MÄLARDALENS HÖGSKOLA
ESKILSTUNA VÄSTERÅS

Competitive and sustainable production

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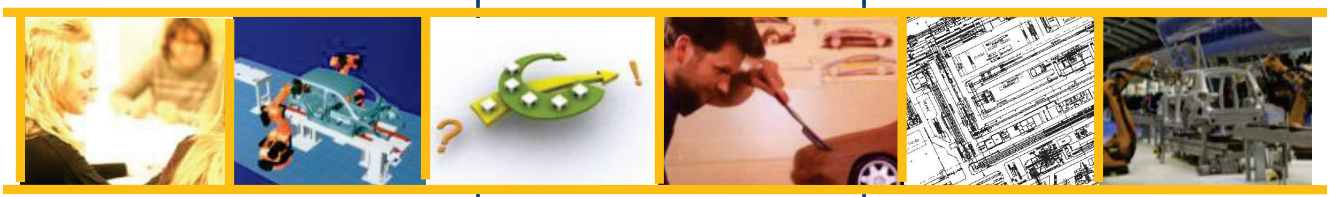
Integrated research profile on ”Innovation and Product realisation” – 3 divisions

Innovation and product realisation



Three practice oriented research groups with a common PhD education

Innovation management

Management and organisation to realise new products, services, business models, technologies or production systems.

Design and Visualization

Analysis and interpretation of images, room and text, based on human centred design.

Product realization

Processes /methods to develop, manufacture and deliver goods and services.

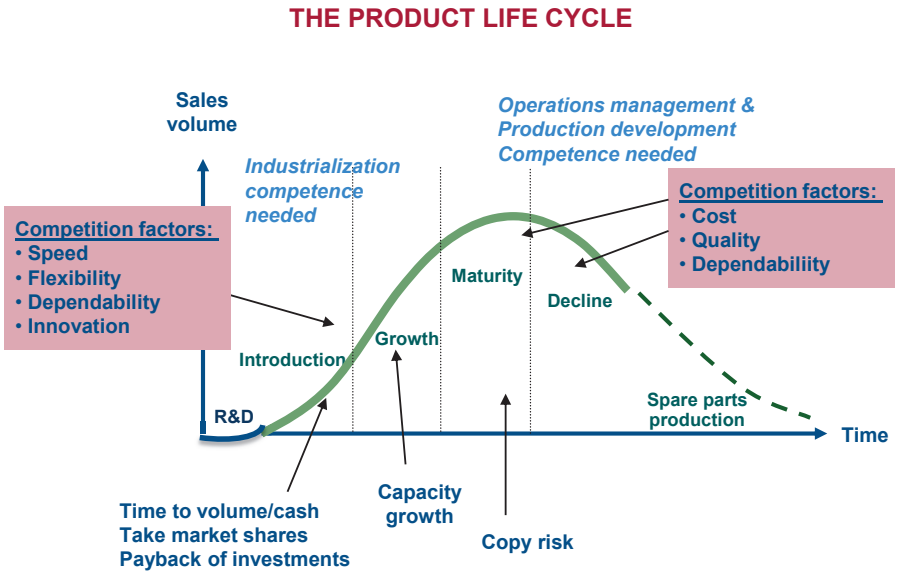
- Product industrialization
- Production system design
- Sustainable production

What is competitiveness?

The product life cycle tells us how to compete

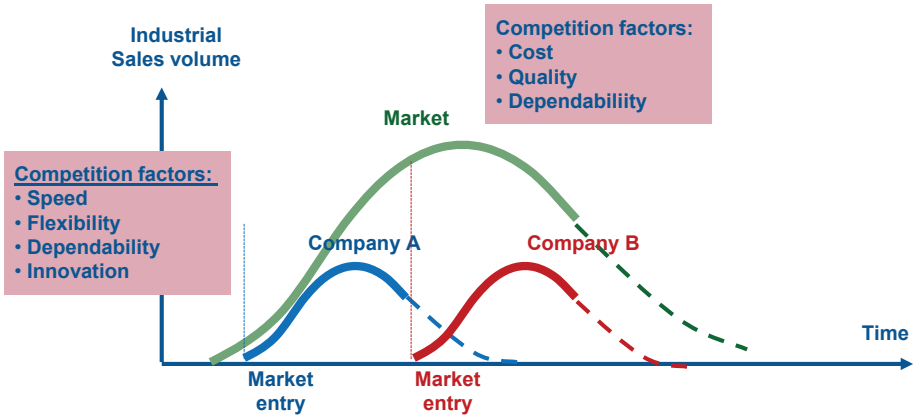
- How mature are the products in your product portfolio?
- The performance objectives are different depending on what life cycle phase the products in our portfolio are in.
- Same product can be in different life cycle phase phase depending on market.
- The products are not always produced in the same production system or at the same site during the whole life cycle.

Understanding the product life cycle's impact on production performance requirements guides production development!



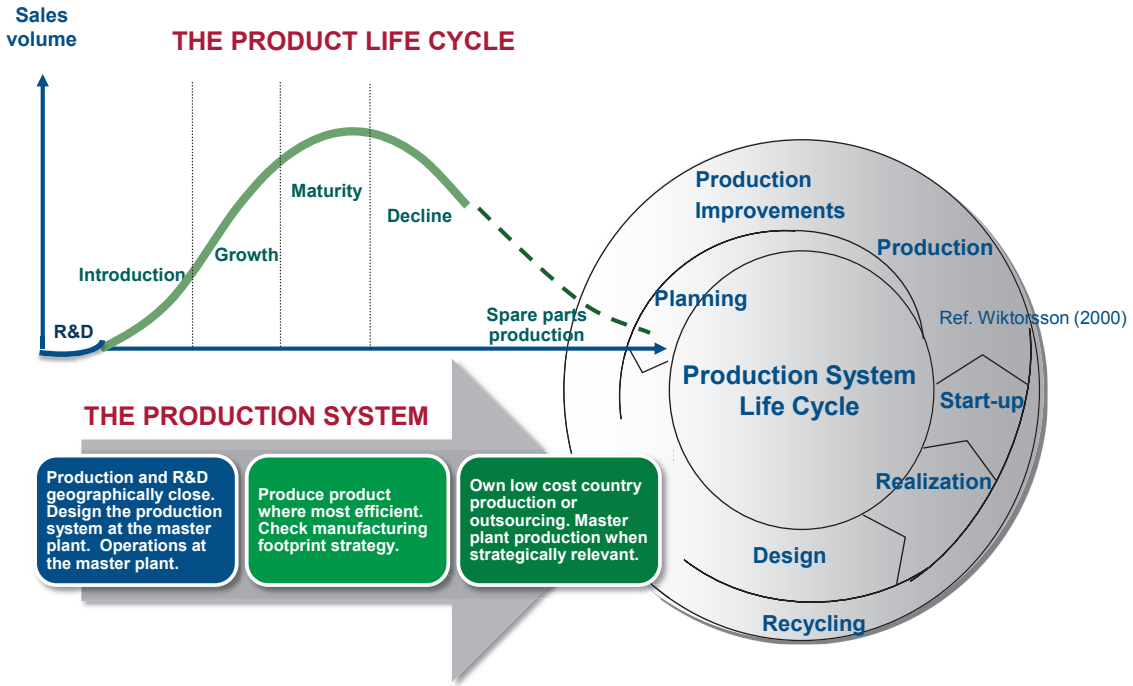
Production requirements vs life cycle phase

Production requirements are affected by the gap between the product life cycle phase and the market life cycle phase



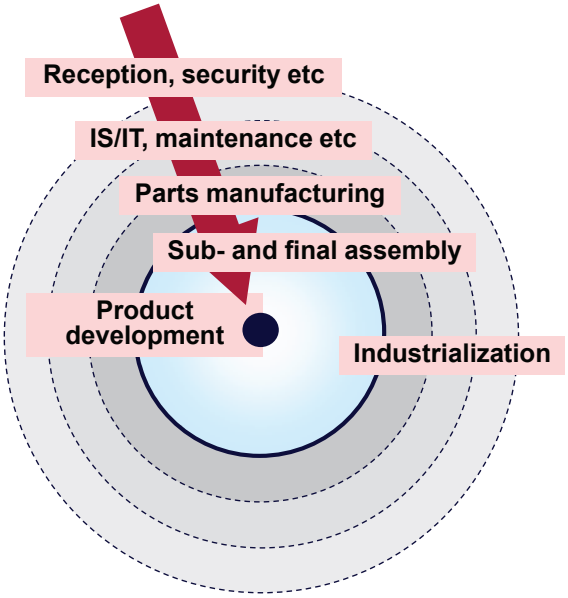
Production start-up on a mature market. Tough requirements on productivity and QDC

How and where to produce depending on the product life cycle



Outsourcing closer to the core

- **Increased focus on core business**
- **Outsourcing as a means for rationalization and specialization**
  - **Risk 1.** Not well-defined core components and core competence
  - **Risk 2.** Unpredictable consequences of outsourcing (short & long term)
  - **Risk 3.** Loss of own intellectual capital. Outsourcing partner becomes competitor.
  - **Risk 4**. Reduced control of leadtime



Competitive manufacturing footprint?

A manufacturing footprint is a consequence of the company's history and current strategy, but could also be:

- **Structural driven:** by growth or consolidation
- **Cost driven:** But labour and material cost is too focused, many hidden costs
- **Market driven:** Following customers' new location and/or new market growth potential
- **Driven by the location of R&D**
- **Driven by a risk strategy to handle** changing global/local demand, trade regulations, currency exchange rates or varying capacity costs
- **Driven by social and environmental concerns – driver of growing interest?**

PRODUCTION LOCATION HANDBOOK

Build the factory…

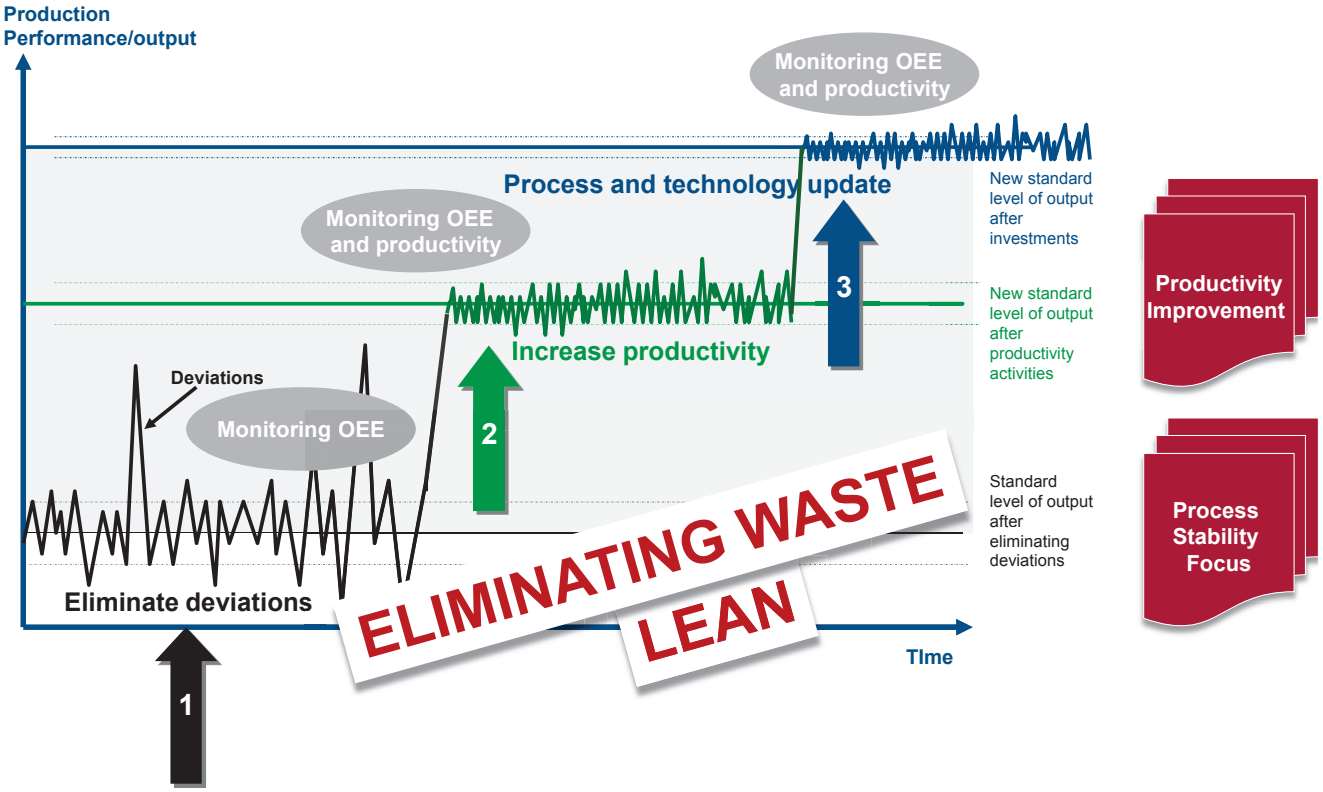
Industrialize new products…

Run the factory…

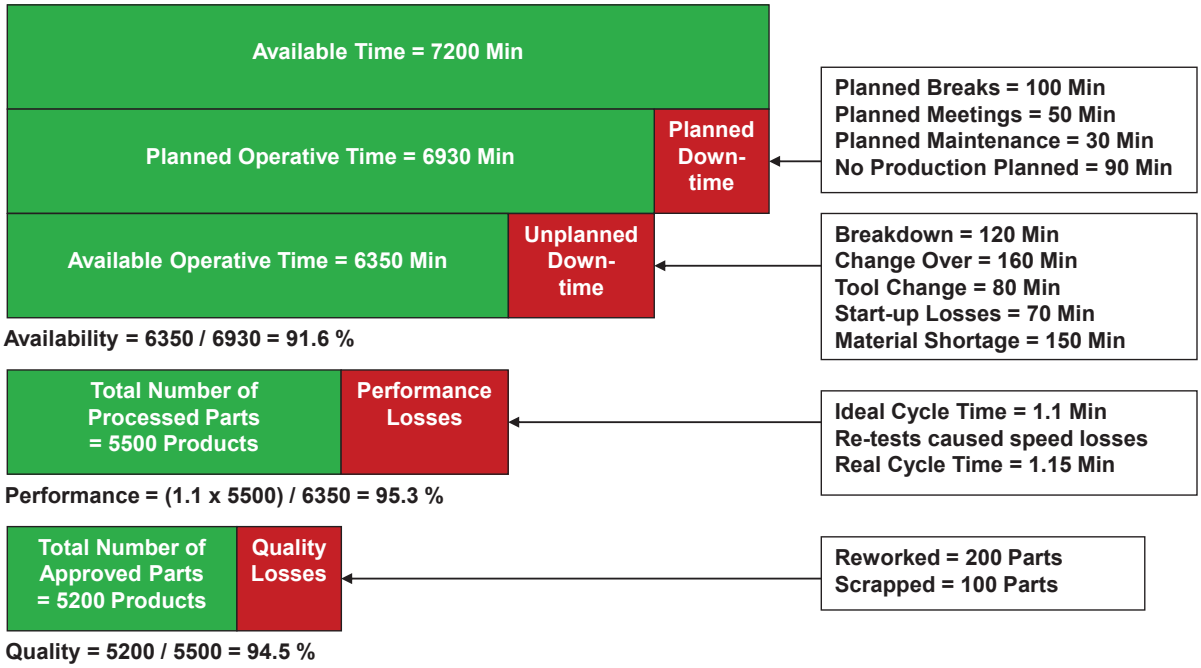
Challenge: High demands on operation's performance

Stable processes is the foundation for resource efficiency

Process stability and productivity – towards resource efficiency



Classic example



OEE = 91.6 % x 95.3 % x 94.5 % = **82.5 %**

World class: OEE 85 – 92 %

TPS or Lean Production
– Ongoing industrial implementation

Visual implementation

Another programme of the year in the manufacturing industry?

or

Cultural implementation

The best way and concept for producing products according to today's global knowledge

1990's → **Trend** → today

The Next Production System Paradigm?

The third paradigm

3 The new Production System

Agile

Bionic

Holonic

Uddevalla

Taking the Lead

World-Class

Competitiveness

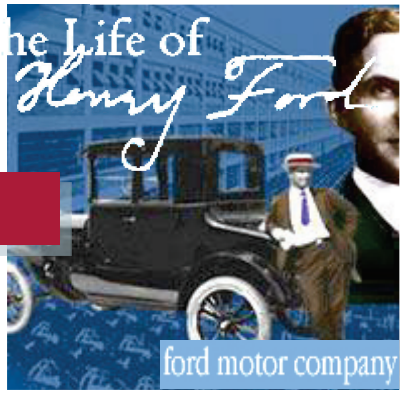
?

The second paradigm

2 The Toyota Production System

The first paradigm

1 The Ford Production System



Swedish production – our competitive means

What do Sweden compete with?

- Overall: Political stability, infrastructure, weather stabile region, high average educational level…
- Industrial structures – accumulated knowledge and experience
- Strong national value of chain across industries (customers – suppliers in Sweden)
- Non-hierachical organizations
- Advanced production systems
- Independent employees, high co-operation abilities
- Flexibility
- Customer-adapted products

What challenges do we face right now?

- General cost level is still high
- Lean transformation with aSwedish accent – still challenging
- Need for flexible working schedules and appointments (blue/white colors) – dynamic workforce
- Need for Union and HR involvement
- Creation of an innovative climate to facilitate stretched goals – towards the learning factory
- The crisis 2008 created a sense of urgency relative the global competition perspective, especially in the vehicle business

Ref: IVA (2006) – process industry

The Next Production System Paradigm = GREEN ?

The third paradigm

3 The new Production System

Unique
Innovative
Resource efficient
Integrated

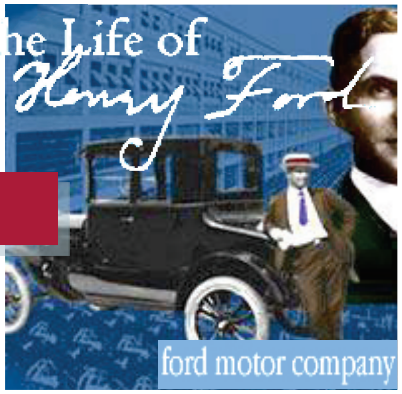
Uddevalla
Agile

Bionic

Holonic

The second paradigm

2 The Toyota Production System



The first paradigm

1 The Ford Production System

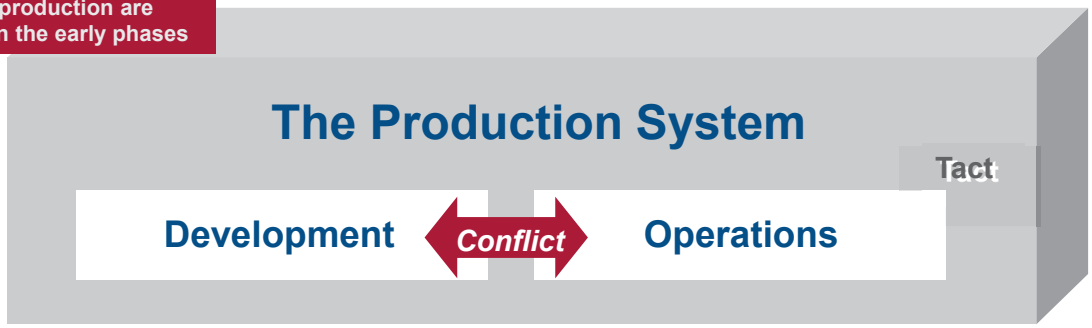
Build the factory…

Industrialize new products…

Run the factory…

The Built-in Conflict Between Development and Operations

Many problems and much waste in production are created in the early phases



Development Output:

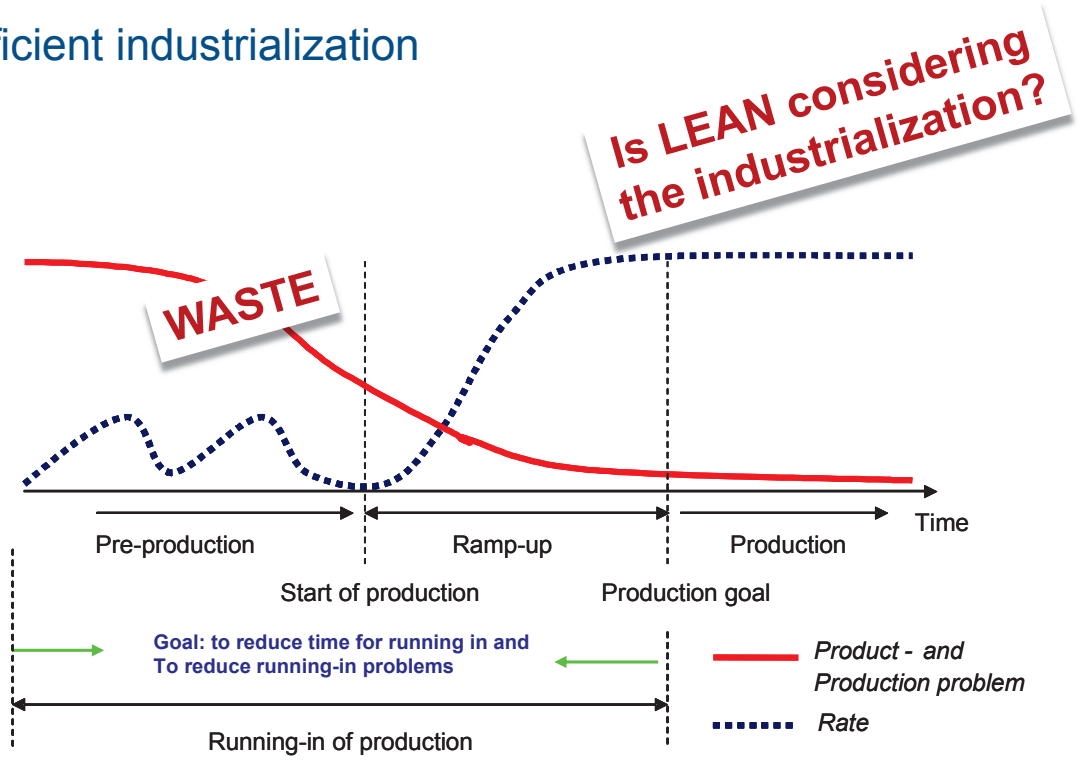
- Output: Modified or new production system
- Priority No.2

Operations Output:

- Output: Products
- Shows the result of the development phase
- Always Priority No.1

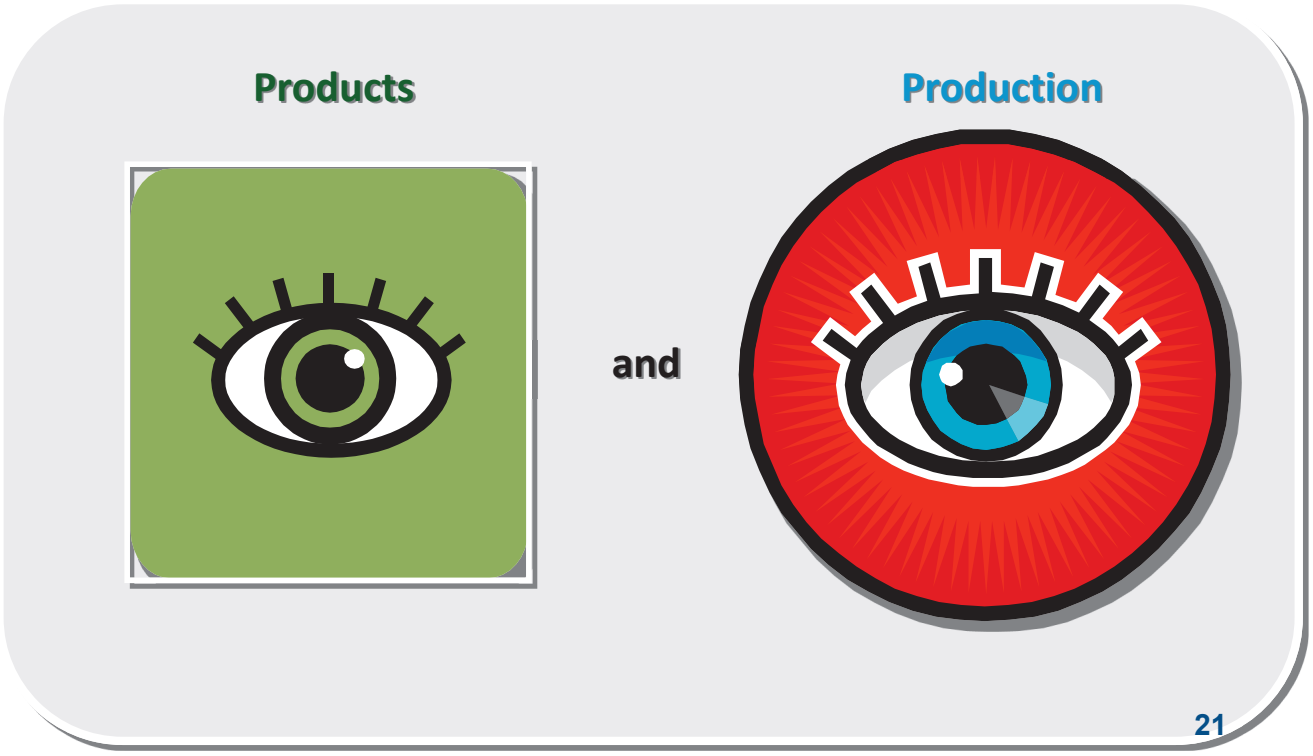
FOR TOMORROW'S SUCCESS:
Strong Management is required to keep speed and focus on the development activities balancing the heavy demands on operations at the same time (TPS → tact and gemba focus)

Efficient industrialization



Ref. Bellgran and Säfsten (2005) modified from Johansson and Karlsson, 1998

Combining perspective



Industrialization …

With the product EYE on…

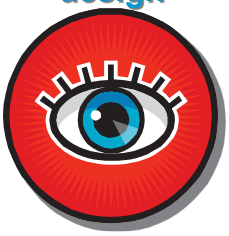
- Reduce product complexity
- Manufacturability (DFMA)
- Configuration: modularity etc
- Reduce number of variants
- Tolerance setting
- PPAP, PFMEA
- Build prototypes
- Prepare for pre-series

Product design

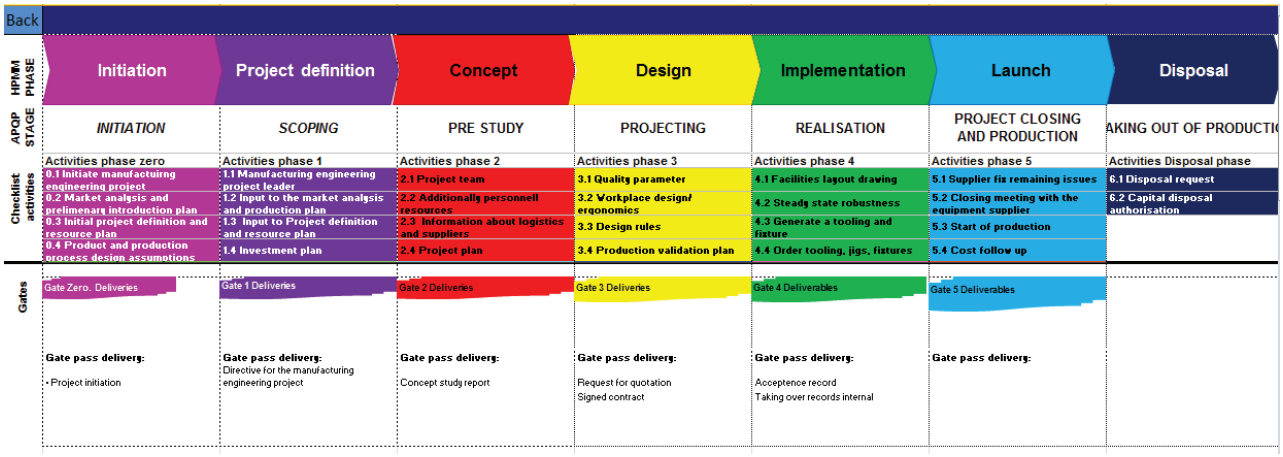
With the production system EYE on…

- Design of a new production system, or change of existing one
- Holistic view: consider material, logistics, people, organization, technical system
- Buy or build equipment and machines
- Choose automation degree
- Make/buy: sourcing
- Footprint decision
- Development of new production technology

Production System design



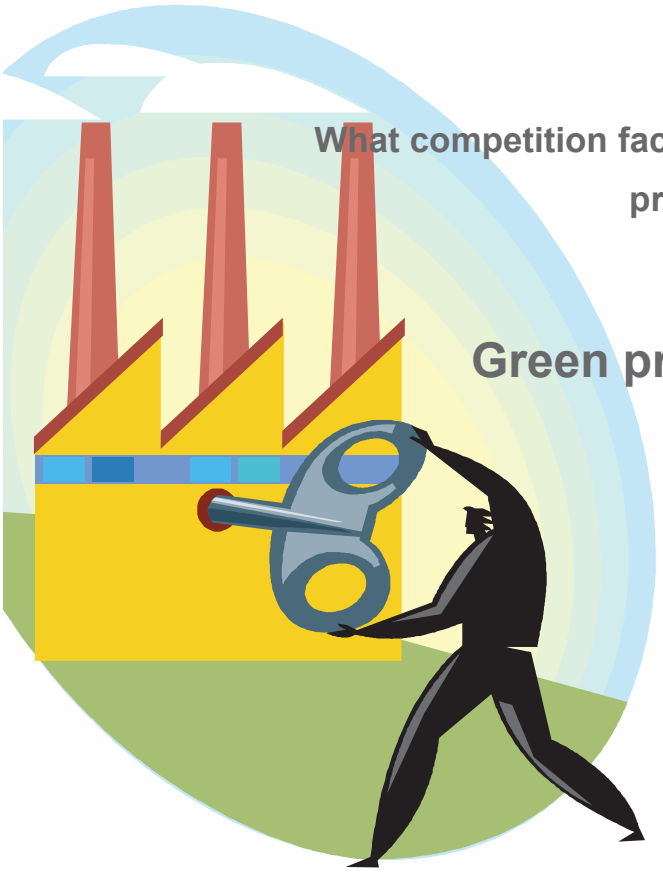
Supporting industrialization – towards resource efficient start-up and operations



Jessica Bruch, 2012

Competing on time to volume

TTT = Time To Technology (time for conceptual development)
TTM = Time To Market (time for introducing new product generations or variants)
TTV = Time To Volume (time for ramp-up to full volume)
TTC= Time to Customer (order processing time)
…Time to Cash



What competition factors do we have to work with to make production a **competitive mean?**

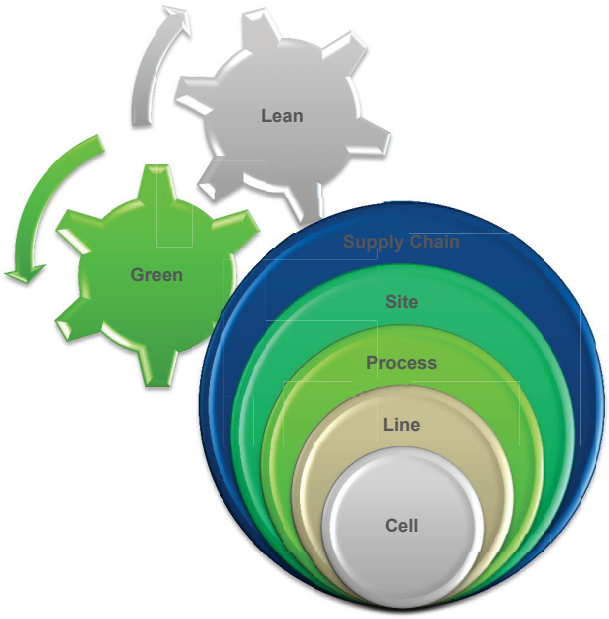
Green production systems contributing to

- reducing **cost**
- adding **value**

→ New business **opportunities**

Research project initiated by Haldex

Green Production Systems



VINNOVA

Green Production Systems
- Inriktning och partners

- **Minska miljöbelastningen från produktion i driftsfasen**
- **Ansats: Miljö reducerar kostnad och adderar värde**
- **Fyra arbetspaket:**
  - **WP1: Kunskapsutveckling; definition av GPS koncept**
  - **WP2: Visualisering**
  - **WP3: Mätning och styrning**
  - **WP4: Metodutveckling**
- **Involvera alla i produktionen i miljöförbättringsarbetet**
- **Integrera ”green” med infrastruktur för ”lean”**

Initiative for excellence in production research

FFI Projekt (2009-2012)

Green Production Systems

- Kunskap om **miljöförbättringsarbete** i *Operations*
- En **Lic** examen (idag produktionstekniker Scania)
- Vetenskapliga **publikationer**
- **Nätverk** skapat inom grön produktion
- Utveckling av **området**: FFI syster projekt och start på uppbyggnad av nytt område på MDH
- Industriellt användbara **metoder**
- GPM **handbok**
- **Affärsmodell** för GPM – första uppdrag sålt
- Påbörjad ansökan om **GPS II**

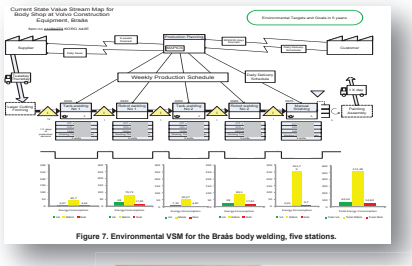
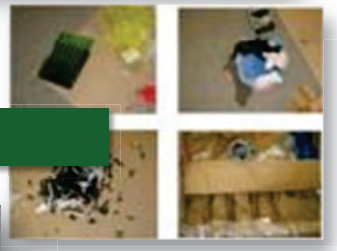
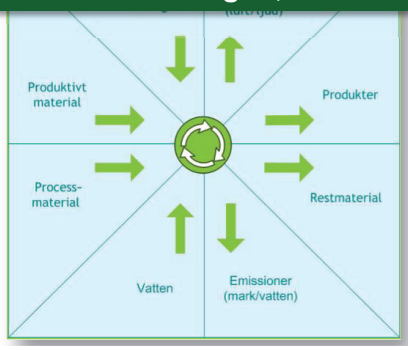
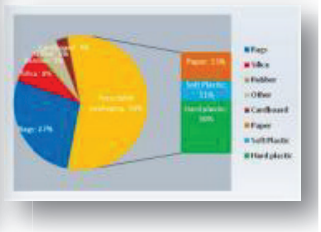


Figure 7. Environmental VSM for the Bråås body welding, five stations.



FFI investering: 2,75 MSEK (budget 6,4 MSEK)





Green performance map

A challenge to industry

To increase the awareness and actions in order to reduce the environmental impact from production operations

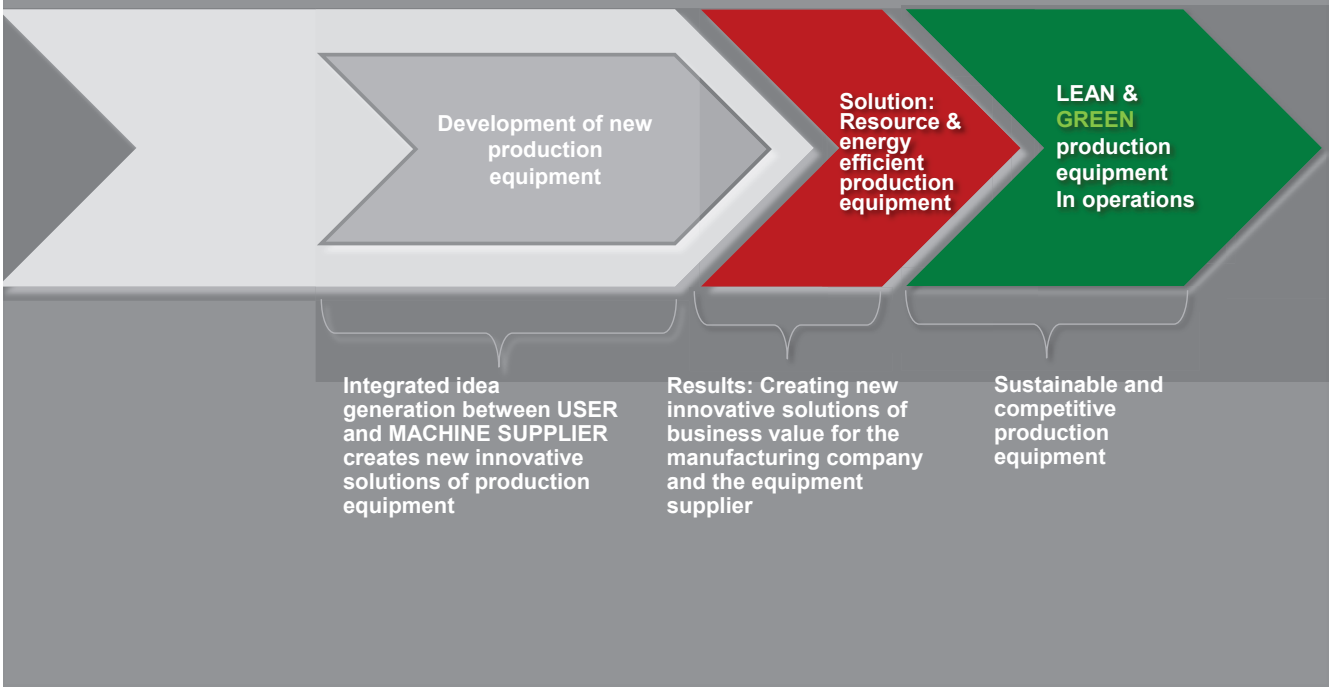
Engage all employees – important for both lean and green

- **Engage all in environmental improvements.**
- **Measure and follow up – use relevant KPI's.**
- **Identify "double KPI's": performance and green**

From reactive to proactive

Put tough environmental requirements on the design and purchase of new LEAN and GREEN production equipment

Designing/redesigning lean & green production equipment



The role of Production Engineering is underestimated

….important both for LEAN & GREEN

OPERATIONS

1. Support & improvements of existing production
2. Industrialization of new products
3. Development of Production Systems & Production Technology

When strong enough:
PE owns the factory production principles

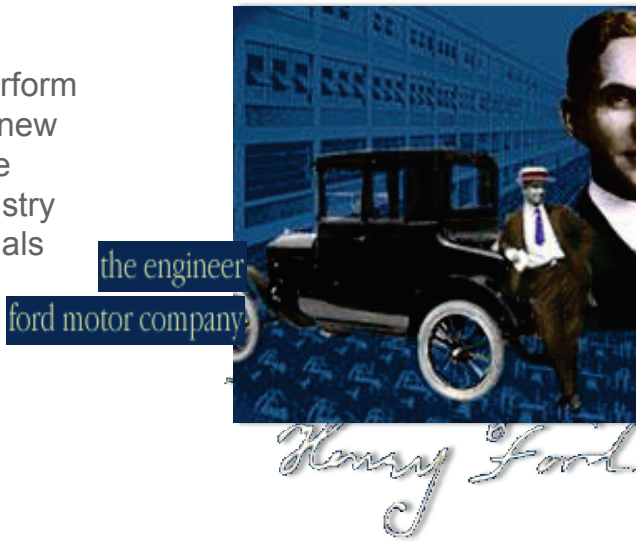
4

Investments:
- Replacement
- Capacity
- Product related
- Environmental

FORD's production development

- Ford had employed 10 – 20 talented mechanics for production engineering (who still didn't have developed established ways to do things)
- Ford allowed extensive experimentation at the production site.
- Ford encouraged the group to perform production experiments and test new methods for measurement, fixture design, tools manufacturing, industry design, quality control and materials planning.
- The production engineers used the best from different production approaches and added new solutions.

WOLLERING
FLANDERS
MARTIN
SORENSEN



Production Engineering at Toyota

Central PE
Project centric*

About Toyota:
"Production Engineering is still as big and powerful as ever."
Liker (2006)

Approximate size

- **3-5% of factory operators**

Responsibilities

- Define the overall production principles
  - Mandate to ensure that VS PE midi/micro design in line with production principles
- Master factory layout (macro level) on a long term (value stream machine allocation arbitrage)
- Support to larger projects
- Own technology roadmap
- Run new machine investment projects (planning and supplier contacts)
- Coordinate development with R&D
- Retain non sharable expertise (I&T PLC tools, …)

Value Stream PE
(reporting to VS)
Improvement centric

- **1-3% of value stream operators**
- **Temporary crew add-on for special projects such as vehicle launch (up to 25 best team leaders in assy department – 500 FTE)**

- Design, maintain and improve the midi and micro design of cells (continuously and with new machine investments) according to production principles
- Run day-to-day continuous improvements
- Troubleshoot and train floor people in troubleshooting
- Share knowledge, work and problem solve on daily basis with quality, maintenance team mates.
- Use special temporary crew for special projects such manufacturing industrialization of a new car

Ref: McKinsey (2007)

Toyota benchmark –

Reference to No of Production Engineers and Production Developers at Toyota

- **3-5 % of factory operators – Production Developers**
- **1-3 % of value stream operators – Production Engineers**

- **Estimated No PE and PD for a company of 500 blue collar:**
  - 500 factory operators (including all blue collar) → 15-25 PD
  - Of them: 400 value stream operators → 4-12 PE
  - Total Production Engineering Staff: **19 – 37 PD + PE**

- **Factors affecting the number of PE and PD:**
  - Size of company
  - OEM or supplier
  - Business: assembly and/or machining
  - Product complexity and production volume
  - Production complexity
  - Management mindset

Everything is really about individuals and the creation of attractive environment for the "right" individuals

…so also in the production engineering field!

Conclusion

- Resource efficiency - is lean – is green
- Lean and green fits
- OEE = excellent green measure
- Involve all – use tools to include environmental improvements in the Kaizen work
- Sometimes you need to increase speed of change = Kaikaku
- Classic production development work is underestimated as a means for improving resource and energy efficiency
- Go from reactive to proactive; move towards the design phase of both products, production systems and comprising equipment

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