Framework for Integrated Manufacturing and Product Service System (IMPSS)

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OUTLINE

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  – New manufacturing challenges

• Integrated Manufacturing and Product Service System (IMPSS)
  – Concept
  – Services Sub-stages

• Proposed Implementation using Grid
  – Proposed Infrastructure Framework

• Conclusion
INTRODUCTION

New Manufacturing Paradigms

- Service
- Environment
- Closed Product Life Cycle Approach
- ICT – E-manufacturing

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INTRODUCTION

• Why Service?
  – Service refers to sales training, product warranties, maintenance, repair, cleaning, reverse logistics, end-of-life, sales of complementary product, upgrading and take back
  – Product technology matured
  – Higher quality of life ⇒ Expectation increased ⇒ Not only require cheap and good product but also quality services
  – Can have niche and customised quality of service
  – Important to consider the service design during service stages
  – Currently service stage very disparate and lack of system
INTRODUCTION

• Why Environment?
  – Increasing international concerns over sustainable development
  – Corporate social responsibility & Extended Producer Responsibility
  – E-waste increasing due to technology advancement
  – Increasing environmental and health issues
  – Legislative drivers such as Waste in Electrical and Electronics Equipment (WEEE)

• Why IT and Web-based?
  – Emergence of Virtual Enterprises
  – Outsourcing Trends
  – Joint ventures
  – Life cycle approach
Integrated Manufacturing and Product Service System (IMPSS)

- The entire product life cycle are to be take care of by the manufacturers
  - Close up the product development life cycle
  - Integrate environmental and service considerations during design
  - Define service stage and End-of-Life as new main stages
  - Integrate and support physical distributed network of manufacturing activities
  - Promote information and knowledge exchange among the different stages as and when necessary.
IMPSS CONCEPT
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• Information and hardware feedback
• Information feedback mainly on transmitting the knowledge of the product and educating the stakeholders of the stages on handling the products
• All the information can be feedback by giving inputs into the integrated system architecture.
• Feedback from the later stages can be communicated back to design stage
• To help maximize the lifespan of the product and minimize the environmental impacts
IMPSS CONCEPT

- This concept is a combination of Product Service System (PSS) in an integrated manufacturing service system (IMPSS).
- The idea is to define and formalise each element in PSS into IMSS and include the environmental tools.
- Integrated management of the entire product life cycle using PSS elements and environmental tools.

<table>
<thead>
<tr>
<th>Product</th>
<th>Extended Product Life Span</th>
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<tbody>
<tr>
<td>Service</td>
<td>Maintenance, Cleaning, Testing, Assessment, Acquisition, Exchange, Education, Take Back, Upgrade</td>
</tr>
<tr>
<td>Actors</td>
<td>Service Engineers</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Service Network</td>
</tr>
<tr>
<td>Environmental Tools</td>
<td>Product Life Span against Environmental Impact Optimisation and Assessment</td>
</tr>
</tbody>
</table>
SERVICE SUB-STAGES

Information Flow

Physical Products and Information Flow

End Of Life Stage

Consumers' Usage Stage

Service Stage

Education

Acquisition

Assessment

Exchange

Take back

Repair

Maintenance

Cleaning

Testing

Consumers' Usage Stage
SERVICE SUB-STAGES

• Each individual sub-stages is independent and yet able to interact with the rest of the sub-stages as and when needed.
• Customer normally 3 reasons – Training, Repair & Upgrade or Exchange
• Training - Information and knowledge exchange
• Repair & Upgrade and Exchange – Hardware included
• Interacts mainly with End-of-Life stage and Consumer Usage stage
PROPOSED IMPLEMENTATION USING GRID
GENERALIZING FOR INTEGRATION OF MANUFACTURING AND SERVICES THROUGH GRID/WEB SERVICES
THE GRID

- Geographically distributed resources over grid environment
- Resources are virtualized into services
- Provision of these services over the Grid

- Virtualized resources are digital and callable by an integrated workflow orchestration system over the grid
- Grid – A facilitator for the exchanges of manufacturing services
PROPOSED INFRASTRUCTURE FRAMEWORK
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• Three-tiered structure with ontology development component and additional extension for other existing independent application systems.
  – First layer: Manufacturing Grid (Manufacturing Resources),
  – Second layer: Platform for manufacturing activities (Middleware)
  – Third layer: Real-time user-interface
  – Extension Wrapper: SCM, MET, CAD etc
  – Additional component: Ontology Design & Development

• Semantic Web Services-based

• Ontology design and development to provide semantics of the framework based on the definition proposed.
PROPOSED INFRASTRUCTURE FRAMEWORK

Manufacturing Grid – Network of distributed manufacturing resources and activities that is interconnected for virtual manufacturing activities

Virtualised Physical Manufacturing Services and activities into web services

Services – Assessment of products, Scheduling for acquisition and appointment, repair, cleaning, testing, take back, education, RFID application
PROPOSED INFRASTRUCTURE FRAMEWORK

Platform for Manufacturing Activities – Middleware engine for handling the requests coming in

Interacts with ontology sub module to search for the web services to be invoked and executed for the tasks to be done.

PROPOSED INFRASTRUCTURE FRAMEWORK

Online Real Time User Interface for user to access the system through web portal – To accept request and also display results (Online monitoring)

Data Integration Extension - To interface with other existing system. Eg. Reverse Logistic and Service Network System
Ontology Repository – Storing ontology developed by ontology engineers using tools such as Protegy.

WSDL files in UDDI will be annotated using ontology and stored in enhanced UDDI as OWL-S files.
CONCLUSION

• New manufacturing challenges and need for new paradigms have emerged. ICT, service management and environmental factors are getting important.

• A new framework for integrated manufacturing product and service system (IMPSS) is proposed for new manufacturing paradigm.

• Grid Service-based infrastructure is being designed for this new framework.

• Service stage is being defined and formalised. Infrastructure can enable a smoother operation for the service network.

• Conceptual work is being done here and prototyping of this system is still undergoing.

• Well-designed and well-established grid infrastructure reap benefits in both business and environmental perspectives.
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THANK YOU!