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.

Competition factors:
- Cost
- Quality
- Dependability

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

How and where to produce depending on the product life cycle

THE PRODUCT LIFE CYCLE

THE PRODUCTION SYSTEM

Production and R&D geographically close. Design the production system at the master plant. Operations at the master plant.

Produce product where most efficient. Check manufacturing footprint strategy.

Own low cost country production or outsourcing. Master plant production when strategically relevant.
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 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?**
Build the factory…

Industrialize new products…

Run the factory…
Challenge: High demands on operation's performance

Stable processes is the foundation for resource efficiency

- Develop and use standards
- Discipline in mindset & behaviour
- Use Lean tools and Poka-yoke
- Focus on eliminating deviations & waste
- Performance & deviations monitoring
- Stable processes

Discipline in mindset & behaviour

- Increase productivity
- New standard level of output after investments
- New standard level of output after productivity activities
- Standard level of output after eliminating deviations

Process stability and productivity – towards resource efficiency

ELIMINATING WASTE

LEAN
Classic example

Available Time = 7200 Min
Planned Breaks = 100 Min
Planned Meetings = 50 Min
No Production Planned = 90 Min

Planned Operative Time = 6930 Min
Planned Maintenance = 30 Min

Available Operative Time = 6350 Min
Breakdown = 120 Min
Change Over = 160 Min
Tool Change = 80 Min
Start-up Losses = 70 Min
Material Shortage = 150 Min

Unplanned Down-time

Total Number of Processed Parts = 5500 Products
Performance = (1.1 x 5500) / 6350 = 95.3 %

Total Number of Approved Parts = 5200 Products
Quality = 5200 / 5500 = 94.5 %

Performance Losses
Quality Losses

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?

1990’s

Trend

Cultural implementation

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

or

today
The Next Production System Paradigm?

1 The Ford Production System

2 The Toyota Production System

3 The new Production System

The first paradigm

The second paradigm

The third paradigm

Taking the Lead

World Class

Competitiveness

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

Ref: IVA (2006) – process industry

What challenges do we face right now?
- General cost level is still high
- Lean transformation with a Swedish 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

Swedish production – our competitive means
The Next Production System Paradigm = **GREEN**

1. **The Ford Production System**
   - Uddevalla
   - Agile

2. **The Toyota Production System**
   - Bionic
   - Holonic

3. **The new Production System**
   - Unique
   - Innovative
   - Resource efficient
   - Integrated

**The first paradigm**

**The second paradigm**

**The third paradigm**

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**Build the factory...**

**Industrialize new products...**

**Run the factory...**
The Built-in Conflict Between Development and Operations

The Production System

Development

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

Operations

- 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

Is LEAN considering the industrialization?

Goal: to reduce time for running in and To reduce running-in problems

Combining perspective

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

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

Industrialization …
Supporting industrialization – towards resource efficient start-up and operations

Jessica Bruch, 2012

| Time to Technology (time for conceptual development) |
| Time to Market (time for introducing new product generations or variants) |
| Time to Volume (time for ramp-up to full volume) |
| 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**
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”

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

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

Development of new production equipment

Integrated idea generation between USER and MACHINE SUPPLIER creates new innovative solutions of production equipment

Results: Creating new innovative solutions of business value for the manufacturing company and the equipment supplier

Solution: Resource & energy efficient production equipment

LEAN & GREEN production equipment In operations

Sustainable and competitive production equipment

Investments:
- Replacement
- Capacity
- Product related
- Environmental

When strong enough: PE owns the factory production principles

The role of Production Engineering is underestimated

important both for LEAN & GREEN

1. Support & improvements of existing production

2. Industrialization of new products

3. Development of Production Systems & Production Technology

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.

Production Engineering at Toyota

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<tr>
<th>Approximate size</th>
<th>Responsibilities</th>
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<tr>
<td>Central PE Project centric</td>
<td>• Define the overall production principles</td>
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<td>• Mandate to ensure that VS PE midi/micro design in line with production principles</td>
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<td>• Master factory layout (macro level) on a long term (value stream machine allocation arbitrage)</td>
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<td>• Support to larger projects</td>
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<td>• Own technology roadmap</td>
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<td>• Run new machine investment projects (planning and supplier contacts)</td>
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<td>• Coordinate development with R&amp;D</td>
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<td></td>
<td>• Retain non sharable expertise (I&amp;T PLC tools, …)</td>
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<tr>
<td>Value Stream PE (reporting to VS)</td>
<td>• Design, maintain and improve the midi and micro design of cells (continuously and with new machine investments) according to production principles</td>
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<td>Improvement centric</td>
<td>• Run day-to-day continuous improvements</td>
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<td>• Troubleshoot and train floor people in troubleshooting</td>
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<td>• Share knowledge, work and problem solve on daily basis with quality, maintenance team mates</td>
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<td>• Use special temporary crew for special projects such as manufacturing industrialization of a new car</td>
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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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