Developing Supply Chain Management System Using DDMRP

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NLMK is Russia’s largest steel manufacturer – and the 16th largest in the world – with 17 million tons production and 72 million tons cargo turnover per year.

The Leader of Steel industry

S&P Plats 2016 Reward

TOP20

In the world steel making companies rating

Efficient steel making company (WSD)

Share of Russian market

Developing Supply Chain Management System Using DDMRP
NLMK Logistics strategy 2014-2017 was focused on cost optimization

- Sensitivity to the quality of logistics services in heavy industry is relatively low in comparison with other sectors. Average OTIF:
  - Heavy industry, steel making ~85%
  - Household Appliances ~90%
  - FMCG and Pharma >95%

- Logistics costs are 10-60% of revenue

- Maintaining a certain level of quality of service is possible due to additional stocks, since the cost of maintaining stocks is relatively low (comparable to WACC), the shelf life of products is not limited

- Priorities for logistics optimization for steel making companies:
  - Costs optimization
  - Inventory optimization
  - Improvement of the quality of service
Significant gains achieved in 2014-2017: $48M cost savings, $45M working capital optimization, $42M improvement of commercial terms ...

![EBITDA increase, $M](chart)

EBITDA increase, $M

- 2013: 0.1
- 2014: 6
- 2015: 15
- 2016: 17
- 2017: 10

![Cash flow increase, $M](chart)

Cash flow increase, $M

- 2013: 24
- 2014: 6
- 2015: 15
- 2016: 16
- 2017: 10

Commercial gains in 2014-2017:
- $48M cost savings
- $45M working capital optimization
- $42M improvement of commercial terms

**Significant gains achieved in 2014-2017:**

- **Cost savings:** $48M
- **Working capital optimization:** $45M
- **Improvement of commercial terms:** $42M

**Development of Supply Chain Management System Using DDMRP**
However, lots of challenges persisted in supply chain management. From the supply of raw materials to mineral companies to the shipment of the finished products, the supply chain faces several key challenges:

- **Long lead time** from raw material suppliers to end customers
- **Short orderbook** as well as challenging deliver requirements from customers
- **High variability within the supply chain** – on both, demand and supply side
- **Lack of transparency for decision making** (gaps in the area of inventories and service level)
- **Potential to improve level of integration in SC planning** and raw material procurement
NLMK selected CAMELOT as thought leader in supply chain management and experienced DDMRP implementation partner to jointly overcome the challenges

- Thought leader in supply chain management providing leading practices for future NLMK supply chain design
- Experienced partner for successful DDMRP implementations across industries...
  - ...enabling thought ware change through trainings and know-how transfers
  - ...ensuring optimum conceptual DDMRP design as basis for implementation
  - ...providing leading DDMRP software solutions based on SAP technology
- “Digital frontrunner” actively driving innovations in supply chain management

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**Russian Supply Chain Community:**
Barkawi MC, Pierau Planung, Visagio, HPM Log, Oliver Wight, Manhattan Inc, FLO, Armstrong & Associates
Total Logistics, AT Kearney

**Gartner:**

**Short list:**
Barkawi MC, Strategy&, Camelot MC, McKinsey, ATKearney, Capgemini, Chainalytics

**ALM Intelligence Research:**

**Personal recommendations:**
McKinsey, Strategy&, Camelot MC, Barkawi MC
The goal of the project was to implement the best practices in client service and inventory replenishment with a focus on international subsidiaries.

Major changes achieved during the project:

**Service level**
- OTIF calculation for the full chain harmonized
- Framework for data collection and visualization has developed
- OTIF management and root-cause analysis process and responsibilities defined
- Monetization approach and next steps for communication with clients described

**Replenishment**
- DDMRP buffer allocation and replenishment tools developed and applied for Clabecq slabs and finished products planning, La Louviere and PA planned till the end of 2018
- DDMRP replenishment for slabs from Lipetsk to Clabecq started in September
- Replenishment for pilot Q&T warehouses based on DDMRP started in July

**E2E SCM**
- E2E planning and replenishment processed developed and implemented
- Roles and responsibilities defined and aligned with current structure
- High level IT requirement defined and aligned with IT strategy
- Inventory level and service level metrics defined (FLOW metrics)
End-to-End OTIF calculation was established for Lipetsk-Clabecq supply chain achieving OTIF stabilization throughout the entire supply chain.

Production OTIF

Logistics OTIF is calculated based on the slab planned delivery time: production month + 3 weeks.

Clabecq

OTIF in Clabecq is measured based on invoicing date indicating the Clabecq internal OTIF on FG.

Way to measure

• Production OTIF calculated for “confirmed date” - end of the production month

Targets

• Targets set up based on benchmarks

Improve

• To have promised date of production after calendar planning implementation

Lack of materials

Production issue

Production issue

Slabs planning and production

• Production OTIF calculated for “confirmed date” - end of the production month

Logistics

• Logistics OTIF is calculated based on the slab planned delivery time: production month + 3 weeks

Targets

• Targets set up based on production OTIF improvement

Improve

• To have promised date of production after calendar planning implementation

Production issue

Integration of MES to increase level of granularity on production OTIF for Q&T to enable automated root-cause analysis

Targets set up based on market situation for local market

Polar star – based on steel industry benchmark

• Integration of MES to increase level of granularity on production OTIF for Q&T to enable automated root-cause analysis
To improve unsatisfactory OTIF performance, root-cause analysis for Clabecq’s OTIF is performed each month

Sample of root-cause analysis, June - August 2018

- **CP:**
  - For analysis of CP OTIF, databases with information on processing of products through production stages in comparison with target dates. Analysis is manually handled by groups of order lines – reasons assigned in the order of reasons according to the pyramids (see left).

- **Q&T:**
  - Detailed data are not available yet, so the analysis is made on significant root causes. The first focus for further IT development is to start to collect data for Q&T OTIF based on the experience gained for CP

<table>
<thead>
<tr>
<th>Production instability</th>
<th>ATP (Available to promise) for Q&amp;T is not stable</th>
<th>Non-OTIF rolling</th>
<th>Actual lead time instability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td><strong>Available to promise process incomplete</strong></td>
<td><strong>Re-rolling because of quality issues</strong></td>
<td><strong>Delays on different production stages</strong></td>
</tr>
<tr>
<td>• Production instability: • Productivity lower than forecasted</td>
<td>• Some specific isn’t taken in account</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Action plan</th>
<th>ATP upgrade for QT integrating plasma capacity limitation</th>
<th>Minimizing the number of re-rolling</th>
<th>Develop aging KPIs to track plates without movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Remontada project started</td>
<td>• Lead time revision for QT</td>
<td>• Minimizing the number of re-rolling</td>
<td>Develop aging KPIs to track plates without movement</td>
</tr>
<tr>
<td>• Structural re-levelling shift organization</td>
<td>• UP to 5% improvement in 2018</td>
<td></td>
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<tr>
<td>• UP to 5% improvement in 2018</td>
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The reasons are shown in pyramids in the order of prioritization for analysis — if the first reason haven’t happened — check the second.
The lead time Lipetsk-Clabecq-Customer is very long and variable placing lots of challenges on supply chain planning and execution.

<table>
<thead>
<tr>
<th>LT Duration (Days)</th>
<th>LT Duration (Weeks)</th>
</tr>
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<tbody>
<tr>
<td>30</td>
<td>4 weeks</td>
</tr>
<tr>
<td>24</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
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<tr>
<td>6</td>
<td></td>
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<tr>
<td>3</td>
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<tr>
<td>1</td>
<td></td>
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<td>1</td>
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</tbody>
</table>

Lead time order-delivery: 49±14.7 (30%)* (7 weeks)

Period between order placement

Total cumulative lead time (full MTO lead time): CP: 110 (16 weeks)// QT: 125 (18 weeks)

Q&T warehouses all over the world are placed to cover the demand of customers with required LT <1 week

Consumption – number of weeks with the consumption in the range

Share of overall consumption per SKU

* One sigma (standard deviation)
DDMRP with the logic to cut the supply chain into pieces by strategically placing inventory buffers was identified as the best solution to cover LT challenges and absorb variabilities from demand and supply side.

Selected placement considerations:

1. **Lipetsk**
   - No lead time compression
   - Space limitations

2. **St. Petersburg**
   - Space limitations/prioritization

3. **Ghent**
   - Good LT compression
   - Currently used as decoupling point

4. **Clabecq**
   - Very good LT compression
   - Space limitations

**LT Duration (days) & potential decoupling point positions**

- **Lipetsk**: 24 days
- **SPB**: 6 days
- **Ghent**: 8 days
- **Clabecq**: 6 days
- **End Customer**: 4 days

**Decoupled LT: 47 days**

- LT CP: 6 weeks
- LT Q&T: 7 weeks
Buffers were calculated per SKU, applying individual planning parameters – it allows to have lower but sufficient stock level in comparison actual data.

Real examples of slabs replenishment based on DDRMP

- 160 slab SKUs analyzed in detail on detailed chemistry

### Slabs 3104_250
- MOQ: 2400 tons
- ADU: 80 tons
- DLT: 47 days
- LTF: high
- VF: medium

### Slabs 3101_200
- MOQ: 960 tons
- ADU: 18 tons
- DLT: 47 days
- LTF: high
- VF: high

- Buffer are not static and recalculated over time
- Quarterly review of buffer & inventory quality (using tactical FLOW metrics) to identify areas for improvement
- Alignment between Local Inventory & Repl. Planner and E2E Inventory & Repl. Manager on parameter adaptions to improve buffer performance

3104_250 stock level simulation, tons
Actual: Avg 4,7kT
Target on hand stock = 4 weeks periodic +3 weeks safety stock

3101_200 stock level simulation, tons
Actual: Avg 1,3kT, 20 days out-of-stock

Developing Supply Chain Management System Using DDMRP
The DDMRP methodology was implemented in the Lipetsk – Clabecq supply chain for slabs enabling significant stock decrease.

Developing Supply Chain Management System Using DDMRP

49% stock decrease

23% stock decrease
For selected finished goods warehouses pilot with usage of DDMRP has started, DDMRP supports the low level of finished goods stock

- Pilot for Q&T Finished Goods started for 3 warehouses Antwerp, Italy and Denmark WHs
- Orders for pilot warehouses placed in July - Sep based on DDMRP and confirmed by SCM and sales locally as sustainable
- Orders placed biweekly instead of monthly
- Stock structure becomes more adequate because of constant tracking of real consumption (OTIF improvement)

Finished goods stock, tons

29% stock decrease

- Central stock
  - Current OH Stock: 3919
  - DDMRP avg OH stock: 2032
- Italy stock
  - Current OH Stock: 834
  - DDMRP avg OH stock: 806
- Denmark stock
  - Current OH Stock: 799
  - DDMRP avg OH stock: 1090
To successfully operate the NLMK multi-stage supply chains with inventory and customer service improvement, the implementation of specific supply chain roles was necessary.

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of Supply Chain Management</td>
<td>Management role with overall accountability for E2E supply chain coordination and guidance providing direction on strategic and tactical issues within the SC, representing the supply chain within S&amp;OP</td>
</tr>
<tr>
<td>E2E Inventory &amp; Replenishment Manager</td>
<td>Tactical role to ensure adequate supply chain configuration within area of responsibility by providing guidance on Inventory &amp; Repl. Mgt., S&amp;OP decisions, and Target Setting</td>
</tr>
<tr>
<td>SC Performance &amp; Improvement Coordinator</td>
<td>Tactical role to coordinate, consolidate, and actively support E2E SC Performance Management (OTIF improvement)</td>
</tr>
<tr>
<td>Local Inventory &amp; Replenishment Planner</td>
<td>Operative role (re)calculating inventory buffers, constantly monitoring inventory levels, and triggering material replenishment</td>
</tr>
<tr>
<td>Supply Chain Agent</td>
<td>Operative role to regularly monitor supply chain events &amp; performance, analyze root-causes, and derive (immediate as well as continuous improvement) actions</td>
</tr>
</tbody>
</table>

**Key interactions between defined roles**

- **E2E Supply Chain Configuration**
  - Guidance on SC configuration, replenishment decisions, initiated improvement measures, etc.
- **E2E Performance & Improvement Management**
  - Guidance & information on SC PM, structural issues, improvement initiatives, etc.
- **Local Replenishment Planning & Execution**
  - Defined & monitor inventory buffers; trigger material replenishment; align with local functions
- **Local Analysis, Monitoring, and Improvement**
  - Exceptions, early warnings, short-term measures
- **E2E Performance & Improvement Coordinator**
  - Constraints, local specifics, upcoming issues
- **SC Performance & Improvement Coordinator**
  - Guidance & coaching on E2E PM; support (templates, tools, etc.)
- **Local Inventory & Replenishment Planner**
  - Projected material shortages, corrective actions
- **E2E Inventory & Replenishment Manager**
  - Information on SC configuration, replenishment decisions, initiated improvement measures, etc.
- **Supply Chain Agent**
  - Exceptions, early warnings, short-term measures
- **Organizational principles**
  - One role is not equal to one specific person or function; a role bundles activities & tasks of similar nature (e.g. in terms of planning horizon, granularity, functional scope)
  - There can be multiple instances of one generally defined roles reflecting specifics of the respective area of application (e.g. specifics regarding geography, value chain stage, product groups, customers, etc.)
  - One role (or instance of a role) can be assigned multiple times (depending on workload to be covered)
  - One person can fulfill more than one role (depending on scope and workload)/ roles can be combined
In the current organizational structure operation level is already exists, for tactical level only 3 additional positions needed – for Clabecq finished goods warehouses management, for Group slabs replenishment and OTIF coordination.

Developing Supply Chain Management System Using DDMRP
Expected benefits – increase of revenue after service level improvement and stock level decrease enables by DDMPR implementation

<table>
<thead>
<tr>
<th>OTIF improvement</th>
<th>Up to 1-2% revenue increase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inventory savings</strong></td>
<td></td>
</tr>
<tr>
<td><strong>NLMK Clabecq</strong></td>
<td>Q&amp;T (slabs)</td>
</tr>
<tr>
<td>136 → 79 days (42%)</td>
<td>69 → 53 days (23%)</td>
</tr>
<tr>
<td><strong>NLMK La Louviere</strong></td>
<td>53 → 51 days (4%)</td>
</tr>
<tr>
<td><strong>NLMK USA</strong></td>
<td>70 → 67 days (4%)</td>
</tr>
</tbody>
</table>
Next steps: AI Demand pattern recognition and forecasting model can boost the performance up to 99% forecast accuracy which will allow to further decrease inventory levels based on more realistic ADU.

### Pattern recognition and demand forecasting

<table>
<thead>
<tr>
<th>Demand patterns</th>
<th># shipments</th>
<th>weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase-in</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Phase-out</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>Sporadic</td>
<td>0%</td>
<td>3%</td>
</tr>
<tr>
<td>Constant</td>
<td>0%</td>
<td>70%</td>
</tr>
<tr>
<td>Trend</td>
<td>0%</td>
<td>20%</td>
</tr>
<tr>
<td>Seasonal</td>
<td>0%</td>
<td>4%</td>
</tr>
</tbody>
</table>

- Prediction of next customer order with an accuracy >90%
Further steps of supply chain development for the 2018-2022 strategic cycle

- Logistical service excellence
- E2E Supply chain processes
- Integrated group supply chain

<table>
<thead>
<tr>
<th>Year</th>
<th>Replenishment</th>
<th>E2E</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>OTIF improvement</td>
<td>Logistical service excellence</td>
</tr>
<tr>
<td></td>
<td>OTIF measurement for NLMK CI, NLL, PA</td>
<td>Demand-driven enterprise concept adoption</td>
</tr>
<tr>
<td>2019-2020</td>
<td>Roll-out for all sites</td>
<td>SC Control Tower implementation</td>
</tr>
<tr>
<td></td>
<td>Customer dialog on OTIF monetization</td>
<td>Processes adaption, KPIs and reporting set up</td>
</tr>
<tr>
<td></td>
<td>DDMRP pilots, implementation for main sites</td>
<td>DDMRP program roll-out for all companies</td>
</tr>
<tr>
<td>2021-2022</td>
<td>DDMRP implementation for other inventories and customers</td>
<td>Forecast based on AI analysis</td>
</tr>
<tr>
<td></td>
<td>OTIF improvement program communication</td>
<td>New roles set up</td>
</tr>
<tr>
<td></td>
<td>Customer SC collaboration</td>
<td>Roll-out for all sites</td>
</tr>
</tbody>
</table>

Developing Supply Chain Management System Using DDMRP

[Diagram showing steps and milestones for each year]