Vertical Integration of Enterprise Industrial Systems Utilizing Web Services

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Presentation outline:

State of the art Technologies

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- Workflows 4
- Ontologies 5

Introduction and motivation

Proposed System

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- Implementation Issues 12

Example Use Case

Discussion and Conclusion

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Web Services :

identified by Uniform Resource Identifier (URI)

described and discovered by eXtended Markup Language (XML) artifacts

support direct interactions with other software applications using XML-based messages via Internet-based protocols.

communicating through XML-based documents.

easily accessible via protocols like

HTTP & SMTP

Web Services enabled by **XML**

their foundation is based on

structured information exchange in a decentralized, distributed environment

SOAP, WSDL, UDDI

SOAP - Simple Object Access Protocol
WSDL - Web Services Description Language
UDDI - Universal Description Discovery and Integration

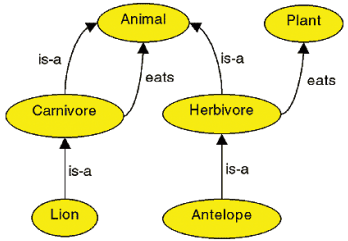
a model and an XML format for WS description

support for both design-time and run-time discovery of WSs.

Ontologies :

a means of representing knowledge

A hierarchically
structured set of terms to describe
a domain that can be used as a skeletal foundation for a knowledge base



Semantic web evolution

need of representing ontologies in semantics

Knowledge described
by ontologies can be noticeable from different users and used for platform independent implementation.

a variety of semantic markup languages, based on the XML standard.

DARPA
DAML+OIL
OWL

all built on top of **RDF**

defense advanced research projects agency
agent markup language+ontology interface layer
web ontology language

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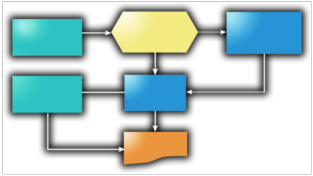
Workflows :



representations of processes suitable for being processed by workflow management systems (WfMS).

provide an enterprise process model with all information needed for its implementation

number/order of activities,
data assignment,
and resource designation.

key technology for automating enterprise processes, mainly at the enterprise layer.

workflow specification standards:
SWAP,
Wf-XML

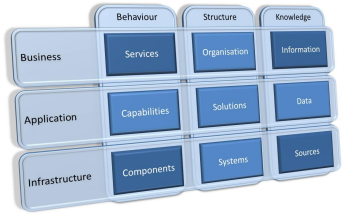
WS workflow standards
WSFL,
XLANG

(BPEL)
(BPEL4People)

Simple Workflow access protocol
Workflow XML
Web Services flow languages
Web Services for business process design
Business Process Execution Language

BPEL4People extends BPEL from orchestration of Web services alone to orchestration of role-based human activities as well.

Layers of the Enterprise :



The Enterprise Layer ····· comprises ERP (Enterprise Resource Planning)

The Plant ····· comprises MES (Manufacturing Execution System)

The Shop Floor

The Field

Upper Layer - Applications

Shop Floor - Industrial manufacturing processes

MES ····· enables ····· Shop floor scheduling
Production & labour reporting
Provision of industrial process data from the Shop floor layer to enterprise layer

Internet Protocol Standards based on it to make Integration of d/t systems & Applications both inside an Enterprise Plant as well as d/t Enterprises

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Methodology :

3 classes

The first class

deals with **processes** residing in one specific layer and **handles integration of its systems and applications.**

The second class

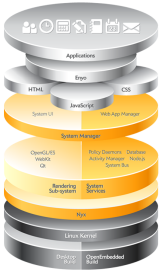
The class deals with processes involving **systems or applications residing in different layers.**

The third class

considers processes involving **different plants or even different manufacturing enterprises** that need to cooperate

All three classes require the openness of systems and applications residing on different enterprise model layers.

Architecture :



leads to enterprise system seamless integration

enables system interoperability

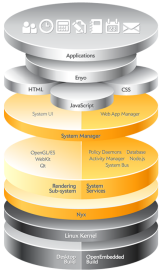
utilizes semantic information for the association in a flexible and intelligent way of enterprise processes to actual systems.

Manufacturing Enterprise Processes

Manufacturing Enterprise Systems:

Association of Enterprise Processes and Systems

Architecture :



Manufacturing Enterprise Processes

An enterprise
process, relevant to any of the above classes, comprises a number of structured operations associated with data exchange and function calls among applications or systems residing in the different enterprise layers

A workflow task may represent:

- a human activity
- a software system invocation

A workflow task has thus to
be associated with the execution of a function or the utilization of a service of the underlying systems or applications

There are two complementary parts to a workflow:

the control flow

the data flow

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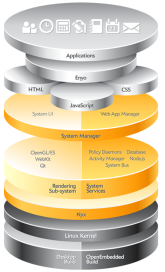
Architecture :

Manufacturing Enterprise Systems:

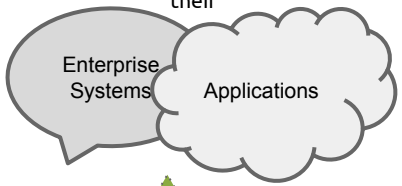
common standardized interfaces

WSs

- allow any piece of software to communicate in a standardized XML messaging format
- construct new and complete enterprise processes

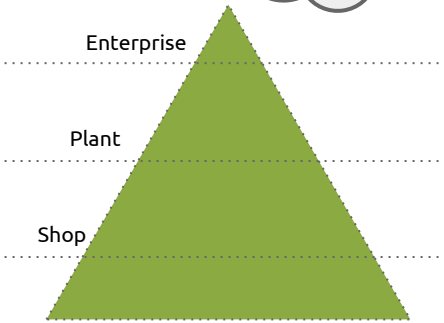


their



Association of Enterprise Processes and Systems

workflow activities ⟷ the available WSs



First Simple Approach

identify the correspondence of a
specific workflow activity to a specific WS and associate them

But, lacks flexibility and reusability,

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Architecture :

... Association of Enterprise Processes and Systems

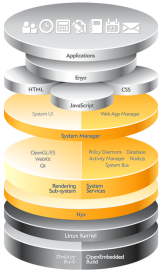
Workflows 

Web Services

Big Idea

An enterprise process description

→ **its ontology + workflow**



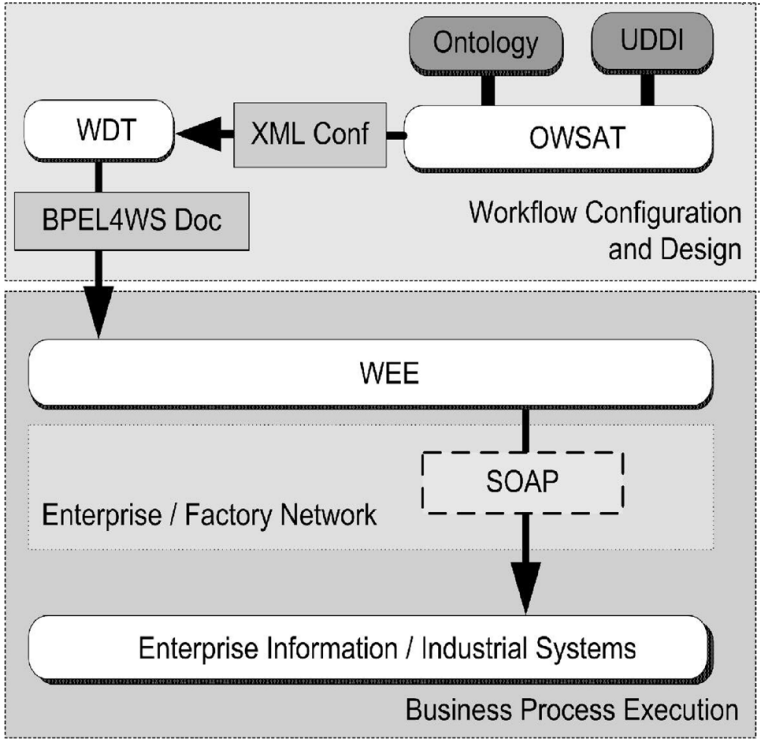
loose coupling between **semantic terms of the industrial workflow** and the **actual WSs** exposed by the enterprise ISs

→ **redesign of industrial processes in a flexible fashion**

Big Idea

reusability of specified processes
provided that business logic is not altered,
workflows are specified by ontological terms rather than system WS calls

Architecture : Implementation Issues



Ontology WS Association Tool

Universal Description, Discovery and Integration

(**UDDI**, pronounced Yu-di:) is a platform-independent, Extensible Markup Language (XML)-based registry by which businesses worldwide can list themselves on the Internet, and a mechanism to register and locate web service applications.

Workflow Design Tool

Workflow Execution Engine

Workflow Configuration and Design

Simple Object Access Protocol

is a protocol specification for exchanging structured information in the implementation of web services in computer networks. It relies on XML Information Set for its message format, and usually relies on other application layer protocols, most notably Hypertext Transfer Protocol (HTTP) or Simple Mail Transfer Protocol (SMTP), for message negotiation and transmission.

using **synonyms** for ontological terms
a **standardized ontological model -** existing standard specifications like **PSL, IEC 61346,** or **STEP**

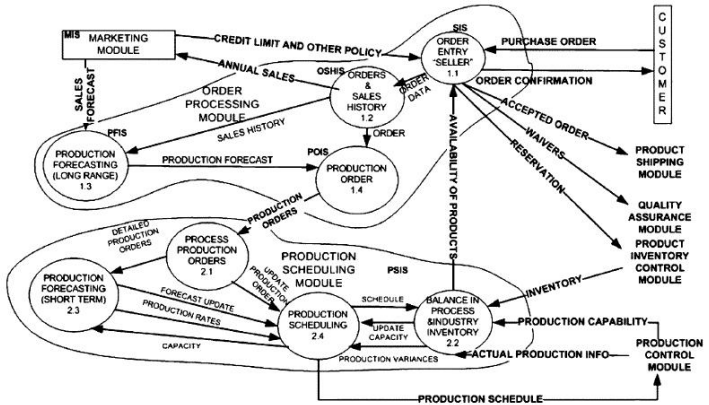
EXAMPLE USE CASE

production scheduling process

order processing

Upper Layer - Applications

Shop Floor - Industrial manufacturing processes



Detailed description of the order processing and production scheduling modules.

order processing — ERP

- ➔ the order entry
- ➔ the orders and sales history
- ➔ the production forecasting
- ➔ the production order

production scheduling process — MES

- ➔ process production orders
- ➔ balance in process and industry inventory
- ➔ production forecasting
- ➔ production scheduling

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Discussion and Conclusion :


Thank you!