

Robot Middleware and its Standardization in OMG

October 10, 2006

International convention Center

Beijing, China

Tetsuo KOTOKU

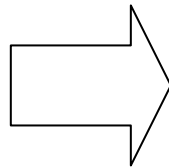
NATIONAL INSTITUTE OF
ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY (AIST)



Introduction

Robot Society in the 21st century

increase of the
high elderly
population



PROBLEMS

- how to support the elderly in their daily lives
- how to keep enough labour force in industrial and social activities



Expanding Robot Application from industry to non-industry

Manufacturing
Automation



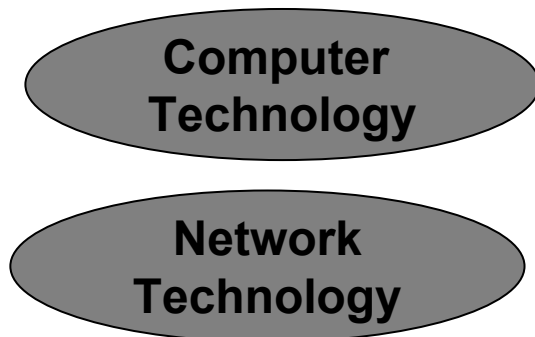
Maintenance
Medical
Home Service
Security
Communication
Entertainment
etc

Introduction

Robot Society in the 21st century

With the rapid progress in computer and communication technology, the robot systems are fast becoming larger and more complicated. Therefore, there is a real need for the software technologies for efficient developments. Now various software technologies are proposed and implemented respectively.

Rapid progress:



Robot Systems

- larger
- more complicated

Single robot

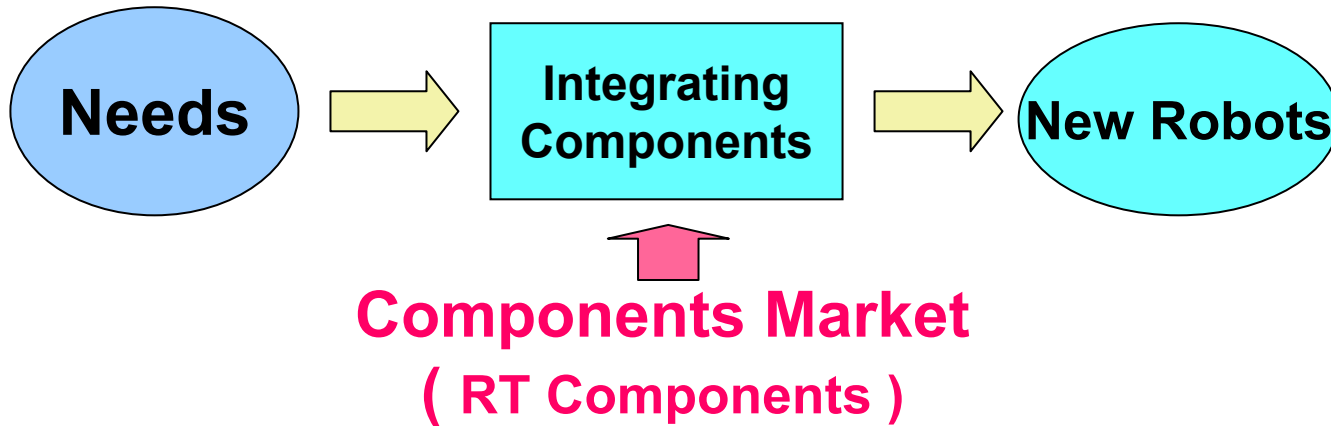
Networked robot



Efficient Development

Technology Strategy (JARA)

How new robotic products will be produced?



Motors



Sensors



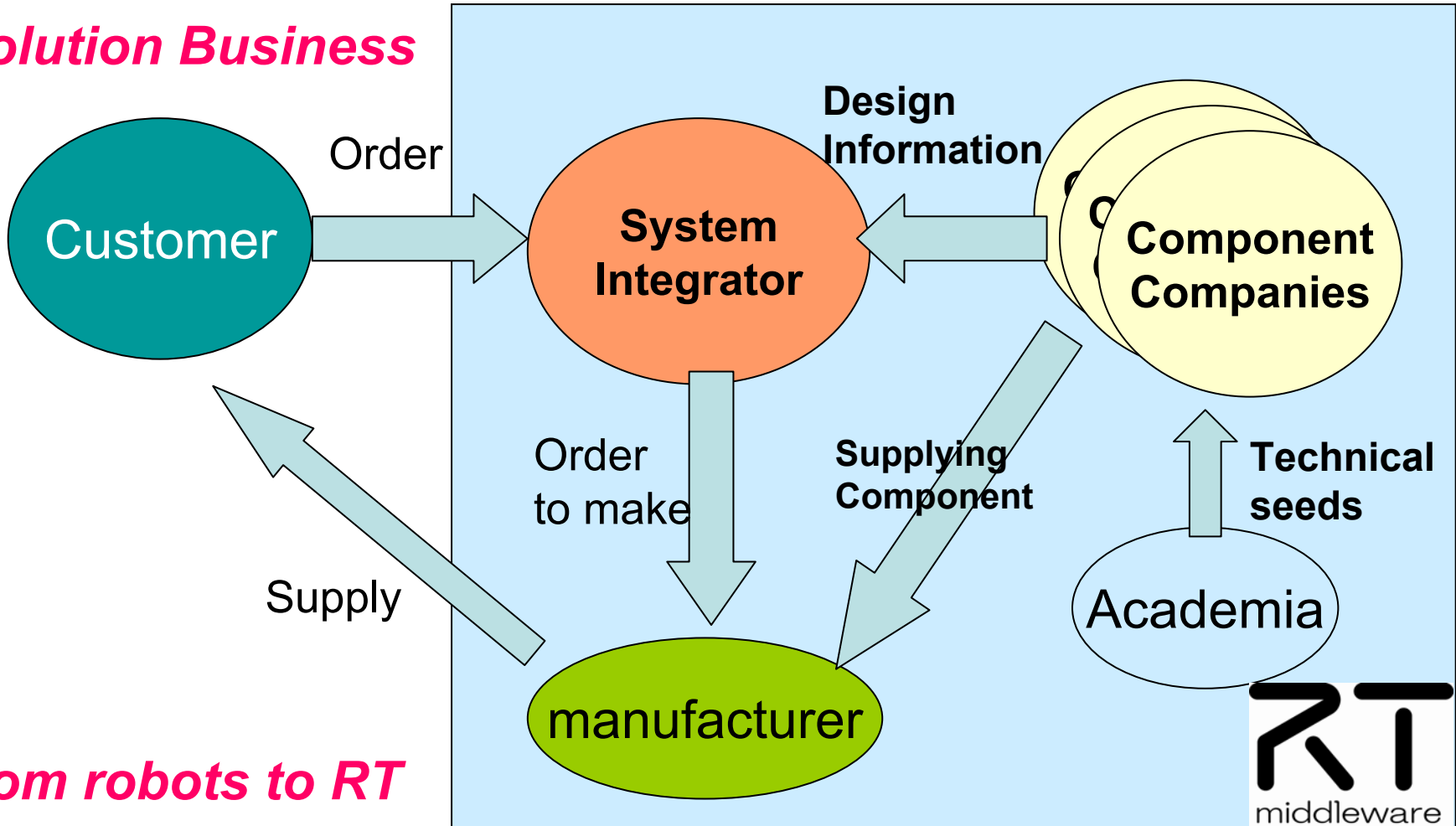
Robot arm



Made-to-Order Business

Technology Strategy (JARA)

Solution Business



from robots to RT

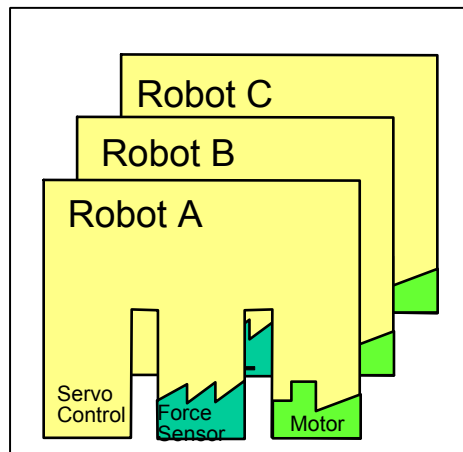


21st Century Business Model

Made-to-Order Business

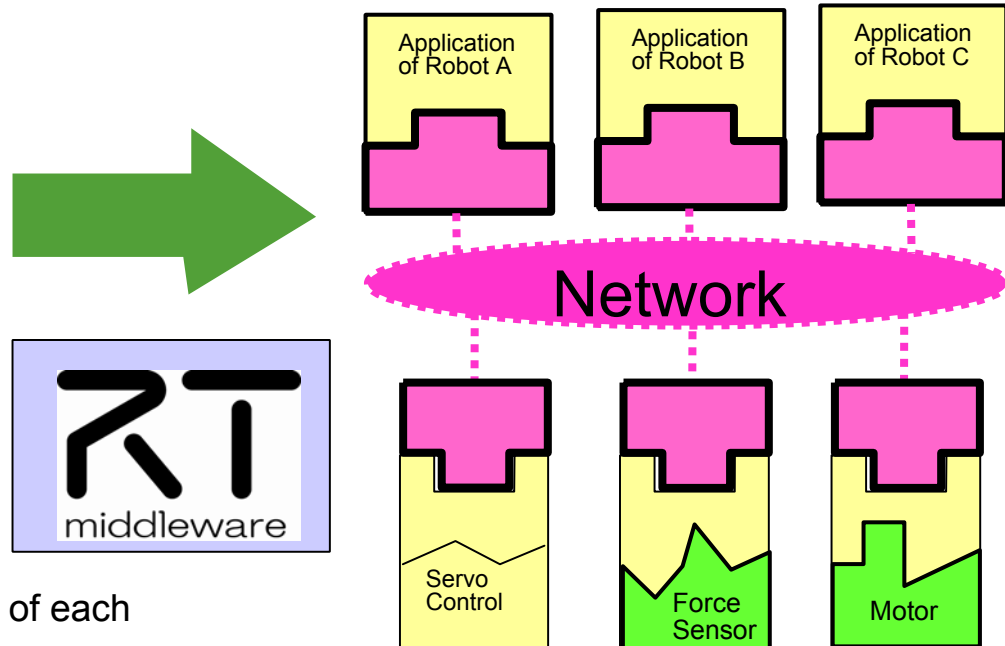
RT Middleware Project

Conventional Robot Systems



- Robot Maker makes Everything of each robot.
- Interfaces of modules in each robot are not defined well. So, it is difficult to re-use them in other robot systems.
- Cost of development is high.
- It is difficult to create a variety of robots

Component Based Robot Systems



- It will be easy to create new robot by re-using existing modules.
- Cost of development of new robot will be low.
- Module suppliers, software module suppliers and system integrators can join the new robot business.
- It will be easy to develop a variety of robots.

Important Issues

- **Preparing for Technological Infrastructure for the System Integration Industry**
- **Robotic components with open architecture controller should be supplied to the market.**
- **Middle-ware, a kind of software which standardizes robotic component connection should be considered.**
- **A specially designed processor for open controller of robotic system should be developed.**

Standardization Activity in OMG

Object Management Group

- **Worldwide software consortium**
 - Distributed Object Middleware (CORBA)
 - Object Model Language (UML)
 - Model Driven Architecture (MDA)
- **Application Fields Specific Standardization**
(Business Enterprise Integration, C4I, Finance, Healthcare, Life Science Research, Manufacture, Software-based Communication, Space, **Robotics**)
-> **Domain Technology Committee**



<http://www.omg.org/>

Robotics DTF



(Since Dec. 9, 2005)

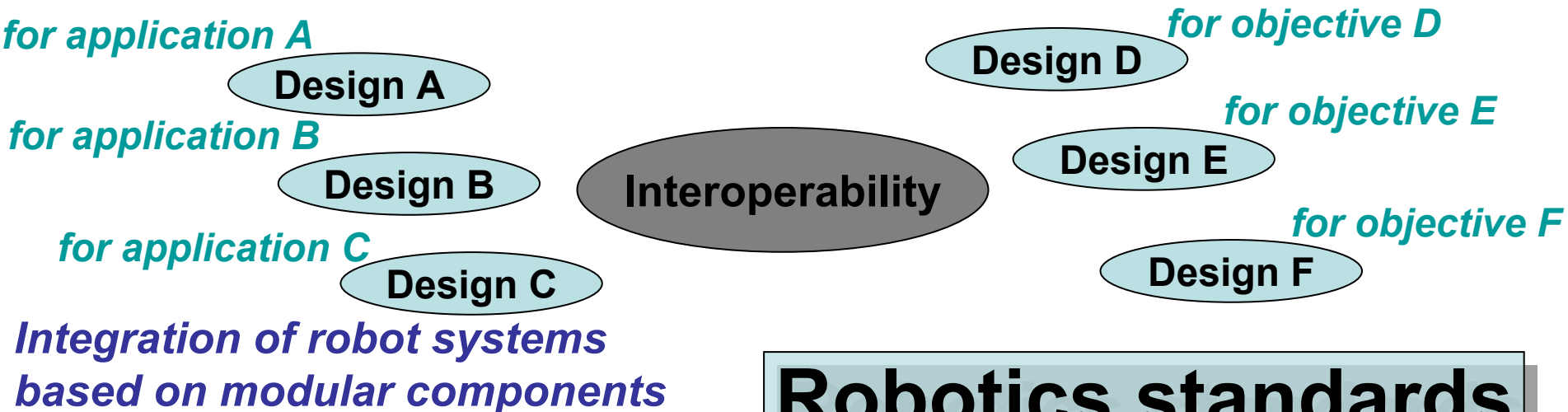
- Yun-Koo Chung (ETRI, Korea)
- **Tetsuo Kotoku** (AIST, Japan)
- Hung Pham (RTI, USA)



<http://robotics.omg.org/>

Standardization Activities

Unfortunately, most of pioneering initiatives are developed independently of the others, driven by specific applications and objectives. In order to settle this state of chaos, we would like to contribute to the promotion of standardization in the field of robotics based on the mutual understanding between the relevant parties.

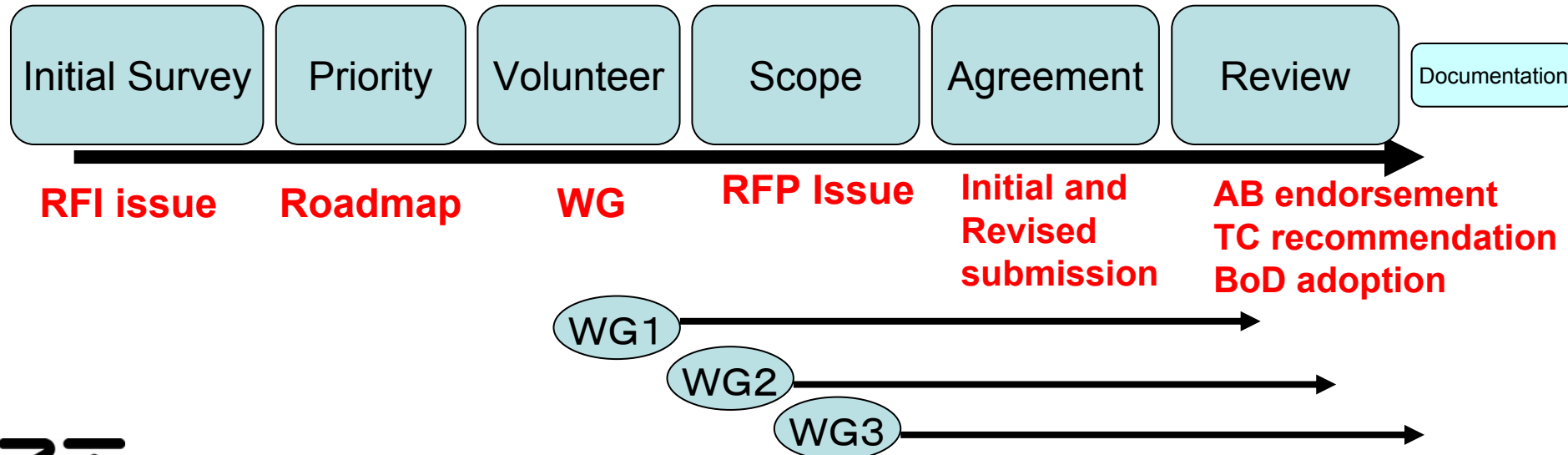




Standardization Process

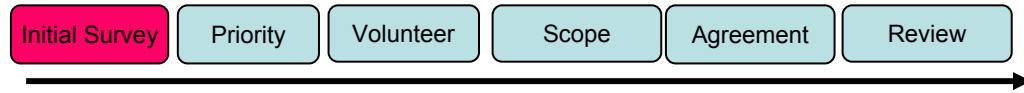
- Agreement based on discussion
- Strict process for fairness
- Leadership by volunteers

5 meetings /year

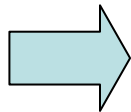


Robotics Domain Task Force

Initial Survey:



- Recruiting discussion members
- Get information for various activities



Request For Information (RFI)

- Presentation and discussion
- Setting up working groups

<http://robotics.omg.org/>

Robotic Systems RFI

Scope of Robotic Systems :

“Systems that provide intelligent services and information by interacting with their environment, including human beings, via the use of various sensors, actuators and human interfaces.”

- Large variation of physical characteristics
 - mobile robots
 - humanoid robots
 - pet robots,
 - manipulator robots
 - autonomous vehicles
 - robot house
 - etc.
- Broad span of applications
 - communication and entertainment robots
 - lifestyle support robots
 - rescue robots
 - transportation robots
 - medical robots
 - etc.

Robotic Systems RFI

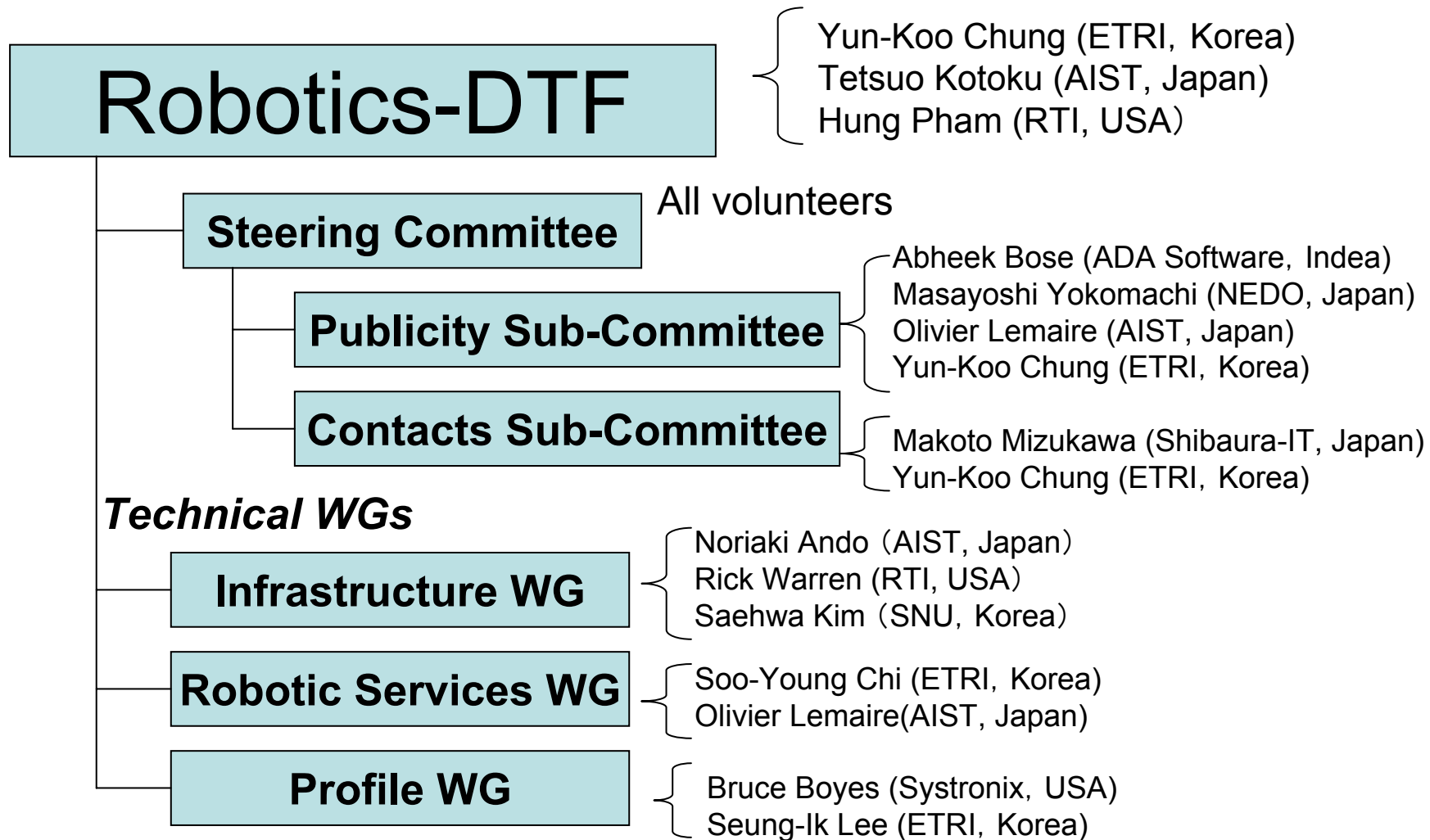
- An RFI may be issued to gather industry requirements and comments at the beginning of standardization phase
- Any person or company may respond
- OMG member decide how to proceed, based on input from both inside and outside the organization
- Access the RFI documents at http://robotics.omg.org/robotic_systems_rfi.htm
- Response deadline was April 4, 2006

RFI Responses

- 1st Batch: 9 presentations in Burlingame
(RTI, Systronix, SNU, ETRI * 2, NEC, NTT, ATR, Toshiba)
- 2nd Batch: 14 presentations in Tampa
(Hitachi, ADA Software, SEC, Mayekawa MFG, ETRI*3, Tsukuba Univ., AIST, Coroware, IHI, PrismTech, THALES, Toshiba)
- 3rd Batch: 6 presentations in St. Louis
(Samsung*2, Fujitsu, ETRI, SAIT, SEC)

Total: 29 presentations

Organization



Robotic Functional Services WG

Co-chairs :

- Soo-Young Chi (ETRI)
- Olivier Lemaire (JARA/AIST)



omg-service@m.aist.go.jp

Robotics Services WG Mission Statement

- The goal of the **Robotics Services WG** is :
 - Establish a clear definition of Robotic service
 - Identify and categorize services commonly used in robotic application and the technologies involved
 - Define standard interfaces that expose these technologies to robotic application developers
 - Coordinate with other groups within the OMG Robotics Task Force to keep specification consistent

Robotic Device and Data Profile WG

Co-chairs :

- Bruce Boyes (Systronix)
- Seung-Ik Lee (ETRI)

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Profile WG Mission Statement

Application Programmer's View

1. Define scope and model of API
2. Define typical devices
3. Device hierarchies (like class hierarchies)
4. Define interfaces & Data structures
 1. Consider standards such as JAUS
5. Device Profiles
 1. Enumeration of available resources
 2. Resource configuration and capabilities

Physical Resource View

1. Apply relevant standards (IEEE, etc) to robotics
 1. Smart sensors IEEE-1451
 2. Precision networked clock IEEE-1588
 3. Arrange presentations on the above at OMG meetings
 1. 1451 in Anaheim?
 2. 1588 in Wash DC? (near NIST)
2. I/O point tagging, provides:
 1. Enumeration of available resources
 2. Storage of configuration and capabilities
 1. on the actual device or as close to it as possible

Infrastructure WG

Co-chairs:

- Saehwa Kim (Seoul National Univ.)
- Rick Warren (RTI)
- Noriaki Ando (AIST)



omg-infrastructure@m.aist.go.jp

Infrastructure WG Mission Statement

- The purpose of the **Infrastructure Working Group** of the Robotics Domain Task Force is *to standardize fundamental models, common facilities, and middleware to support the development and integration of a broad range of robotics applications.*
- This working group should collaborate with other groups within OMG.
 - Common facilities
 - Fundamental services general to wide range of robotics applications.

Robotic Technology Component (RTC)

- Adopted in the Anaheim Meeting (September 29, 2006)
- Component model for robotics
 - Basis for software modularization and integration at infrastructure/ middleware level in this domain
 - Builds on – does not replace – general-purpose component models



National Institute of Advanced
Science & Technology (AIST)



Real-Time Innovations
(RTI)

Call for Participation

OMG Technical Meeting in Washington DC

December 4-8, 2006

Robotics-DTF meeting

- WG meetings [Mon., Tue., Thu.]
- Plenary meeting [Tue., Wed.]
- Steering committee [Monday]
(any volunteers are welcome!)

<http://www.omg.org/registration/>

Contacts:

Home Page:

<http://robotics.omg.org/>

Mailing List:

robotics@omg.org

Discussion:

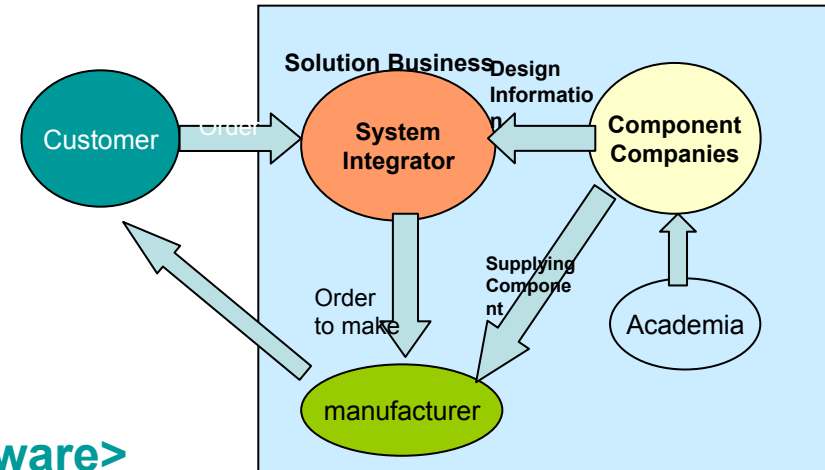
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- omg-service@m.aist.go.jp
- omg-profile@m.aist.go.jp
- omg-tool@m.aist.go.jp

Conclusions

< Key Technology of RT >

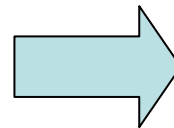
Module-base Open Architecture

- Inter operability
- reusability
- portability
- development tool



<Development and diffusion of RT middleware>

Standardization



< meet the market needs >
New RT Industry