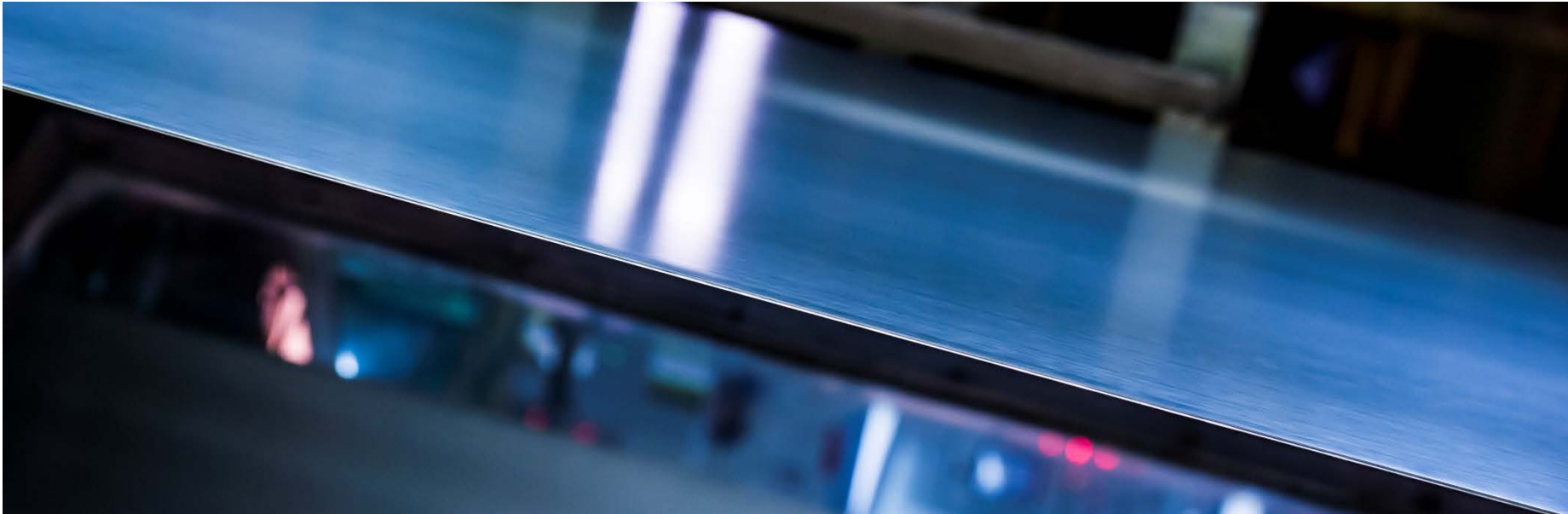


Industry 4.0 and the Digital Future
Rizwan Janjua, Future Steel Forum, Warsaw



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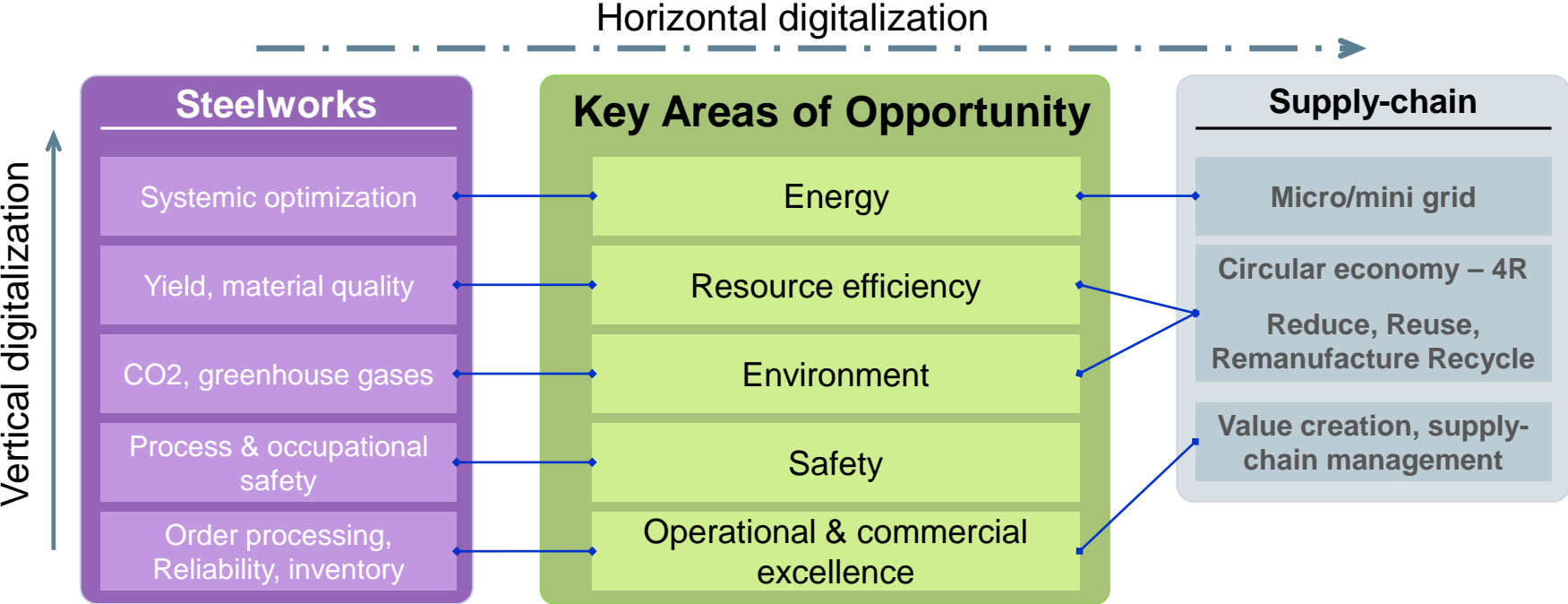
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Preparing for a digital future

- 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



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*



High yield – 100% Quality, zero waste



Make to order – Dynamic swift response

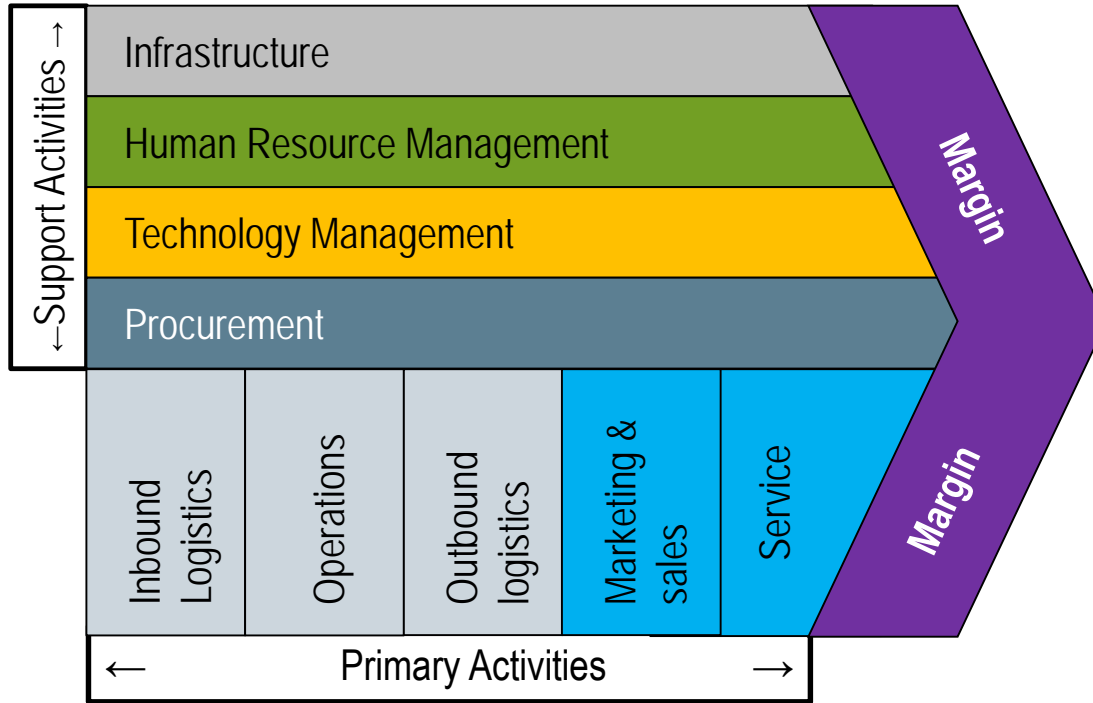


Real-time actionable information

* **DIFOTIS** – Delivery in Full on time in specification

Industry 4.0 - what are the biggest impact areas in steel?

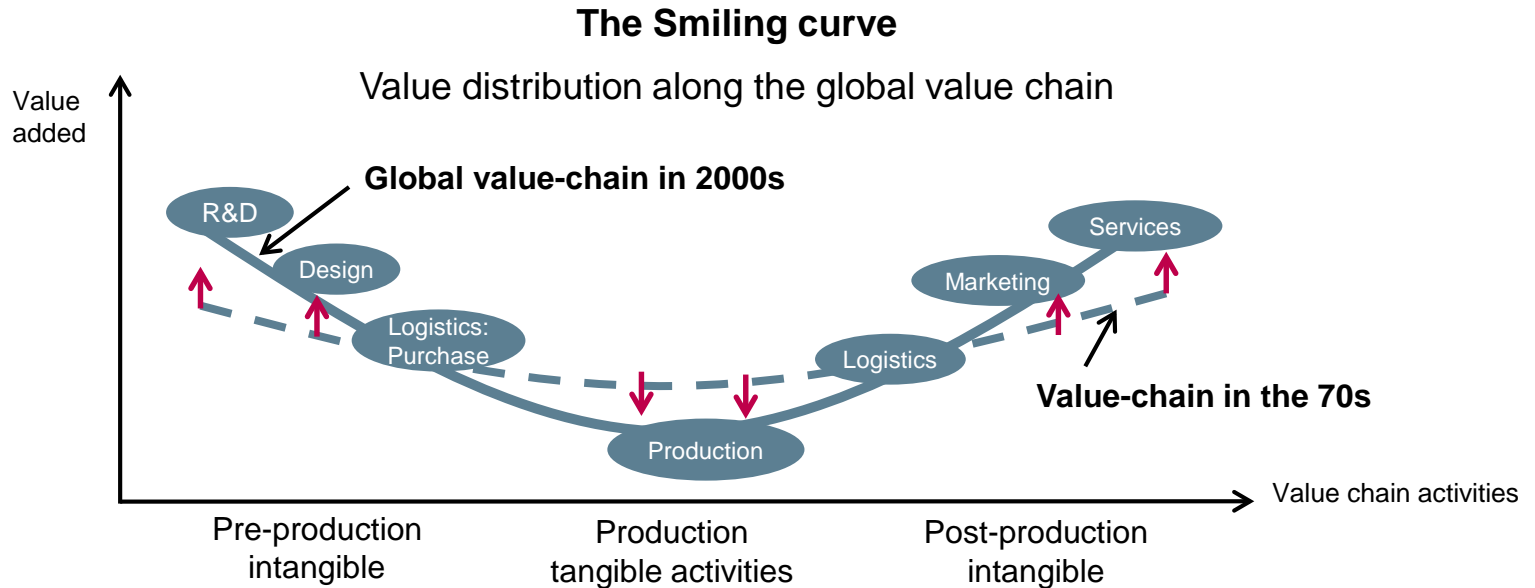
Value Chain - Generic



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

Value Chain

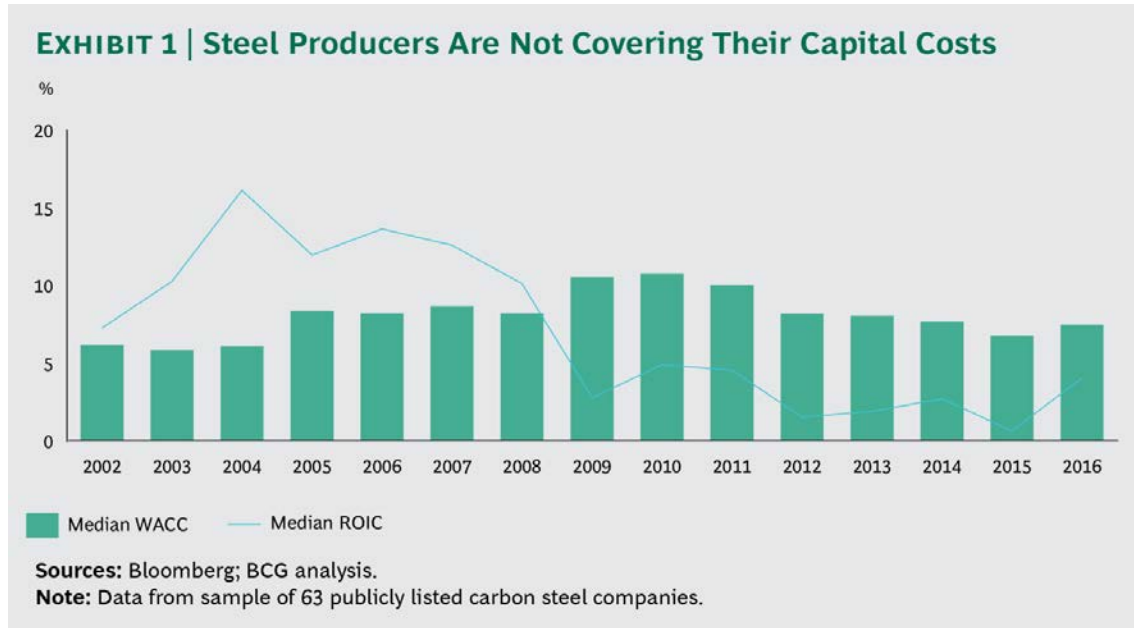
- Value addition shrinking in production



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

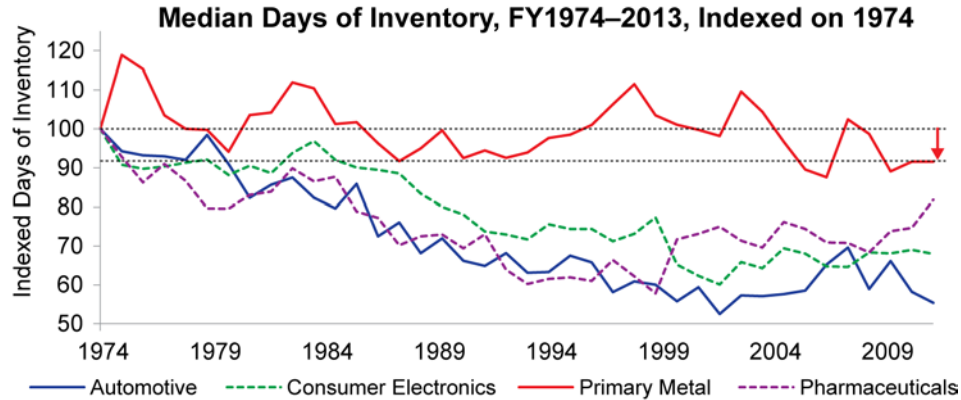
Source: BCG, *Solving Steel's Value-Added Riddle*, Feb 2018

WACC: Weighted Average Cost of Capital

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



Source: COMPUSTAT North American and Global public financial accounting data for 2013

Transportation, direct labour and inventory holding costs*:

Pharmaceuticals	11%
Mining	11%
Specialty chemicals	12%
Carbon steel	20%
Retail	5%
Automotive	6%

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

- 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

Freeing up capital

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

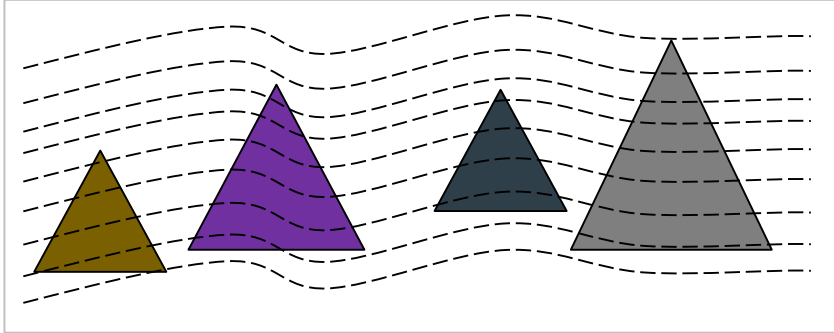
$ROA = \text{net income} / \text{total assets (Fixed Assets + Working Capital)}$

Logistics & Delivery Service

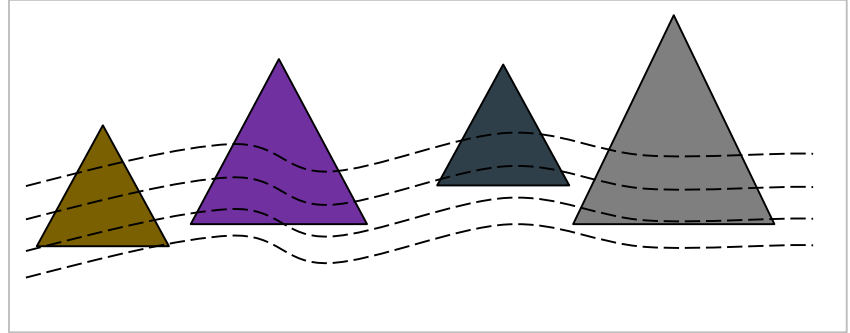
- Shift from 6 weeks to 6 days delivery performance
- Flexible product change over counted in minutes.
- Low stock or inventory
- Order & product tracking direct on line from raw materials to customers' end product
- Customer inventory management

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

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

Production planning strategies

Consumer industries	Process industries
Classic pull system (JIT)	Classic push system (MRP)
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	MRP system computes production schedules for all levels based on forecasts of sales of end items
Deliver right amount of product at the right time –	Once produced, subassemblies are pushed to next level whether needed or not
Each item has a fixed destination	Lot of internal flows, rework
WIP (work-in-process) inventories to an absolute minimum	Large inventories
Eliminate waste – Higher quality & faster error detection	Large quantities of scrap before errors are discovered
High flexibility – fast setups & changes allow small batch sizes	Lower flexibility – bigger batches

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

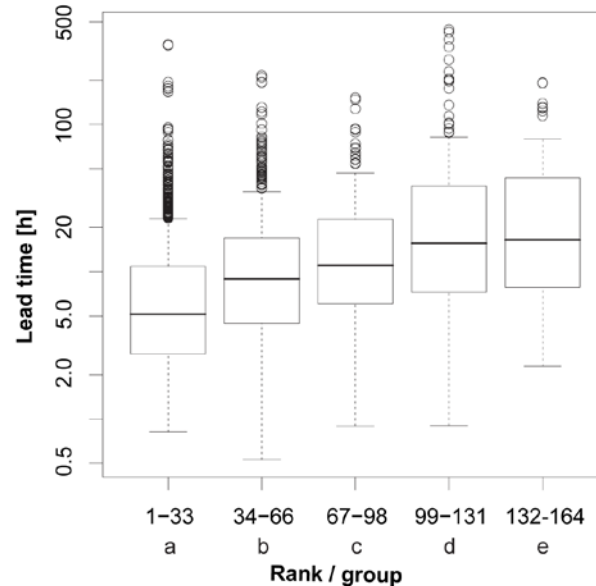
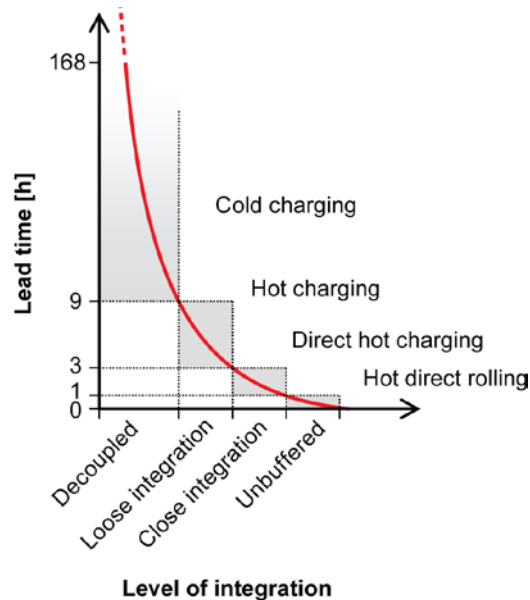
Flexibility & Lean production

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



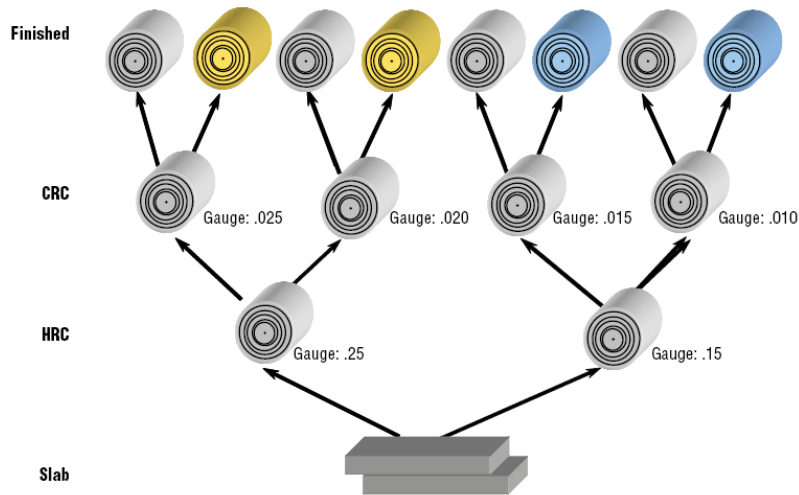
Stainless steel strip plant

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

Source: J. Storck, STRATEGIC AND OPERATIONAL CAPABILITIES IN STEEL PRODUCTION, Doctoral Thesis, KTH Stockholm, Sweden, 2009, ISBN 978-91-7415-507-5

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.

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