Flexibility Oriented Production Systems
Concept for Small and Medium Sized Enterprises

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Outline

- Introduction
- Flexibility Oriented Production System
- Suitability for SMEs and Validation
- Conclusions
A Production System shows the right way to achieve goals in terms of increasing the performance, the quality, the profitability and the customer satisfaction.

Origin of Production Systems - Toyota

Highest quality, lowest cost, shortest lead time by eliminating wasted time and activity

Just in Time (JIT)
- Takt Time
- One-piece flow
- Pull-system
- Kanban

Kaizen
(Culture of Continuous Improvement)

Jidoka
- Manual or automatic line stop
- Error-proofing
- Visual Control

Stability

Standardization
Western Production Systems

<table>
<thead>
<tr>
<th>Production-strategies</th>
<th>Total Quality</th>
<th>Just-in-Time</th>
<th>Asset-Light</th>
<th>Flexibility &amp; Agility</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design-guidelines</td>
<td>Standardization</td>
<td>Synergy</td>
<td>Transparency</td>
<td>Individual responsibility</td>
<td>Consistency</td>
</tr>
<tr>
<td>Subsystems</td>
<td>Flow of material system</td>
<td>Processing system</td>
<td>Personnel system</td>
<td>Planing and controlling system</td>
<td>Quality system</td>
</tr>
<tr>
<td>Methods &amp; Tools</td>
<td>System analysis</td>
<td>Requirement profil</td>
<td>System configuration</td>
<td>System implementation</td>
<td>Control &amp; Sustainability</td>
</tr>
</tbody>
</table>

Examples of Production systems

First ones in western countries: the large automotive groups and other Original Equipment Manufacturers (OEM):

- Achievement of high profitability
- Expanding to further industrial sectors and their suppliers
- Process oriented Production Systems are gaining significance among small and medium sized enterprises
SME's flexibility Requirements

- Costumer oriented
- Low market power
- Grown structures
- Flatt hierarchy types
- Specialized products
- Small and medium sized enterprises
- Strongly worker oriented
- Little Process standardization
- Suppliers
- Customers

Goal Definition FlexPro 2010

Taking into account specific SMEs' requirements: company size, resources, flexibility requirements, single unit or small batch production, costumer relevant order processing...
Introduction

Flexibility Oriented Production System

Suitability for SMEs and Validation

Conclusions

Background information

- Existing approaches for implementing process oriented production systems must be adapted and redefined according to SMEs’ specific flexibility requirements.

- Flexibility Oriented Production Systems for SMEs –FlexPro 2010– is a joint research project where developing, implementing and validating such a concept is the main goal.
Steps Taken (1/2)

- Enterprise specific analysis of the existing problems
- Analysis of the worker's skills and their tasks
- Definition of reference processes

Steps Taken (2/2)

- Finding out the potential areas to be improved
- Identifying "typical wastes" along the order processing

- Making sure to be able to handle future flexibility requirements
- Modularization of the production system’s elements
### Concept Overview

#### Methods
- Product oriented Layout
- PPS Methods
- Value stream
- FMEA
- TPM
- Quality Circuit
- Info-Integration
- Duties & Skills
- Group Work
- Pay Programm
- Process standards
- Visualization
- Order/ Tidiness
- CIP
- Problem Solving
- Process Sampling

#### Category Groups
- Flow of Materials & Logistics
- Robust Processes
- Work Organization
- Standardization & Visual Management

#### Elements
- Flexibility Achievement
- Goal Definition
- Standards of Methods
- Evaluation of Qualification

#### Prerequisites
- Monitoring
- Implementation Strategy
- Project Management
- Motivation and Guidance

### 3D Concept Alignment

#### Elements
- Evaluation of Qualification
- Standards of Methods
- Goal Definition
- Flexibility Achievement

#### Category Groups / Methods
- Work Organization
- Group Work

#### Prerequisites
- Motivation & Guidance
- Project Management
- Implementation Strategy
- Monitoring
Degree of Maturity:

- Not fulfilled: 0% - 15%
- Partially fulfilled: 16% - 50%
- Mostly fulfilled: 51% - 85%
- Completely fulfilled: 85% - 100%

(based on the ISO 15504)

Evaluation tool

Flexibility achievement

Schritt 1: Initial Evaluation

Schritt 2: Definition and priorization of goals

Implementation in the partner enterprises

Schritt 3: Flexibility Analysis

Schritt 4: Definition of improvement measures

Schritt 5: Implementation
Goal definition

1. Definition of the long term goals
2. Discrete weighing of the long term goals and an arrangement in order of priority
3. Deriving of the operative “flexibility goals”

Procedure: Goal definition (1/2)

1. Definition of the long term goals
   - Long term goals (Examples):
     - International Expansion (USA)
     - Duplicating the capacity
     - Delivery date accuracy >95%

   Prio 1: Delivery date accuracy >95%
   Prio 2: Duplicating the capacity
   Prio 3: International Expansion (USA)

2. Weighing and arrangement in order of priority
   - Flexibility related?
     - no
     - yes

   Deriving the strategy: Flexibility oriented strategy
3. Deriving of the operative “flexibility goals”

Translating long term goals into operative flexibility goals: (in Workshops)

Current flexibility status disclosure

○ = 0  ● = 1  ▼ = 2  ▼ = 3  ● = 4

“Flexibility transformer”

Flexibility type

Flexibility index

Overflexibility

Upper Limit

Current status

Underflexibility

Lower Limit

Flexibility Visualization (1/2)
Flexibility scorecard

Example: Worker flexibility

<table>
<thead>
<tr>
<th>Goals</th>
<th>Achieving the flexibility types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities</td>
<td>Filling out the flexibility scorecard</td>
</tr>
<tr>
<td></td>
<td>On a regular basis (e.g. quarterly)</td>
</tr>
<tr>
<td></td>
<td>Calculating of the status and defining the upper and lower limit</td>
</tr>
<tr>
<td>Visualization</td>
<td>Transferring these values to the diagram</td>
</tr>
<tr>
<td>Results</td>
<td>Diagram good for decision making and in order to follow the flexibility types in time</td>
</tr>
</tbody>
</table>

Flexibility scorecard

Standards of methods – flexibility type

Method’s sorting matrix for the flexibility types

<table>
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<tr>
<th>Product flexibility</th>
<th>Lot size flexibility</th>
<th>Worker flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use</td>
<td>Cost of implementation</td>
<td>Use</td>
</tr>
<tr>
<td>CIP-Workshops</td>
<td><img src="image1" alt="Diagram" /></td>
<td>Duties &amp; Skills</td>
</tr>
<tr>
<td>Pay Programm</td>
<td><img src="image3" alt="Diagram" /></td>
<td>Visualization</td>
</tr>
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</table>

= 0

= 1

= 2

= 3

= 4
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SME – „FlexPro meaning“

See (the needs)…

…Master (the challenges)…

…Earn (the benefits)!

Flexibility oriented…

- Flexibel and problem oriented
- Modular an combinable
- Specifically adaptable to the needs of the enterprise

…production system…

- All areas of manufacturing are taken into account
- Method networking
- Efficient production with waste minimization

…for SMEs

- Easy (simple scales, standard software, Checklists)
- Limited to key methods
- Cost related

Validation overview

<table>
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<tr>
<th>Work organization</th>
<th>Continuous improvement</th>
<th>Standardization Visual Management</th>
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<td>Flow of materials &amp; Logistics</td>
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**Implementation Examples (1/5)**

- **Standardization Visual Management**
- Visualizing quality standards
- Indications on the floor
- Live Visualization of machine data

**Implementation Examples (2/5)**

- **Work organization**
- Team specific key performance figures
- Concept for a performance oriented remuneration program
Implementation Examples (3/5)

Continuous improvement

Signalization of the correct pedal use

Definition of the correct piece orientation

Implementation Examples (4/5)

Flow of materials & Logistics

Reducing stock of inventory through a value stream design

Developing and implementing a concept for optimizing a site overlapping production control system
Evaluation overview

- Increasing production capacities between 10% and 20%
- Reducing stock of inventory between 15% and 25%
- Achieving higher machine availabilities around 15%
- Decreasing the throughput time about 10%
- Reducing logistics related costs between 10% and 25%
- Improving delivery date accuracy up to 97%
Conclusions

- Process oriented production systems have been introduced.

- An approach to implement an enterprise specific flexibility oriented production system has been presented.

- Methods, tools and procedures have been crosschecked regarding simplicity, clearness and usability, in order to provide an SMEs’ specific approach.

- Examples of how the proposed concept can be implemented and some of subsequently achieved results, have been described.