Systematic redesign of manufacturing systems for aerospace

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Johan Vallhagen, 2016-10-12
These results are part of an ongoing project

“Methodology for Visual Production Development”

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Agenda

1. Background and introduction to the research
2. Examples of case studies and learnings
3. A systematic method for using visualisation
4. Lessons Learned
"Greenfield" … (very few opportunities)
Brownfield … (more often)
Production changes … (most common)

Update the production system:
- Replace old machines
- Introduce a new process
- Start up of a new product
- Add capacity

... or make improvements:
- Logistics & material handling
- Production planning & execution
- Quality …
Idea and vision …

Tools easy to learn and use

- Games
- Google Earth

- Lean Production principles
  - ”Go to Gemba”

Develop a system that let us
”Go to the future Gemba”
Scientific approach

Mental models of production systems

Virtual representations of production systems

Real production systems
3D laser scanning – how does it work?

Surface of object

Laser

Mirror

Pulse Track

Fig. 5

Laser Diode

Receiver
Scan data (point cloud)
Why 3D laser scanning and Point Clouds?

Need for virtual representation
- Accurate and realistic
- Can be created in short time

Inaccurate factory documentation
- Blueprints, CAD models etc. are often not updated
- Does not include production material

As-build factory representation
- Capture the current state in the factory
- It shows the actual production environment
Examples from case studies

We have learned step by step
Moving old and installing new equipment
Clooning a cell and modify the workshop
Value Stream Mapp, ”7-flows” of production and the block layout defines the Production System
First visualization of the system
Workshops with visualisation

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Focus area</th>
<th>Aim</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Product and Process</td>
<td>Ensure that all value stream functions are included in the system.</td>
</tr>
<tr>
<td>2</td>
<td>Installation and Maintenance</td>
<td>Eliminate installation problems and ensure maintenance requirements and abilities.</td>
</tr>
<tr>
<td>3</td>
<td>Production sequence</td>
<td>Ensure an efficient workplace and safe and healthy conditions.</td>
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</tbody>
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Worskhop set-up

Documentation:
• 7-flows of production
• Specifications, drawings, etc.
• Document: risks, problems, etc
• …
## Identified problems and risks

<table>
<thead>
<tr>
<th>7-flows category</th>
<th>Problems and risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>4, 5</td>
<td>The counter for tool changes is too high up on the machining center, a platform needs to be build.</td>
</tr>
<tr>
<td>1, 2, 4</td>
<td>The planned walkway is too narrow, equipment and material should not be placed too close to the walkway.</td>
</tr>
<tr>
<td>1, 2, 5</td>
<td>The cranes supporting each machining center were placed too close to a wall, causing problems with transporting materials in between.</td>
</tr>
<tr>
<td>2, 4, 5</td>
<td>The door entrance door was located too close to one of the machining centers, which can cause temperature problems in the machining center during winter season.</td>
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<tr>
<td>5, 6, 7</td>
<td>The comparison between the scan data and 2D CAD layout showed that walls and pillars in the building were positioned at the correct location. However, other parts were missing from the 2D CAD layout such as the ventilation system.</td>
</tr>
</tbody>
</table>
The resulting work method
Conclusions

- 3D laser scanning an important technology for supporting the redesign process of production systems
- Benefits drive from the accurate and realistic point clouds of the existing shop floors
- Verify the planned layouts before implement
- Reduce the necessary time for planning and discussions, and the risk for costly design errors
- 3D visualisations easier to understand
- A structured method of working with the technology during redesign projects is necessary