European Roadmap for Cyber-Physical Systems in Manufacturing

Recommendations & Research Priorities for Cyber-Physical Systems in Manufacturing: sCorPiuS findings

Brussels – Nov, 15th
sCorPiuS investigates the role of CPS as a lever to empower manufacturing performance and proposes the creation of a roadmap capable to preempting the most important technological trends.

The project purpose is to support the planning of the Research and Innovation activities with the involvement of the most important European stakeholders.

The main objective is to perform activities for creating consensus, community building and awareness within the targeted communities of the European Union.

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sCorPiuS - European Roadmap for Cyber-Physical Systems in Manufacturing

Overall Plan

Phase 1
- State of the Art and Knowledge Capture
  - Breakthroughs and Obstacles Clustering

Phase 2
- Draft Vision
  - Breakthroughs and Obstacles sub-Clustering
  - GAP Analysis

Phase 3
- Final Vision
  - Validation Event
  - Research Priorities
  - Draft Roadmap

Phase 4
- Validation Events and Social Surveys

ICT & Technology Recommendations
- Roadmap 1st release
- Roadmap 2nd release

Recommendations

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State of the Art – Knowledge Captured

More than 80 breakthroughs related to CPS implementation in Manufacturing have been identified and grouped in 6 main clusters.

Phase 1:
- State of the Art and Knowledge Capture
- Breakthroughs and Obstacles Clustering

Phase 2:
- New data-driven services and business models
- Data-based improved products
- Closed-loop manufacturing
- Cyberized plant/“Plug & Produce”
- Next step production efficiency
- Digital ergonomics

Phase 4:

Validation Events and Social Surveys

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Phase 3
- Research Priorities

Phase 4
- Workshops and Validation

sCorPiUSS Vision considers CPS on both product and process lifecycle

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The roadmap is composed by **14 Research Priorities** addressing the more relevant areas where adoption of CPS is bringing higher impact.

<table>
<thead>
<tr>
<th>N.</th>
<th>Research Priority</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Predictive and preventive self-learning systems</td>
</tr>
<tr>
<td>2</td>
<td>Caring for People in manufacturing Systems</td>
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<tr>
<td>3</td>
<td>Knowledge and skills for the next generation manufacturing</td>
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<td>4</td>
<td>CPS Enabled reconfiguration of automated manufacturing systems</td>
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<td>5</td>
<td>Novel production management tools and models for CPS-based production</td>
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<tr>
<td>6</td>
<td>Full Product LifeCyle data collecting and analysis</td>
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<td>7</td>
<td>Cyber Native Factories</td>
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<td>8</td>
<td>Digitisation of value networks</td>
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<td>9</td>
<td>Next generation customer driven value networks</td>
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<td>10</td>
<td>Manufacturing as a Service (MaaS) – Servitisation of autonomous and reconfigurable production systems</td>
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<td>11</td>
<td>Customer at the center - from design to disposal</td>
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<td>12</td>
<td>Product Service Systems (PPS): products with embedded service delivery capability</td>
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<tr>
<td>13</td>
<td>European Circular Economy Open Platform for CPS</td>
</tr>
<tr>
<td>14</td>
<td>Material and resource efficiency in manufacturing</td>
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Standards & Rules Recommendations

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<table>
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<tr>
<th>Type</th>
<th>Description</th>
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| Cultural, Educational and Perception  
i.e. “Cultural issues - "Not me first" and readiness of people”, “Stakeholders readiness and attitude”, “Education & cultural gaps inside & outside the plant”, “Underestimation and low trust of CPS possibilities”, “CPS acceptance”. | There is the need to fully involve School and University in an significant effort to spread awareness of CPS adoption concepts in manufacturing, promote them as motivation for young people to approach the manufacturing reality. In this area it is also necessary to bring CPS concepts outside the niche bounders of people of the specific sector and to spread the possible advantages in adoption (e.g. support to impaired or elder people) and to smooth down fears of adoption (e.g. issue related to security or privacy). |
| Overestimation of costs  
i.e. “CPS and related infrastructure cost” “Costs of digital ergonomics are high”. | From the feedbacks we collected there is the perception that CPS technologies are “expensive” (both in term of infrastructure and implementation) and that is independent from the expected advantages. We will recommend in our Roadmap to consider (especially for SME) the opportunity for supporting modernization investments. |
| Law, Regulations, Technology Enablers and EU Macro Economic Factors | C-level people and Business and Operation managers are sensitive to aspects that are beyond the technical and process aspects, like Liability of the utilization of CPS, both as a provider and as a utilizer and respect of various laws and legislations. This bring up the point to carefully consider a review in some area of the Legislation to address changing conditions and players. Another aspect to consider is related with the almost complete dependency of Europe from the US based technology suppliers and information “Giant”. Such situation could create an unbalanced relationship that could impact attitude to invest in new technologies like CPS. |
| Standards and certifications | For industrial manufactures, the increasing complexity of CPS-ized products, the evolution of the possible implication and consequences of their utilization and considering that the same product is commercialized in many countries, it brings up the issue of product certifications for each possible market. That could represent a major effort to undertake (especially for SME with a limited production volumes). |
General Recommendations

1. **Education** to prepare not only the young workers and engineers for the digitalized challenges in manufacturing but also the experienced work force to make the transitions and the migration process a success with positive attitude in the society. This includes the necessity to establish learning programs on several levels of education from trainee programs to university.

2. **Autonomous decision makings** by machines always involves the danger of harming human beings which are affected by these decisions. In terms of legislation the consequence may not be suitable to forbid these technological developments but rather to clarify the existing legislation according to these new technological risk and safety aspects.

3. **Standardization of technical interfaces and data handling** must be driven by industry and the European product providers. Politics can support this development and by that strengthen the European manufacturing technology economy.
### Research Priorities

<table>
<thead>
<tr>
<th>Research Priorities</th>
<th>sCorPiuS title</th>
<th>Context Factors</th>
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<tbody>
<tr>
<td>RP01</td>
<td>Predictive and preventive self-learning systems</td>
<td>G1 Cultural, Educational and Perception</td>
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<td>RP02</td>
<td>Caring for People in manufacturing Systems</td>
<td>G2 Estimation of costs and ROI models</td>
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<td>RP03</td>
<td>Knowledge and skills for manufacturing</td>
<td>G3 Laws &amp; Regulations</td>
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<td>RP04</td>
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<td>RP05</td>
<td>Novel production management tools and models</td>
<td>G4 EU Macro Economic Factors</td>
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<td>RP07</td>
<td>Cyber Native Factories</td>
<td>G5 Standards and certifications procedures</td>
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**Research Priorities: ranking exercise**

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- **Short Term**
- **Medium Term**
- **Long Term**

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Project Findings

For further information visit our web-site or contact us!
http://www.scorpius-project.eu

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