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Real-time project / facility management and coordination using software agent technology

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Real-time project / facility management and coordination using software agent technology

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Shen, Weiming

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Outline

- **Software Agents and Multi-Agent Systems**
- **Why Use Software Agents ?**
- **FIATECH Roadmap / Vision**
- **FIATECH Roadmap Element 6 on Project and Facility Management, Coordination and Control**
- **What can Software Agents Do for PFMCC ?**
- **Case 1: Maintenance Project Management**
- **Case 2: iShopFloor/eShopFloor**
- **Case 3: Enterprise Collaboration**
- **Conclusion**

Agent Technology

- Derived From
 - Distributed Artificial Intelligence
 - Software Engineering
 - Communication Networks
 - Coordination Theories
 - Social Science
 - Economics
 -

What is an Agent ?

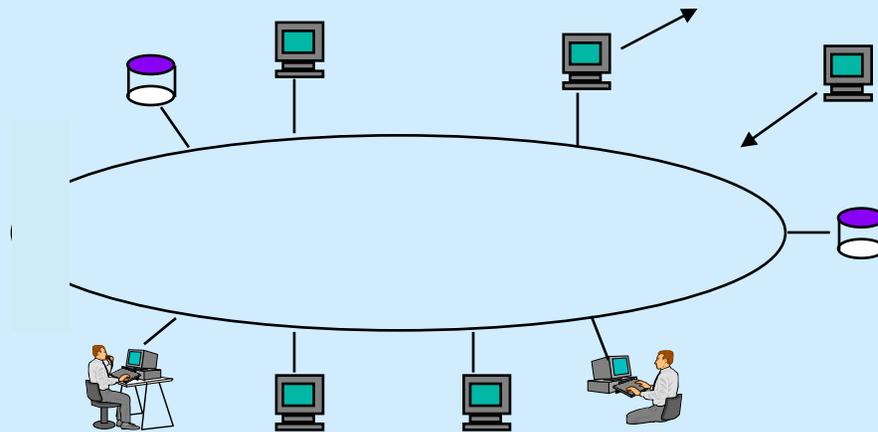
- My definition:
 - An agent can be defined as a **software system** that communicates and cooperates with other software systems to **solve a complex problem** that is beyond of the capability of each individual software system.
 - An agent can be used to represent a physical resource, an organization, or an existing software application (e.g., CAD, ERP, database, ...).

Multi-Agent Systems

- Agents are best developed not in isolation but as parts of a multi-agent system
- A multi-agent system can also be defined as ‘a loosely coupled network of problem solvers that work together to solve problems that are beyond their individual capabilities’.

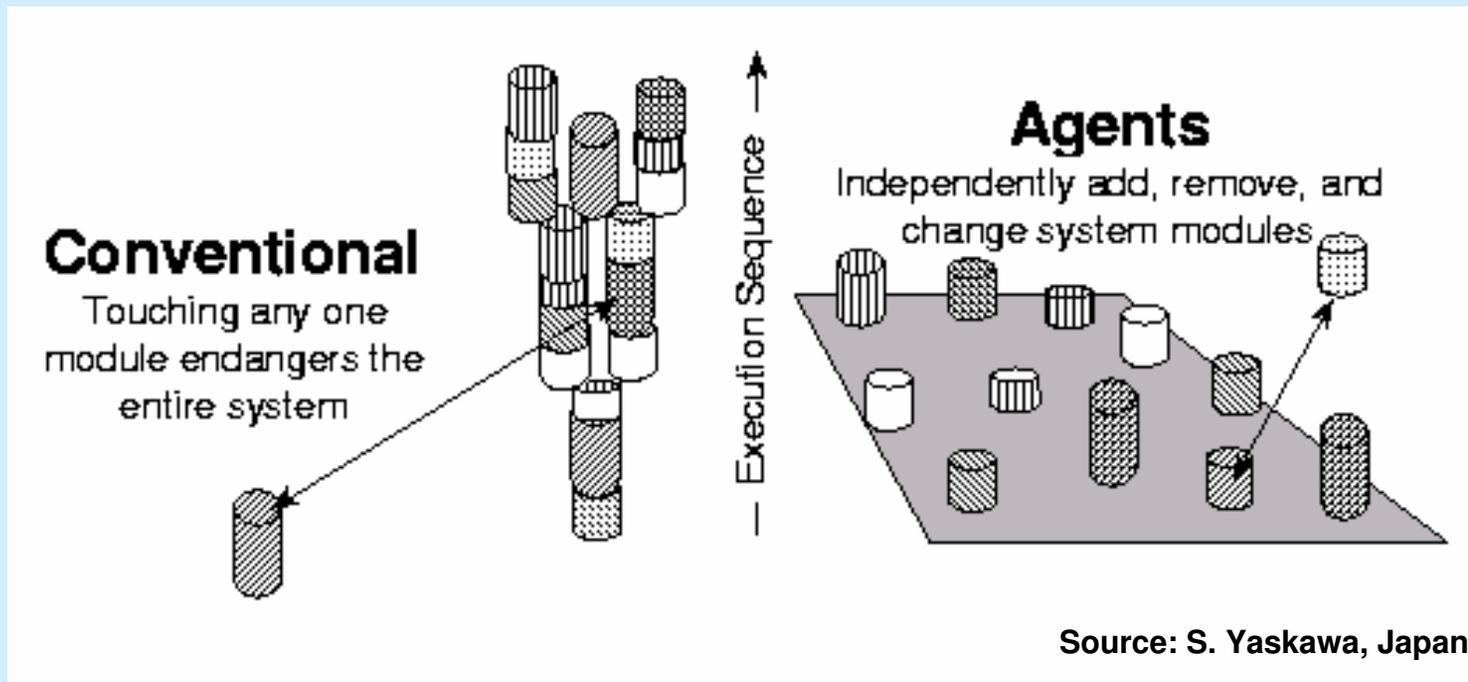
Why Use Agents?

- **Open & Dynamic:**
 - agents can be added and removed from the environment (e.g., a construction project management system) at **run time**
 - agent-based systems are self-configurable at **run time**



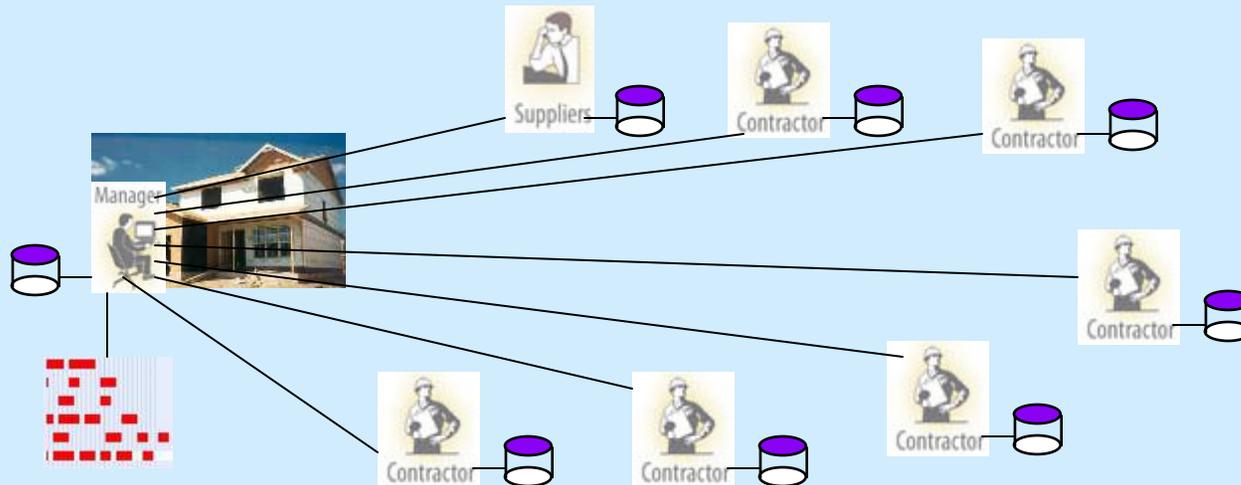
Why Use Agents?

- **Fault-tolerance and Self-heal:**
 - a system with **autonomously** functioning components (e.g., in a facility operation and management system) **will not collapse** when one or more of the **components fail or malfunction**

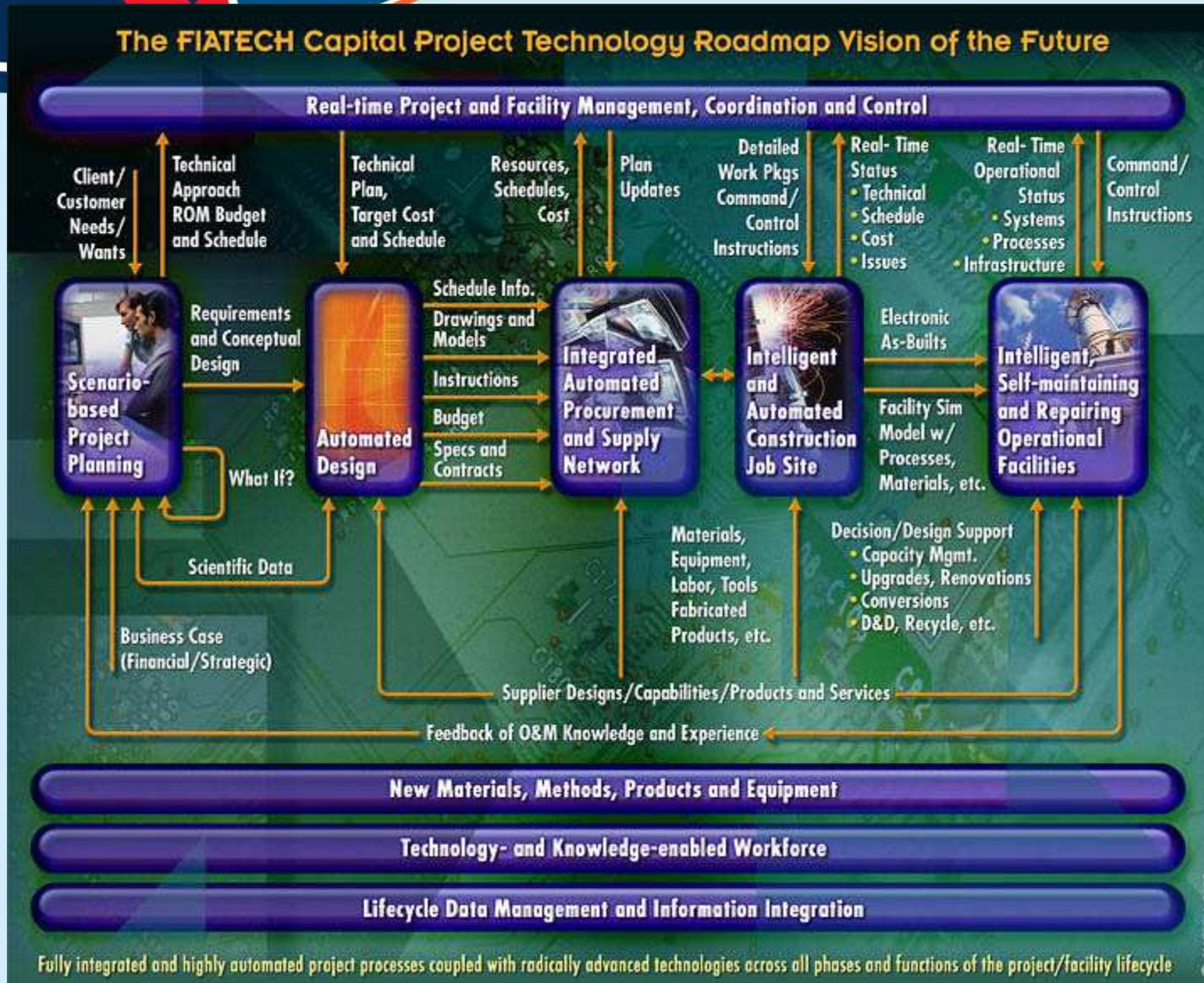


Why Use Agents?

- **Distributed & Dynamic**
 - Many real-world problems
 - **inherently distributed** and **cannot be solved** using centralized solutions
 - **cannot be solved** using single engineering tool or solution



FIATECH Vision



FIATECH RM EI.6

- **FIATECH Roadmap Element 6: Real-time Project and Facility Management, Coordination and Control**
 - A system or tool that provides *continuous* visibility to all plans and tasks throughout the planning, design, construction and facility lifecycle (nuclear power plants, hospitals, ...)
 - Integration of
 - Sensor networks for real time data collection
 - During the construction for real time project management
 - During the operation for real time intelligent facility management
 - Asset lifecycle information system for condition assessment
 - Systems of contractors and suppliers
 -

Applications of Software Agents

- Integrate heterogeneous legacy software systems
- Facilitate communication, collaboration and coordination among geographically distributed, multicultural, and multidisciplinary project team members
- Provide support in distributed project / facility information management, conflicts detection and resolution
- Speed up the decision making process because of the access to accurate and real time information
- Avoid or reduce disruptions to facility operations
-
- → Increase management efficiency and productivity

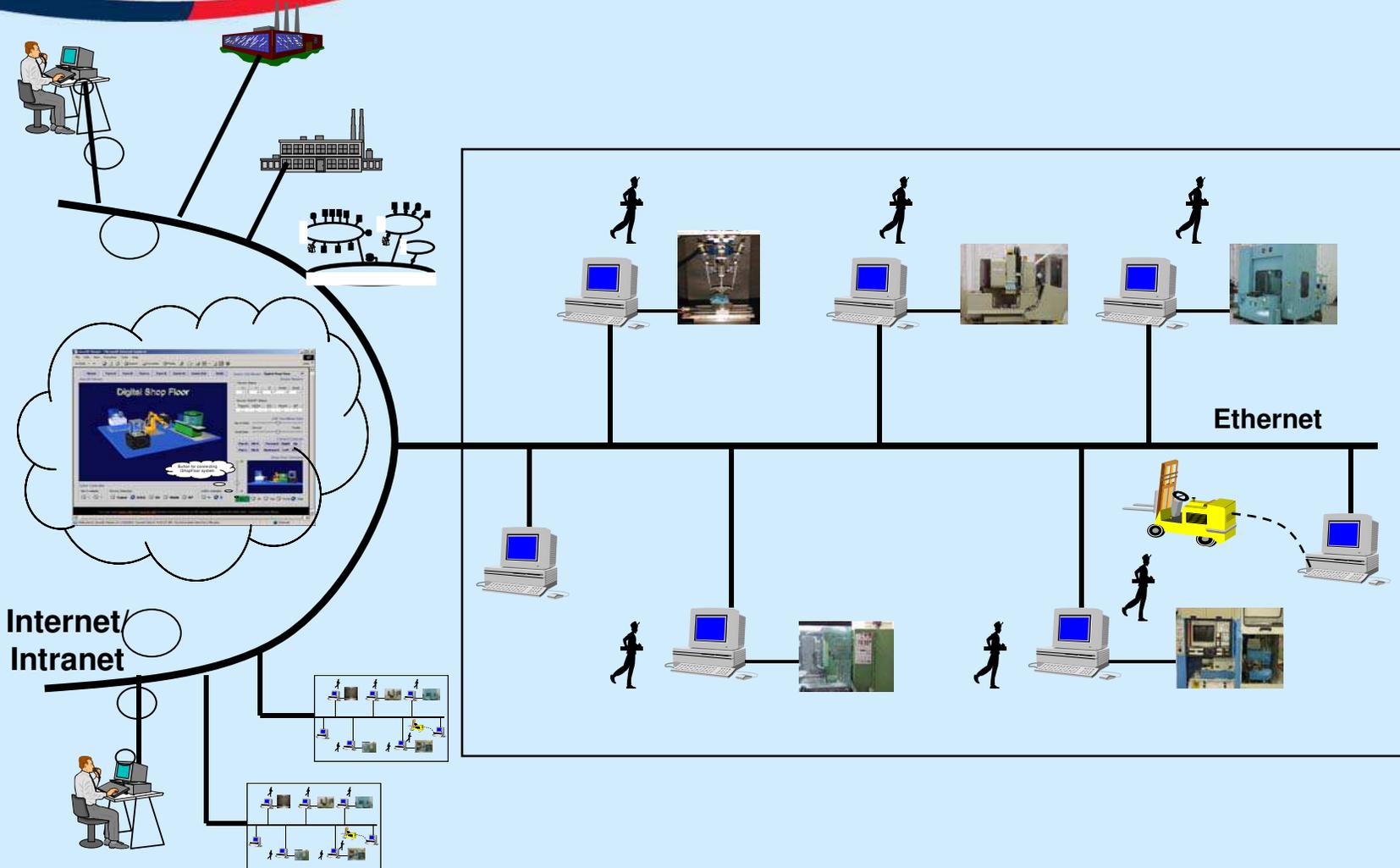
Case 1: Maintenance Management

- Integration with existing systems / databases for
 - Fleet management
 - Human resource management, including staff training
 - Equipment management
 - Part / material management
 - Daily operations planning and reporting
 - Distributed decision making
 - Remote monitoring and management
 -

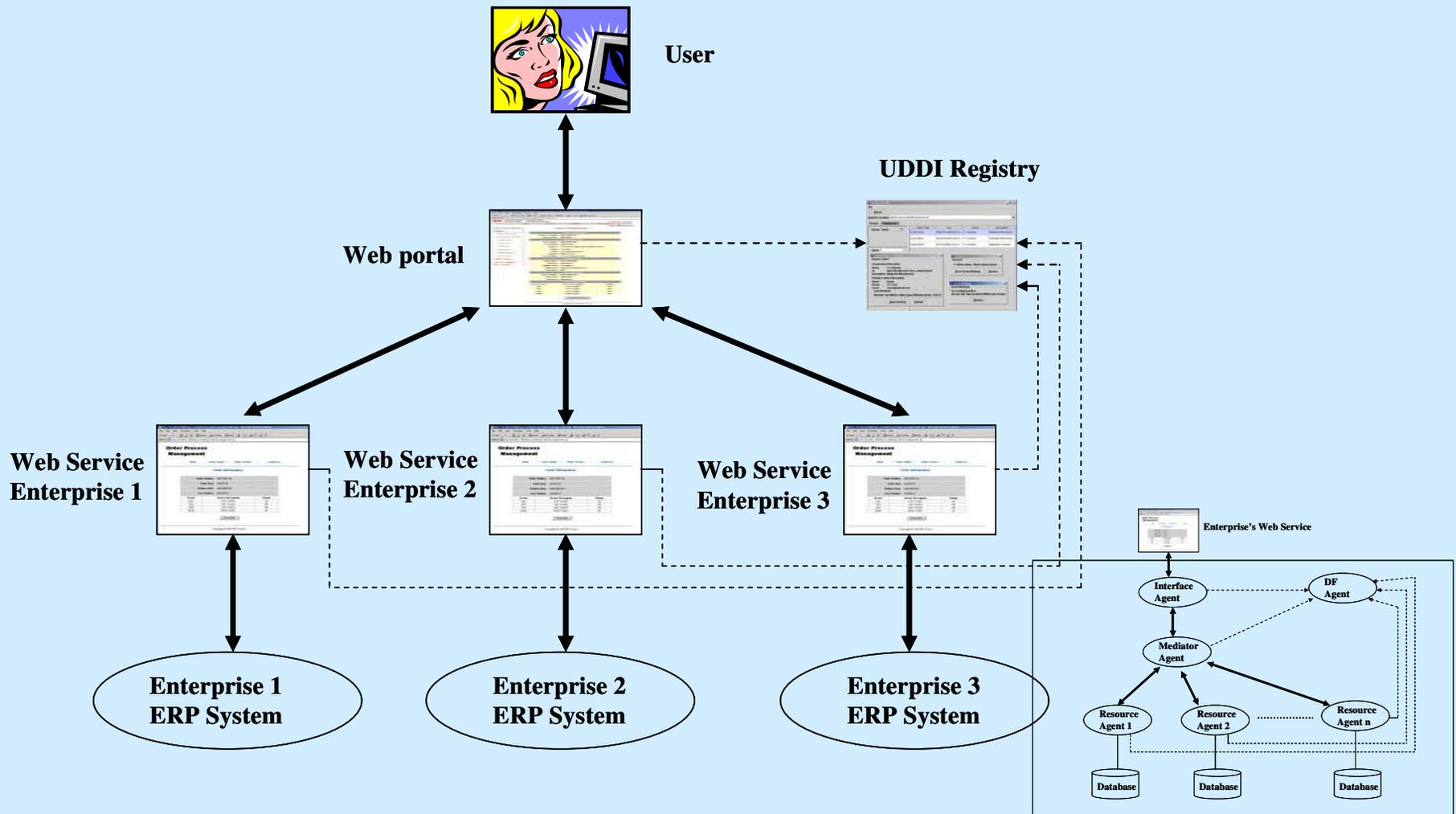
NRC-CMRC

From *Discovery*
to *Innovation...*

Case 2: iShopFloor/eShopFloor



Case 3: Enterprise Collaboration



Case 3: Enterprise Collaboration

http://localhost:8080/jsp-examples/jnrc/servicebundle.jsp - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Search Favorites Media

Address http://localhost:8080/jsp-examples/jnrc/servicebundle.jsp

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Home | Service | Suppliers | My Account

Welcome vinson!
Aug 25, 2004 [Logout]

Service Bundle

1. Add, edit or delete your service.

Service Name	Service Description	Volume	Choice
CNC	CNC TASK1	120	<input type="radio"/>
CNC	CNC TASK2	100	<input type="radio"/>
CNC	CNC TASK3	100	<input type="radio"/>
EDM	EDM TASK1	60	<input type="radio"/>

2. Input your service delivery date.
Delivery Date (yyyy/mm/dd):

3. Submit your order

Service Introduction

Place your order

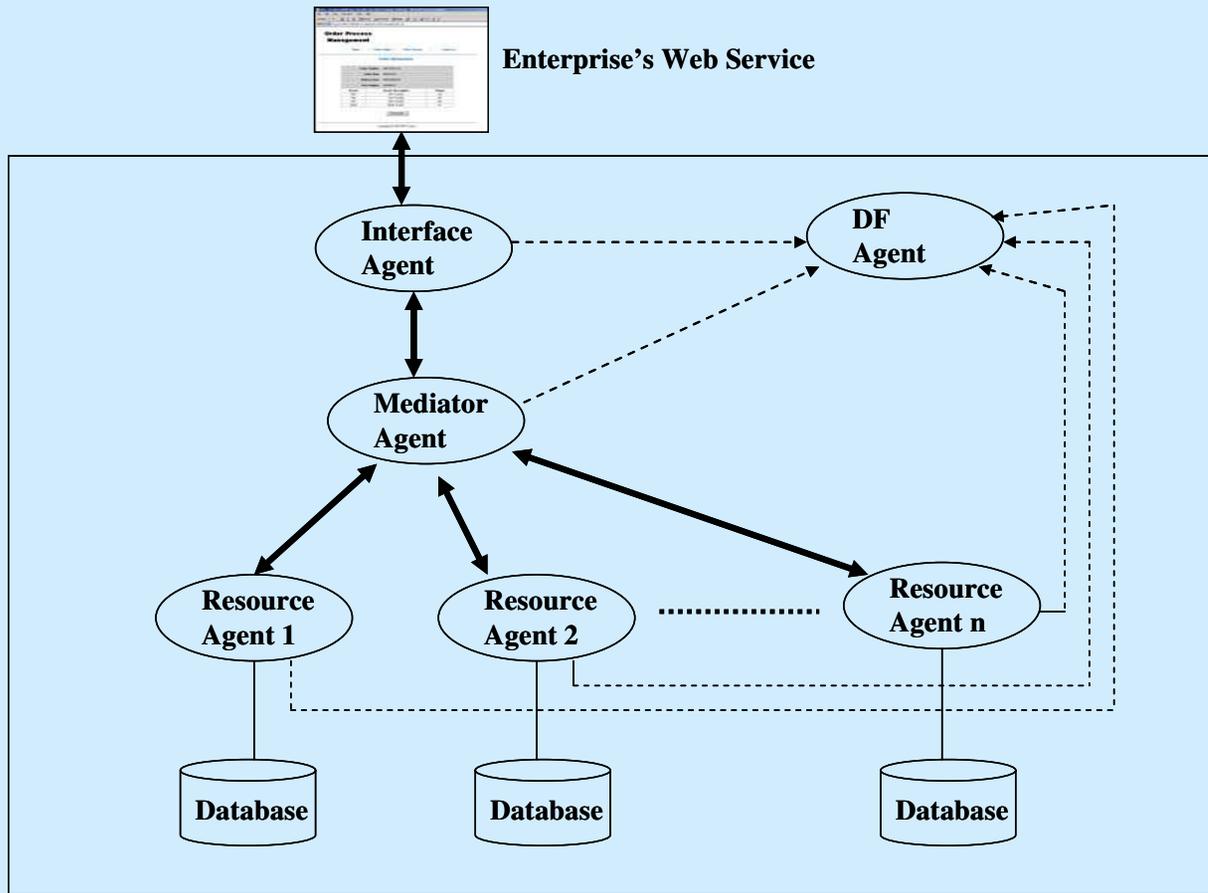
- Add service to bundle**
- Generate order
- Check order
- Call for bid
- Order list
- Bid decision
- Check contract
- Send contract

Service suppliers

My Account

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Case 3: Enterprise Collaboration



Case 3: Enterprise Collaboration

Gantt Chart for Shop Floor Scheduling

Machine: ■ machine ia ■ machine ja ■ machine ea ■ machine la

```

registered agents info
agent name: df, port: 9001, start time: 2004/08/30-10:06:49, status
agent name: ea, port: 9007, start time: 2004/08/30-10:06:52, status
agent name: fa, port: 9008, start time: 2004/08/30-10:06:54, status
agent name: ia, port: 9004, start time: 2004/08/30-10:07:00, status
agent name: ja, port: 9005, start time: 2004/08/30-10:07:04, status
agent name: la, port: 9006, start time: 2004/08/30-10:07:05, status
agent name: if, port: 9003, start time: 2004/08/30-10:09:26, status
agent name: me, port: 9002, start time: 2004/08/30-10:10:03, status
-----
msgid: abbreviation_df-df-- message detail info
from: df ea fa ia ja la if me
agent name: me, start time: 2004/08/30-10:10:03, status:
port: 9002, name: me
-----
msgid: abbreviation_df-df-- message detail info
from: df ea fa ia ja la if me
protocol: Fipa-Request
perfermative: Request
contentkey: pushregistry
-----
from: me
to: ea fa
protocol: Fipa-ContractNet
perfermative: Call-For-Proposal
contentkey: callforproposal
3:
Time table has been updated ! ---->
0: 2004/08/01:00
1: 2004/08/02:01
2: 2004/08/02:01
3: 2004/08/02:07
4: 2004/08/03:02
5: 2004/08/03:06
6: 2004/08/04:00
-----
contentkey: callforproposal
3:
Time table has been updated ! ---->
0: 2004/08/01:00
1: 2004/08/02:01
2: 2004/08/02:01
3: 2004/08/02:07
4: 2004/08/03:02
5: 2004/08/03:06
6: 2004/08/04:00

```

Case 3: Enterprise Collaboration

http://localhost:8080/jsp-examples/jnrc/contract.jsp - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://localhost:8080/jsp-examples/jnrc/contract.jsp

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Home | Service | Supplier | My Account

Welcome vinson !
Sep 25, 2004 [Logout]

Contract Information

Contract Information

Contract Number: 040725094751
Contract Date: 2004/08/25

User Information

User Number: 040624094336
User Name: vinson wang
Address: 123 Street London ON Canada P4A 5A1
Phone: 111-2222
Email: vinson@hotmail.com
Payment: Master Card
Card Number: 1111-2222-3333-4444

Bid Information

Bid Number: 040725093008
Bid Date: 2004/08/25
Bidder Name: TI company
Bidder Info: Integrated Manufacturer
Total Price: 950

Order Information

Order Number: 040725091156
Order Date: 2004/08/25
Ship Date: 2004/09/11

Service Information		
Service Name	Service Description	Volume
CNC	CNC TASK1	120
CNC	CNC TASK2	100
CNC	CNC TASK3	100
EDM	EDM TASK1	60

Service Introduction

Service

- Place your service
- Add service to bundle
- Generate order
- Check order
- Call for bid
- Bid decision
- Check contract**
- Send contract
- Order tracker**
- Service suppliers**
- My Account**

Agent Technology: State-of-the-Art

- Research
 - More than 15 years of extensive researches
 - Thousands of related publications
- Development
 - Prototypes at research labs
 - Few testbeds / showcases
 - Frameworks / tools available
- Deployment
 - A few industrial deployments

Conclusion

- Agent-based approaches offer a number of advantages: flexibility, modularity; reconfigurability; scalability; upgradeability; robustness (including fault recovery).
- Agent technology can be well applied to implement real time project and facility management, coordination and control.
- Agent technology has been studied for more than 10 years, and ready for industrial applications.

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*From Discovery
to Innovation...*

Thank You!

