Methodologies for Innovation in industrial environment: an example of Eco-sustainable solutions design

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Body Welding
AGENDA

- COMAU at a glance
- Automation Drivers
- Manufacturing systems Evolution
- EMC2-Factory: an example of Eco-sustainable solutions design
- Project Overview
- Project Approach: the Methodology
- Project Application in Body Welding Environment
- Conclusions
COMAU MISSION

COMAU is a leading GLOBAL provider of advanced manufacturing systems, INNOVATIVE sustainable automation and service solutions.
COMAU STRATEGY

SOLUTION ORIENTED
- The best automation competence across a wide range of key technologies
- Fully integrated capability in product, process and service solutions

GLOBAL
- 25 operative centers located in 15 countries, led by global processes
- 70% resources in BRIC countries
- Global project management based on PMI® standards, customized for local market needs and cultures

INNOVATIVE
- High density automation cells to hone and optimize investments
- Energy saving products and service solutions
- Lean production approach
GLOBAL AUTOMATION DRIVERS

• New production technologies facilitate the introduction of technological innovations in consumer goods and services, that are key to achieving sustainable new products at affordable costs

• Industry global automation trends in manufacturing systems are characterized by the following drivers:

  – FLEXIBLE & SCALABLE MANUFACTURING SYSTEMS
  – LOW COST MANUFACTURING SYSTEMS
  – MATERIALS AND ENERGY CONSUMPTION REDUCTION
  – NEW MATERIALS
  – LEAN MANUFACTURING CONCEPT
Depending from the different **REGIONS** where the manufacturing industries are located, the development of new manufacturing systems are driven by the application of a low-cost per unit strategy balancing quality, cost effective automation technologies and personnel-energy-logistic costs.
MANUFACTURING SYSTEMS & GLOBAL AUTOMATION

MANUFACTURING SYSTEMS  
FACTORS

ENVIRONMENTAL SUSTAINABILITY

SOCIALLY SUSTAINABLE

PRODUCTION COMPETITIVENESS

GLOBAL AUTOMATION  
DRIVERS

LOW COST MANUFACTURING SYSTEMS

FLOOR SPACE REDUCTION

ENERGY REDUCTION

LEAN MANUFACTURING CONCEPT

FLEXIBLE & SCALABLE MANUFACTURING SYSTEM

NEW MATERIALS
MANUFACTURING SYSTEMS EVOLUTION

- SUSTAINABLE HI-TECH ASSEMBLY SOLUTIONS
- HIGH QUALITY PROCESSES AND PRODUCTS

- ENVIRONMENTAL SUSTAINABILITY
  - Power management strategies
  - Novel actuators and drives
  - Light weight structures

- SOCIAL SUSTAINABILITY
  - Safe and ergonomic solutions for human-equipment interaction
  - Simple interface for human-equipment interaction

- PRODUCTION COMPETITIVENESS
  - High performance solutions
  - High process quality
  - Modular system architecture
  - e-Services
  - Virtual manufacturing

- HIGH FLEXIBILITY & SCALABILITY
- REUSABLE AND EASILY CHANGED OVER
**EMC2 Factory**

**Eco Manufactured Transportation Means from Clean and Competitive Factory**

Grant Agreement no: 285363

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>EMC2-Factory</th>
<th>Eco Manufactured Transportation Means from Clean and Competitive Factory</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUNDING AGENCY</td>
<td>European Commission – FP7-NMP-FoF 2011-1</td>
<td></td>
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<tr>
<td>FUNDING SCHEME</td>
<td>Collaborative Project - Large Scale Project</td>
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<tr>
<td>MAIN OBJECTIVES</td>
<td>Cleaner and more resource-efficient production in the manufacturing of transportation systems</td>
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| PROJECT KEYWORDS | • Sustainable manufacturing  
|                 | • Holistic perspective in efficiency approaches  
|                 | • Manufacturing demonstrators |
| TIMETABLE      | Oct 2011 – Sep 2014 (36 months)                                                                        |
**PROJECT VISION**

“By 2020, European transport sector eco-factories will be able to reduce energy, resource consumption, and emissions by more than 30% per output unit below 1990 levels”

**OVERALL OBJECTIVE**

Enable European manufacturing industries to overachieve Europe 20/20/20 program targets through development of advanced sustainable technologies, methods and tools while enabling industrial applicability and commercial exploitation

**BUSINESS OBJECTIVES**

**SCIENTIFIC AND TECHNOLOGICAL OBJECTIVES**

- Process planning, simulation and optimization methodologies
- Monitoring environmental performance
- Alternative sustainable manufacturing processes
- Intelligent components and control strategies

**CONSENSUS OBJECTIVE**

- Community Building
- Knowledge transfer
- Dissemination / Exploitation
- Standards
Reduction of energy and resource consumption in the European transportation manufacturing

- **Energy and resource efficient process technologies**
  (focus on machining, joining, assembly)
- **Innovative production control systems**
  and efficient **process control devices**
  (e.g. drives, actuators and sensors)
- **New methods and tools for** planning, optimization and life cycle evaluation
  to support the **design and management of eco-factories**
  (e.g. simulation, decision support tools)
- **Provide an holistic perspective**
  moving away from isolated resource efficiency approaches
PROJECT APPROACH

Integrated approach towards machines, tools and building facilities energy efficiency

As-Is Analysis
- Factory visit
- Visualization of production process
- Identification of improvement areas
- Identification of energy wastes

To-Be Design
- Design alternative scenarios
- Production process re-engineering
- Design economic and ecological production flow

Machine / equip. selection
- Drives and actuators
- Machine modeling (simulation)
- Monitoring equipment
- Energy efficient drives…

Layout planning
- Rough/Ideal/Real/Detailed Layout
- Econ. and ecol. layout considering production and building together

Operation
- Continuous improvement
- Optimization of production planning and control
- Definition of green practices…
- No Building
- No Construction

Requirements for Eco-Factory

Decision making tools

Methodologies and tools
BW AUTOMOTIVE PILOT: THE PLANT

Melfi SATA Plant

Jeep Renegade Class B-Suv
Joining Process Optimization

Data Collection & monitoring

Body Welding Systems

Energy Simulation

Welding Line Lightening

Integrated drives and fluidic circuits optimization

BW AUTOMOTIVE PILOT
Independently from the process type and from the panels material used, the Assembly process is driven by 2 main factors:

- To achieve and maintain the **Quality** and **Geometry** of the panels assembly.
- To freeze the Geometry of the assembly obtained through a robust **Joining process**.

The panels flow through the operations is assured by the Material Handling, that along with the type of Tooling used and the technological level of the Joining process define the plant Automation level.
In order to perform all the needed operations the elements have to be:

- taken to and introduced into the line area (\textit{line feeding})
- moved into the tooling to perform the joining operation (\textit{loading}) and taken out from the operation position after the process is completed (\textit{unloading})
- moved from an operating station to the next one or from a line to the next one (\textit{transfer system})

The Part Transfer can be realised by robots or by means of a transfer system.
Theoretical Data Collection
from Electric Design department (Power of Motor, Welder, Elevator)
Guidelines Measurement definition

On-field Measurements
using a suitable Network Analyzer

Data Analysis and Elaboration
for product improvement and validation
DATA COLLECTION & MONITORING

Body side – Versaroll Line
- Compact Welding Gun
- COMAU Smart Robot Lightening
- Compact Cell Configuration “BRIC”
Conventional car production lines employ spot welding for sheet metal joining.

Laser welding was examined as a possible energy efficient replacement.

Energy consumption technology comparison:
- Resistance spot welding
- Laser welding
ENERGY SIMULATION TOOL

1. INPUT DATA

<table>
<thead>
<tr>
<th>Nominal Values</th>
<th>Qty</th>
<th>Operation Time in the Cycle Time [s]</th>
<th>Movements in each cycle</th>
<th>Main Consumption Parameters</th>
<th>Nominal Power [kW]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Versaroll (First floor + Ground Floor)</td>
<td>1</td>
<td>6</td>
<td>2</td>
<td>Motor</td>
<td>1.76</td>
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<tr>
<td>Robot</td>
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<td></td>
<td>3</td>
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<td></td>
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<td>Welding Spot</td>
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<td>2</td>
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<td>6.5</td>
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<tr>
<td>Versatil</td>
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<td>3</td>
<td>6</td>
<td>Motor</td>
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<tr>
<td>Pallet Conveyor</td>
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<tr>
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<td>1</td>
<td>20</td>
<td>Motor</td>
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</tr>
</tbody>
</table>

2. ENERGY/AVAILABILITY CALCULATION

3. OUTPUT ANALYSIS

4. SHOP FLOOR VALIDATION

Tool for Estimation of the Energy Consumption
Manufacturers at the global level will continue to push for new manufacturing systems based on a **low-cost per unit strategy**

Research and innovation for **affordable automation technologies** will represent therefore a **major challenge** to meet growing demand for manufacturing new products balancing **quality** with **personnel/energy/logistics** costs

A new **holistic approach**, viewing manufacturing system as a whole, integrated towards machines, tools and building facilities energy efficiency is required in order to meet this balance for future manufacturing system.

A **methodology** for cleaner and more resource-efficient production in the manufacturing of transportation systems, developed inside the European project **EMC²- Factory**, has been illustrated, along with the application in the Automotive for Body Welding Environment.
THANK YOU FOR YOUR ATTENTION

http://www.emc2-factory.eu/