Advanced supply chains are equally well planned at all three levels—strategic, tactical and operational. Large capital intensive Chemical & Petroleum industries have traditionally been leaders in institutionalizing strategic planning that optimized their Net Present Value (NPV). Yet, like many other industries, at tactical and operational levels, they continue to be driven by cost minimization of independent sub-processes.

This paper highlights the improvement opportunities in real-world tactical and operational planning, especially when such planning is automated through modern Advanced Planning and Scheduling (APS) systems that employ sophisticated quantitative tools. Alternate approaches are necessary when packaged APS systems do not fit the details of a planning process.

The progression to holistic or enterprise-wide planning, which can provide additional benefits, has also been indicated. The difference between cost minimized and profit maximized planning are next illustrated through typical examples from two stages of the Supply Chain. Recent Market Surveys have identified the most critical and widely adopted Supply Chain Technologies. This paper identifies which of these planning processes could be given an integrated profit orientation.

Finally, it is pointed out that when dealing with the Customer-Chain, profit metrics become essential elements of Supply Chain Operating Reference templates. As every business has to be market facing, this profit theme will permeate through all planning phases.
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- Scheduling ocean going petroleum tankers, for Oil Coordination Committee
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- Retail store workforce & airline crew planning scheduling system
- Consultant to Fortune 500 Chemical Company for global Supply Chain Design.
- Consultant to leading liquid/chemical 3PL in developing Corporate Vision for growth and Strategies & Tactics to achieve them.

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Table of Content

Strategic Supply Chain planning maximizes NPV…………………………………….4
Automation of planning – evolution from MRP to APS…………………………….6
  Profit optimization using Advanced Planning and Scheduling systems………7
Profit orientation of planning – from AtP to PtP………………………………………7
Integration of planning – holistic, enterprise-wide………………………………….8
Case study: Profit maximization in Distribution planning…………………………9
Case study: Profit maximization in Production planning…………………………10
Supply Chain technologies that should be profit-oriented…………………………11
The Customer-Chain introduces profit orientation…………………………………13
References………………………………………………………………………………14
The Next Generation Supply Chains – Integrated and Profit Maximized

Strategic Supply Chain planning maximizes NPV

Energy is in the news. A demand-supply imbalance in the oil and refinery industry, coupled with an impending environmental catastrophe, is shaking up the globalised economy like never before. At the same time, markets are shifting geographically. Large new downstream petro-chemical plants have reached advanced stages on drawing boards while a spate of mergers and acquisitions are also being witnessed.

While deciding the quantum, nature and timing of the large capital investments that are required to drive these initiatives, planners carefully examine long-range demand profiles, feed forecasts, technology developments, risks and regulatory environments. Expenses, both capital and operational, are balanced against expected shadow prices, revenues and margins. They compute the discounted time value of the money, or the Net Present Value (NPV), for selected scenarios that promise not only positive NPVs but also justify their economic rents.

Planners for a refinery, that could cater to an existing Euro II market in the immediate horizon and then gradually move into a 51 cetane regime, may select a more expensive Diesel Hydrotreator as part of a higher Nelson complexity process chain to maximize profits over the longer time period. Minimizing costs is never the sole priority in such exercises.

Heavy chemical process industries, including petro-chemicals and lubricants, widely plan profit optimized [Valkov, 2006]. Large integrated mining and metallurgical complexes share a similar dependency on very large capital infusions and execute their plans in a similar holistic fashion, selecting the “best” combination of mining the ore reserves, primary and secondary beneficiation flows and sales permutations for intermediate and final products [Jerez et al, 2003].

Strategic planning in Petroleum, Chemical, Mining, Metallurgy and all other capital-intensive industries integrates the Supply Chain with the Marketing views to optimize the profit of the entire enterprise over a long horizon. Supply Chain network planning decides the capacities and natures of the nodes (locations) and arcs of the supply chain. Assets, input sourcing, inventory and production planning constitute other major components of the overall chain. Marketing decides the demand segments to serve and suggests product pricing taking into account other supplies and competition. The impacts of all components are combined to create the different strategic scenarios and each is analysed in depth, the final steps bearing similarity to Table 1. The integrated view of supply chain is illustrated in Figure 1.
The Next Generation Supply Chains – Integrated and Profit Maximized

Table 1: NPV based strategic plan [Jerez et al, 2003]

<table>
<thead>
<tr>
<th>Decision Option</th>
<th>Base</th>
<th>1</th>
<th>2A</th>
<th>2B</th>
<th>3</th>
<th>4</th>
<th>5A</th>
<th>5B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Existing (Full)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. Existing (Partially)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. Shut down</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4a. Contract renegotiated – X</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4b. Contract renegotiated – Y</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5a. Expanded - Diesel Hydrotreater</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5b. Expanded - Naphtha Splitter</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6a. With project live – VGO</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6b. With project live – AL4</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6c. With project live – Mexox</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>NPV of Strategy</td>
<td>N1</td>
<td>N2</td>
<td>N3</td>
<td>N4</td>
<td>N5</td>
<td>N6</td>
<td>N7</td>
<td>N8</td>
</tr>
</tbody>
</table>

Net present values N1 to N8 of the listed strategic options will be considered together with other factors justifying the economic rents before making final choice.

<table>
<thead>
<tr>
<th>NPV computation, Strategy 5A</th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Million Kg</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td>150</td>
<td>510</td>
</tr>
<tr>
<td>Gross margin Rs per Kg</td>
<td>2.2</td>
<td>2.2</td>
<td>2.2</td>
<td>2.0</td>
<td>1.8</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Investment Rs crore</td>
<td>-125</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-125</td>
</tr>
<tr>
<td>Gross profit Rs crore</td>
<td>0</td>
<td>0</td>
<td>88</td>
<td>180</td>
<td>162</td>
<td>150</td>
<td>560</td>
</tr>
<tr>
<td>Fixed production costs Rs crore</td>
<td>-30</td>
<td>-32</td>
<td>-34</td>
<td>-35</td>
<td>-36</td>
<td>-26</td>
<td>-82</td>
</tr>
<tr>
<td>Transport &amp; storage Rs crore</td>
<td>-10</td>
<td>-22</td>
<td>-24</td>
<td>-26</td>
<td>-28</td>
<td>-20</td>
<td>-82</td>
</tr>
<tr>
<td>Other costs Rs crore</td>
<td>-10</td>
<td>-20</td>
<td>-20</td>
<td>-21</td>
<td>-22</td>
<td>-10</td>
<td>-82</td>
</tr>
<tr>
<td>Free cash flow Rs crore</td>
<td>-125</td>
<td>-20</td>
<td>-20</td>
<td>-20</td>
<td>-10</td>
<td>-10</td>
<td>-50</td>
</tr>
<tr>
<td>Discount factor 8.0%</td>
<td>-125</td>
<td>-20</td>
<td>-20</td>
<td>-20</td>
<td>-10</td>
<td>-10</td>
<td>-50</td>
</tr>
<tr>
<td>After discount</td>
<td>-125</td>
<td>-20</td>
<td>-20</td>
<td>-20</td>
<td>-10</td>
<td>-10</td>
<td>-50</td>
</tr>
<tr>
<td>NPV</td>
<td>54.63</td>
<td>-126.00</td>
<td>-18.62</td>
<td>24.01</td>
<td>60.27</td>
<td>61.01</td>
<td>44.92</td>
</tr>
</tbody>
</table>

Often national social priorities may not permit full market freedom, especially in pricing some of the products. In such situations, strategic plans maximize profits for products outside the administered-price regime, minimizing costs for the others [SenGupta et al, 2002]. However, the products are all linked and the overall flavour of planning remains profit-oriented.

Fig 1: Extended Strategic Supply Chain optimization model [Shapiro, 2001]

Thought leaders in industrial planning [Goldratt and Cox, 1986] and Supply Chain [Shapiro, 2001] confirm that cost minimization is “too timid & short-sighted” and this practice of revenue or profit maximization is the only logical choice as cost has a lower limit of zero but, there is no upper limit to revenue/throughput.
Thus, both in practice and theory, there is widespread recognition of how essential a “holistic profit optimization” view of planning processes is to improve the efficiency and profitability of industrial complexes. Sub-optimization can be eliminated and the company-wide NPV can be attained if one integrates all processes and units within the chain. Stakeholders of these complexes benefit when all aspects are linked into one holistic planning model, with the maximization of NPV mathematically defined as the objective function. The next section describes this integration.

**Automation of planning – evolution from MRP to APS**

Over the last three decades, computerized planning systems have evolved from Material Requirement Planning (MRP) to Advanced Production Scheduling (APS). J. Orlicky of IBM developed MRP in the early 1970s to backward plan time-phased Materials (components/raw materials) requirements, starting from master production schedules, bills of material and inventory status reports. MRP helps in evaluating the requirements-feasibility of production plans. Distribution Resource Planning (DRP) does likewise for the Distribution components.

The Manufacturing Resource Planning (MRP II) and Enterprise Resource Planning (ERP) extend the functionalities of MRP & DRP. They assist in understanding resource capacity violations and provide the information to manually resolve the conflicts. However, they do not automate this process.
Fig 4: Interaction between Enterprise planning systems

In the late 1990s, Advanced Planning Systems (APS) evolved to automate much of the decision making. APS aims at computing optimized plans under a wide range of constraints like demand and price forecasts, materials availability, machine capacity, etc. They assist in planning, rapid re-planning or simulation of different elements of the enterprise and use advanced tools for forecasting, queuing and optimization from modern techniques of Statistics, Operations Research, Computer Science, etc.

Profit optimization using Advanced Planning and Scheduling systems

Over the last decade, major Supply Chain Management software vendors like i2, SAP, Manugistics, JDA have been supporting Advanced Planning and Scheduling, including Enterprise Profit Optimization by tracking segmented demand fulfillment. Most of the demand, pricing, supply, costs, resource and other data is available in the SCM system databases. However, often it is difficult to cover all aspects of revenue and cost within the restricted options in packaged systems [Sboui et al, 2002], especially when processes are composed of multiple sub-processes. Optimizing the sub-processes separately would lead to sub-optimality and recourse to specialized external planning systems becomes inevitable. As all other functions are covered within the SCM software, it would be best to obtain information integration between these external solutions and the SCM databases [Marjolein, 2003]. The external solutions can be customized to address the very unique problems of different planning process.

Profit orientation of planning – from AtP to PtP

The orientation of APS is user-defined. If modeled focusing on inventory, capacity or other internal factors, cost-minimized plans would result. On the other hand, if modeled as a pull system, driven by demand and price forecasts, it could produce profit-maximized supply chain plans. Around 2000, AMR Research introduced the Demand-Driven Supply Networks (DDSN) to do so. Its major differences with “traditional” supply chains are given in Table 2.

<table>
<thead>
<tr>
<th>Table 2: Key Differences between Traditional &amp; Demand-driven Supply Networks (Caruso et al, 2004)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area</strong></td>
</tr>
<tr>
<td>Demand</td>
</tr>
<tr>
<td>Replenishment</td>
</tr>
<tr>
<td>Planning</td>
</tr>
<tr>
<td>Performance Management</td>
</tr>
<tr>
<td>Performance Measurement</td>
</tr>
<tr>
<td>Network Boundaries</td>
</tr>
<tr>
<td>Product Innovation</td>
</tr>
<tr>
<td>Culture</td>
</tr>
</tbody>
</table>
The DDSN paradigm is also expressed in APS through transition of the "order promising" in terms of Availability to Promise (AtP), Capable to Promise (CtP) and Profitable to Promise (PtP), illustrated in Figure 5.

![Diagram](image)

**Fig 5: From Available to Capable and Profitable**

While AtP and CtP limit themselves to timely order delivery, PtP begins by accepting orders based on their financial implications. As the demand–supply scenario dynamically varies from one plan period to the next, so could the reaction to a specific opportunity. PtP assures that the right customer gets the right order at the right time, in the most profitable manner. [McKenna, 1988 and Marjolein, 2003]

**Integration of planning – holistic, enterprise-wide**

Once, at strategic level, the asset plan, product mix and market share are finalized, the supply chain network design determines the locations of the production and distribution channels (nodes of the supply chain) and the interconnection between those locations (arcs). The tactical and operational levels of planning ensure that the supply and distribution of products are aligned to the strategic plans. Figure 6 illustrates an integrated model for such holistic planning.
This framework links the expected dynamic flows of material and information driven by forecasted demand under a competitive environment and as constrained by the internal capabilities. In a top-down approach, the segmented demand forecasting at the top, introduces the profit orientation into the planning.

**Case study: Profit maximization in Distribution planning**

Consider a third party logistics (3PL) service provider involved in the global transportation of liquid chemicals using ISO tank containers. To address both spatial and temporal demand imbalances, the service provider needs to continuously optimize its inventory deployment by repositioning its assets (containers) over time, based on forecasted demand. The commonly used approaches try to minimize the total cost of repositioning while meeting the forecasted demand [Erera et al, 2007], e.g.

Minimize

\[
\text{Costs (empty reposition + holding + leasing)}
\]

subject to

- Penalty for (non-segmented) demand not loaded

Forecasted (non-segmented) load for each lane

Container flow balance

Shipping lane capacities

for all operational planning periods in planning horizon, over entire network but with non-segmented demand.

where ‘lane’ is the combined ocean and land transportation route between origin and destination.

Neither the revenues nor the costs of the shipments enter into the computation and the penalty reflects the opportunity loss. These models trade off costs of empty asset redeployments against revenue opportunities.
The most important characteristic of these models is that neither demand nor service is segmented and all demands at all locations are intrinsically equivalent.

The alternate approach is to maximize the discounted profit after segregating demand at different price and service points. Not only could the contributions vary between two demands for different lanes or routes, they could also vary within the same route depending on the customer profile or the nature of handling.

Maximize
   Total (segmented) weighted discounted contribution of demand loaded
   - Costs of (empty reposition + holding + leasing)

subject to
   Forecasted segmented load for each lane
   Container flow balance
   (Segmented) shipping lane capacities
   for all service segments, all operational planning periods within planning horizon, over entire network.

The possible contributions of different service segments are inputs for the computation that balances supply (capacity) against segmented demand to prioritise the loadings. The weights reflect the differences between long and short-term measures of contribution from key and spot customers.

**Case study: Profit maximization in Production planning**

The lubricant production is a two stage process involving blending and filling. Base oils are blended with additives in appropriate proportion as per grade. Filling is the process of packaging the blended material into different sizes of containers called SKUs. A large lubricant manufacturer can begin with 70-100 grades of blends to create 500-600 of SKUs in about 80-100 batch runs a month. These batch sizes are determined on the basis of the forecasted demand at SKU level, the sizes of the available blending tanks, etc. The processing time for a grade of lubricant at a blending unit depends not only on the set up time and precedence compatibility with other grades of lubricants, but also on the evacuation time of the blending tank. This time is governed by the filling operation which in turn depends on the mix of SKUs in the forecasted demand. To sequence the batches of different grades at blending unit, the common approaches minimize either total completion time or maximum tardiness or maximum earliness or their weighted sum. Ignoring inventory costs, the model is

Minimize
   Penalty for missing batch due dates

subject to
   SKU demand forecasts
   Resource requirements for batch/SKU
   Resource compatibility & availability
   for all batches & SKUs, all operational planning periods within planning horizon..

Very often, sales would demand batches with due dates that lead to conflicts in resource availabilities and the planner would have to virtually arbitrate between
them. Profit or contribution provides the best balance through a model simplified by ignoring inventory costs:

Maximize

Total expected contribution of SKU mix produced
- Penalty for missing batch due dates

subject to

SKU demand forecasts
Resource requirements for batch/SKU
Resource compatibility & availability

for all batches & SKUs, all operational planning periods within planning horizon..

If this plan is computed over several operational time periods, the impact of both the contribution and the raw materials and finished inventory may be discounted to reflect a more accurate cash flow picture.

**Supply Chain technologies that should be profit-oriented**

Market analysis of Supply Chain technologies does not go the level of detail where the issues of profit or cost orientation become explicit. Here, we identify the most widely practiced (hyped) processes, as identified by these analyses, where one could benefit by introducing a profit orientation and integrated planning.

In 2006 Gartner reported on the “Hype Cycle” for Business Process Platforms (BPP) in SCM, in two dimensions (Fig 7):

- Technology or innovation maturity level
  - Technology trigger
  - Peak of (inflated) expectations
  - Trough of disillusionment
  - Slope of enlightenment
  - Plateau of productivity
- Years to mainstream adoption
  - < 2 years
  - 2-5 years
  - 5-10 years
  - > 10 years
  - Obsolete

**Fig 7: Typical Gartner Hype Cycle**

**Fig 8: Gartner Hype Cycle for SCM business processes**
The Next Generation Supply Chains – Integrated and Profit Maximized

The following identified as “Priority” SCM technologies on the cusp of the 2+ year window have a strong contribution to profit-oriented planning, especially when performed in a holistic enterprise-wide manner (Fig 8) [White et al]:

- Inventory strategy optimization
- Strategic sourcing applications
- Price optimization
- Sales and operations planning

Forrester’s TechRadar describes popular industrial technologies in three dimensions

- Phases of ecosystem maturity
  - Creation in lab
  - Survival in market
  - Growth during adoption
  - Equilibrium in installed base
  - Obsolescence

- Risk-Adjusted Business Impact
  - High
  - Medium
  - Low
  - Negative

- Trajectories
  - Significant success and a long life span
  - Moderate success and a medium to long life span
  - Failure and a short life span (not shown in Figure)

The technologies listed below are prime candidates for modelling profit-maximized, where the Forrester TechRadar for Supply Chain expects moderate to significant success [Koetzle and Metcalfe, 2007]

- Advanced Inventory Optimization
- Price optimization
- Demand forecasting & planning
- SC performance management
- Advanced planning & scheduling
- Enterprise asset management
The Customer-Chain introduces profit orientation

Large companies have enjoyed significant profit and revenue advantages over their peers using the operations reference models, Supply-Chain Operations Reference (SCOR) and Design-Chain Operations Reference (DCOR), defined by Supply Chain Council. These models provide a common framework and an operating communication standard for the sharing of best practices in supply chain management. SCOR and DCOR models focus on actual operations and do not address the profit orientation to supply chain optimization. However, the recently developed Customers Chain Operations Reference (CCOR) model addresses customer-facing processes. The metrics of CCOR directly include revenue, profit and customer value. Therefore, the plans developed within CCOR would necessarily have to look beyond cost minimization towards revenue, profit and customer contribution optimization and this view will then permeate through the entire process.

<table>
<thead>
<tr>
<th>Performance Attribute</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>Customer Loyalty Index</td>
</tr>
<tr>
<td></td>
<td>Perfect Contracts</td>
</tr>
<tr>
<td></td>
<td>Perfect Assists</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>Lead-to-contract Cycle Time</td>
</tr>
<tr>
<td></td>
<td>Assist Cycle Time</td>
</tr>
<tr>
<td></td>
<td>Quote Turnaround Time</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Change Reaction Cycle Time</td>
</tr>
<tr>
<td>Cost</td>
<td>Cost of Selling</td>
</tr>
<tr>
<td></td>
<td>Cost of Assists</td>
</tr>
<tr>
<td></td>
<td>Warranty Cost</td>
</tr>
<tr>
<td>Asset Management</td>
<td>Customer Conversion Rate</td>
</tr>
<tr>
<td></td>
<td>Customer Growth Rate</td>
</tr>
<tr>
<td></td>
<td>Assists per Customer</td>
</tr>
<tr>
<td>Profitability</td>
<td>Gross Revenue</td>
</tr>
<tr>
<td></td>
<td>Customer Franchise</td>
</tr>
<tr>
<td></td>
<td>Average Profit per Customer</td>
</tr>
</tbody>
</table>
References


Goldratt, E.M and Cox J. (1986), The goal: A process of ongoing improvement, North River Press, Great Barrington, MA.

Jerez, R., Featherstone R. and Scheepers, L. (2003), Strategic planning models using mathematical programming techniques, METSOC, Canadian Institute of Mining, Metallurgy and Petroleum (CIM), Santiago, Chile.


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