systems

- Critical success factor
- Data are usually available: how should you use them to make the correct decisions
- How should data be shared?
- What is the impact of internet
- Will such tools give a competitive advantage?
- Focus on commercial systems in this course

Key Issues in supply chain management

Customer value

- A measure on the company’s contribution to its customer
- Have superseded measures such as quality and customer satisfaction
- How should it be measured?
- Can smart pricing strategies be used to improve supply chain performance
- We focus on different ways of measuring performance in the value chain and on pricing schemes

Supply Chain issues

Lambert and Cooper

- How should the company’s contribution to its customer be measured?
- Can smart pricing strategies be used to improve supply chain performance?

Figure 3: Supply chain management framework: elements and key decisions [7]

Figure 4: Supply chain management: fundamental management components [8, p. 12]
Challenges

- Key business processes and relationships among them
- How to describe or map a complex supply chain
- Customer value measured in...
- Metric for performance measure
- How should one modify a supply chain to improve it
- What determines with whom to link business processes
- What decides the type or level of integration you need.

- We will investigate this topics from a perspective with focus on economical theory and operations research in this course

Management accounting (Seal et. al.)

- There has been relatively little focus from management accounting towards supply chain thinking
- Management accounting is still important
  - Make or buy or other alliances/partnerships
  - Resource utilization
  - Information sharing and performance measurement
  - Input for plans.
- Why?
  - Cost improvements as a consequence of co-operation
  - The suppliers estimated cost is important for the producers purchasers
  - Cost drivers may affect several parties in the chain
  - Knowledge of the product architecture used on performance measuring
  - Information sharing
    - Open book
    - Trust
    - The role of cost data and other information sharing in the construction of an agreement
    - Used in measuring the performance of a partnership
    - Transfer pricing versus contracts

The optimization perspective

- Operations research models covers network design and optimization well.
- Has more trouble with co-operation and competition strategies, contracts, or other relational issues
- May focus on strategic issues for a a single company
  - More trouble with development of partnership agreements
- Tactical and operational planning works fine within a company
- Less focus on network co-operation and conflicting interests.
Institutional economics

- Focus on explaining relationships.
  - Asymmetric information
  - Contracts
  - Transactions
  - Boundaries between firms

What to learn from this?

- Uncertainty and decision flexibility matters
- Global co-ordination is important
- Each tradition has its own approach two deal with these two aspects in the value chain
- Our main focus in the course will be on coordination of the value chain with input from management accounting, from institutional economics and from operations research.