Industry 4.0 and the Digital Future
Rizwan Janjua, Future Steel Forum, Warsaw
Disclaimer

For presentations to the general public:

This document is protected by copyright. Distribution to third parties or reproduction in any format is not permitted without written permission from worldsteel. worldsteel operates under the strictest antitrust guidelines. Visit worldsteel.org\About us for detailed antitrust guidelines.
Preparing for a digital future

- A paradigm shift in the way we source, produce, market, sell and provide support & service
- Digital capabilities need alignment towards organizational goals:
  - INTERNAL
    - Processes & value chain
    - Structure
    - People & culture
  - EXTERNAL
    - Supply chain
    - Direct Customers and End Customers
Digitalization: Areas of opportunity for the steel industry

**Key Areas of Opportunity**

- Energy
- Resource efficiency
- Environment
- Safety
- Operational & commercial excellence

**Steelworks**
- Systemic optimization
- Yield, material quality
- CO2, greenhouse gases
- Process & occupational safety
- Order processing, Reliability, inventory

**Supply-chain**
- Micro/mini grid
- Circular economy – 4R
- Reduce, Reuse, Remanufacture Recycle
- Value creation, supply-chain management

**Horizontal digitalization**
Vertical digitalisation - Drivers

**INDUSTRY DRIVERS**
- Min. in-process inventory
- Reliability – Minimum down-time
- Safety – Process & Occupational

**CUSTOMER NEEDS**
- Quality
- Transparency
- Customization
- Circular economy
- DIFOTIS*
- Flexibility
- Service orientation

**Additional Needs**
- High yield – 100% Quality, zero waste
- Make to order – Dynamic swift response
- Real-time actionable information

*DIFOTIS* – Delivery in Full on time in specification

**Safety** – Process & Occupational

**Reliability** – Minimum down-time

**Min. in-process inventory**

**Quality**

**Transparency**

**Customization**

**Circular economy**

**DIFOTIS**

**Flexibility**

**Service orientation**

**High yield** – 100% Quality, zero waste

**Make to order** – Dynamic swift response

**Real-time actionable information**

**Safety** – Process & Occupational

**Reliability** – Minimum down-time

**Min. in-process inventory**
Industry 4.0 - what are the biggest impact areas in steel?
Value Chain - Generic

Michael Porter -
Competitive Advantage:
Creating and Sustaining Superior Performance, 1985
Value Chain

- Value addition shrinking in production

The Smiling curve
Value distribution along the global value chain

Global value-chain in 2000s

Pre-production
intangible

Production
tangible activities

Post-production
intangible

R&D
Design
Logistics: Purchase
Logistics
Marketing
Services

Source: Interconnected Economies Benefiting from Global Value Chains, OECD 2013
Investment for adding value – Steel Industry

Logic for investing more capital: ROIC > WACC

ROIC: Return on Invested Capital
WACC: Weighted Average Cost of Capital

Source: BCG, Solving Steel’s Value-Added Riddle, Feb 2018
Where is the money?

- Steelmakers have reduced influence on:
  - Raw material costs, and
  - Price of products
- How about Conversion Costs?
Inventory – hog on the working capital

- Inventories in process industries account for up to **56.7% of net working capital**\(^1\)
- An inventory reduction of **10%** in the primary metal sector could increase the return on assets (ROA) by **78.0%**\(^2\)

\(^1\): COMPUSTAT North American and Global public financial accounting data for 2013; including pharmaceutical, chemical, primary metal and mining firms
\(^2\): COMPUSTAT North American and Global public financial accounting data for 2013

Transportation, direct labour and inventory holding costs*:

<table>
<thead>
<tr>
<th>Industry</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmaceuticals</td>
<td>11%</td>
</tr>
<tr>
<td>Mining</td>
<td>11%</td>
</tr>
<tr>
<td>Specialty chemicals</td>
<td>12%</td>
</tr>
<tr>
<td>Carbon steel</td>
<td>20%</td>
</tr>
<tr>
<td>Retail</td>
<td>5%</td>
</tr>
<tr>
<td>Automotive</td>
<td>6%</td>
</tr>
</tbody>
</table>

*Industry week benchmarking database, Dow Jones Reuters Business Interactive LLC, Factiva, Cefic.
Freeing up capital

- Getting liquidity along the value chain
  - Raw materials
  - Work in process (WIP)
  - Finished goods

\[
ROA = \frac{\text{net income}}{\text{total assets (Fixed Assets + Working Capital)}}
\]
Logistics & Delivery Service

- Shift from 6 weeks to 6 days delivery performance
- Flexible product change over counted in minutes.
- Low stock or inventory
- Order & product tracking direct on line from raw materials to customers' end product
- Customer inventory management
Inventories or Buffer stock can hide problems

- Suppliers’ reliability, customers orders
- Equipment failures & delays
- Poorly trained workers
- Defective materials & Waste
- Poor scheduling, Changeover time

Excessive inventory masking issues

Lean inventory reveals problems
Lean Production in Steel Industry?
## Industry Archetypes

<table>
<thead>
<tr>
<th>Consumer industries</th>
<th>Process industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>End of value chain – close to end consumers (B2C)</td>
<td>Beginning of the value chain (B2B)</td>
</tr>
<tr>
<td>Higher demand visibility</td>
<td>Lower demand visibility</td>
</tr>
<tr>
<td>Higher variable costs</td>
<td>High fixed costs - economies of scale</td>
</tr>
<tr>
<td>Higher degree of manufacturing volume flexibility</td>
<td>High utilization rates – Low flexibility</td>
</tr>
<tr>
<td>Discrete manufacturing - “assembly-line” e.g. automotive, electronics, consumer goods</td>
<td>Continuous manufacturing e.g. chemical, primary metals etc</td>
</tr>
<tr>
<td>Small batches</td>
<td>Bigger batch size</td>
</tr>
<tr>
<td>Products counted in number</td>
<td>Products measured in volume/weight</td>
</tr>
</tbody>
</table>
## Production planning strategies

<table>
<thead>
<tr>
<th>Consumer industries</th>
<th>Process industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classic pull system (JIT)</td>
<td>Classic push system (MRP)</td>
</tr>
<tr>
<td>Production at one level only happens when initiated by a request at the higher level. That is, units are pulled through the system by request</td>
<td>MRP system computes production schedules for all levels based on forecasts of sales of end items</td>
</tr>
<tr>
<td>Deliver right amount of product at the right time – Each item has a fixed destination</td>
<td>Once produced, subassemblies are pushed to next level whether needed or not Lot of internal flows, rework</td>
</tr>
<tr>
<td>WIP (work-in-process) inventories to an absolute minimum</td>
<td>Large inventories</td>
</tr>
<tr>
<td>Eliminate waste – Higher quality &amp; faster error detection</td>
<td>Large quantities of scrap before errors are discovered</td>
</tr>
<tr>
<td>High flexibility – fast setups &amp; changes allow small batch sizes</td>
<td>Lower flexibility – bigger batches</td>
</tr>
</tbody>
</table>
Can steel industry adopt a hybrid planning system?

- Two most important impetus on Industry 4.0:
  - Greater visibility – horizontal integration in the supply-chain for reducing accuracy of forecasting for MRP
  - Minimise “bullwhip” – reduction of WIP & final inventory leading to reduction in Working Capital
Flexibility & Lean production
The bullwhip effect

- Amplification of orders occurring within a supply chain in the upstream direction
- Even if the demand is fairly stable it leads to:
  - High working capital (unnecessary inventory)
  - Costs (unstable production, poor reliability of equipment)
  - Lost revenues (supply / delivery shortfall)
  - Increased lead times
Reduction of work–in–process (WIP) for lean production

- Slab inventories in even well–managed plants can reach 10 to 20 days
- Mean transfer time for slabs (and WIP) is sensitive to product variety
- Reduction of WIP requires flexible production, delivering right–sized batches for low–volume products

Stainless steel strip plant

Sample: 164 combinations of steel grade & slab width, arranged in five groups, a–e

Order coupling policy – flexibility

- Steel production follows a ‘V’ shaped bill of materials
- Identification of Customer Order Decoupling Point (CODP) or “order penetration point” depends on product portfolio

- **Low product variety**: Higher performance if the production system exhibits a high degree of process flexibility downstream from the order coupling point.
- **High product variety**: Higher performance when the production system exhibits a high degree of process flexibility upstream from the order coupling point.
Process flexibility

- Order size less than minimum batch size in steelmaking—continuous casting (SCC) necessitates buffering
- If the equipment is inflexible, buffering becomes necessary and the amount (WIP inventory) increases with the product variants/range
- Product range is directly correlated to flexibility in upstream & downstream direction
- Measures to increase flexibility:
  - Reduce setup times (CC, rolling)
  - Reduce yield losses (e.g. change of width or grade in CC)
  - Improve process control using CAQC systems
  - Remove constraints on product sequence
Conclusions

- Industry 4.0 has much more potential than just automation
- Steel industry is CAPEX intensive and assets need to run at max capacity
- Inventory is responsible for high working capital
- In order to adopt ‘lean’ manufacturing model, bullwhip effect needs to be minimised – thereby necessitating visibility in the supply chain
- The next generation of industry 4.0 solutions would likely have more emphasis on software; necessitating
  - Hybrid systems (incorporating JIT & ERP/MRP)
  - Collaboration in supply chain (horizontal digitalization) for superior demand visibility
  - Standardization of data exchange & compatibility
  - Information security
Thank you for your attention.

For further information contact:

Dr Rizwan Janjua | Head, Technology
World Steel Association
Janjua@worldsteel.org | T: +32 (0)2 702 89 00 | worldsteel.org