Agent-based Process Management for SOA and WS Applications

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Agent-based approaches for SOA and WS, in print

• W3C Web Services Architecture
  http://www.w3.org/TR/ws-arch/

• Service-Oriented Computing:
  Semantics, Processes, Agents
  by Munindar Singh and Michael Huhns
Traditional business process handling

Simple nested processes
Service-oriented handling - 1

Adaptive Process Manager (Agent Server)

Current State

Plan Library

Process request

Events
Service-oriented handling - 2

Adaptive Process Manager (Agent Server)

Current State

Plan Library

Objective

Condition 1

Logic

Condition 1

Logic

Condition 1

Logic

Process request

Events
Service-oriented handling - 3

Adaptive Process Manager (Agent Server)

Process request

Events

Current State

Plan Library

Objective
Condition
Logic
Condition
Logic
Condition
Logic

Agent-based Process Management
How goal-directed agents work in agents - 1

Agent-based Process Management

Adaptive Process Manager (Agent Server)

Goal Hierarchy

Current State

Plan Library

Process request

Events

Goal

Sub-goal

Logic

Condition 1

Logic

Condition 1

Logic

Condition 1

Logic

Condition 1

Logic

Condition 1

Logic

Condition 1

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Condition 1

Logic

Condition 1

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Condition 1

Logic
How goal-directed agents work in agents - 2

Adaptive Process Manager (Agent Server)

Goal Hierarchy

- Goal
- Sub-goal

Current State

Plan Library

Events

Process request

Condition

Process

Condition

Process
How goal-directed agents work in agents - 3

Adaptive Process Manager (Agent Server)

Goal Hierarchy
- Goal
- Sub-goal

Current State

Plan Library

Events
- Process request

Condition
- Process

Agent

Condition
- Process

Objective

Condition
- Process

Logic
- Condition

Logic
- Condition

Logic
- Condition
Agent-based processing for SOA and WS, thus far

Implicit Programming

Adaptive Process Execution

- Design only Plans and Agent Data
- Independent components easily added or modified
- Agent manages program flow control by dynamic process assembly
- Agent handles error and recovery path

Not

- Program flow must be explicitly coded at design
- Complex and rigid
- Involves tedious programming
- Becomes unmanageable or limits possible variations
Implicit Programming

Explicit Programming

Process
Order
Wafer Fabrication
Assembly
Test
Ship

Variables
C: Customer (RFID, MCU, RISC)
O: Order (RFID, MCU, RISC)

A few simple plans made of few steps
Implicit Programming

Explicit Programming

Process Order C,O

If “RFID”

Procure Wafer C,O

Wafer Fabrication C,O

Receive Wafer C,O

Assembly C,O

Test NA C,O,R,P

Ship NA C,O,R,P

Process
Wafer Fabrication (In-house or Sub)
Assembly
Test
Ship

Variables
C: Customer
O: Order (RFID, MCU, RISC)

Agent Solution

A few simple plans made of few steps
Implicit Programming

Explicit Programming

Process
- Wafer Fabrication (In-house or Sub)
- Assembly
- Test
- Ship

Variables
- C: Customer
- O: Order (RFID, MCU, RISC)
- R: Region (APJ or ROW)

Agent Solution

A few simple plans made of few steps
Implicit Programming

Explicit Programming

Process
Wafer Fabrication (In-house or Sub)
Assembly
Test
Ship

Variables
C: Customer
O: Order (RFID, MCU, RISC)
R: Region (APJ or ROW)
P: Plant (Capacity)

Agent Solution

A few simple plans made of few steps
Implicit Programming

Explicit Programming

Process
Wafer Fabrication (In-house or Sub)
Assembly (In-house or Sub)
Test
Ship

Variables
C: Customer
O: Order (CMOS, RFID, MCU, RISC)
R: Region (APJ or ROW)
P: Plant (Capacity)

Agent Solution

A few simple plans made of few steps
**Agent-based Process Management**

**Implicit Programming**

**Explicit Programming**

**Variables**

- **C**: Customer
- **O**: Order (CMOS, RFID, MCU, RISC)
- **R**: Region (APJ or ROW)
- **P**: Plant (Capacity)

**Agent Solution**

**Process**

- Wafer Fabrication (In-house or Sub)
- Assembly (In-house or Sub)
- Test
- Ship

**Variables**

- **C**: Customer
- **O**: Order (CMOS, RFID, MCU, RISC)
- **R**: Region (APJ or ROW)
- **P**: Plant (Capacity)

**Process**

- Wafer otherwise
- Assem Cap at P1 otherwise
- Assem otherwise
- Assem O=CMOS otherwise

**A few simple plans made of few steps**
Adaptive Process Execution

Coded at design execution

- Only coded execution paths can happen
- Need explicit error and recovery paths
- Complexity limited to “manageable” size
- Failure result in manual intervention

Adaptive Process Execution

- Execution path built as needed “on-the-fly”
- Focused on achieving goals (end-result)
- Automatic recovery in case of failure
- Great number of combinations with few plans
- Significantly reduced manual intervention

Reduces Time To Market and Total Costs of Ownership

- Increases application robustness, especially for unplanned situations
- Reduces design requirements ➔ faster and cheaper delivery
- Lowers cost of operations through reduced manual interventions
Adaptive Process Execution

Case 1:
MCU for APJ customer, no capacity available at plant P1

Agent-based Process Management
Adaptive Process Execution

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Adaptive Process Execution

Case 1:
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Diagram of process execution:

- Process Order
  - If "RFID" Y: Procure Wafer
  - Wafer Fabrication
    - If "CMOS" Y: Receive Wafer
      - Get Capacity
        - Ship to P1 C.O.
        - Assembly C.O.
          - If "APJ" Y: Test APJ C.O.R.P.
            - Otherwise: Ship APJ C.O.R.P.
          - N: Ship NA C.O.R.P.
        - Otherwise: Ship to P2 C.O.R.P.
          - Otherwise: Wafer Test NA C.O.R.P.
    - Otherwise: Ship to P2 C.O.P.
      - Otherwise: P1 Test Cap? N: Ship to P1 C.O.P.
        - Otherwise: Assembly C.O.
          - If "APJ" Y: Test APJ C.O.R.P.
            - Otherwise: Ship APJ C.O.R.P.
          - N: Ship NA C.O.R.P.
        - Otherwise: Receive Wafer C.O.
          - Otherwise: Get Capacity
            - Ship to P1 C.O.
              - Otherwise: Assembly C.O.
                - If "APJ" Y: Test APJ C.O.R.P.
                  - Otherwise: Ship APJ C.O.R.P.
                - N: Ship NA C.O.R.P.
              - Otherwise: Ship to P2 C.O.P.
                - Otherwise: P1 Cap? Y: Ship to P1 C.O.P.
                  - Otherwise: Assembly C.O.
                    - If "APJ" Y: Test APJ C.O.R.P.
                      - Otherwise: Ship APJ C.O.R.P.
                    - N: Ship NA C.O.R.P.
                  - Otherwise: Receive Wafer C.O.
                    - Otherwise: Get Capacity
                      - Ship to P1 C.O.
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                          - If "APJ" Y: Test APJ C.O.R.P.
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                          - N: Ship NA C.O.R.P.
                        - Otherwise: Ship to P2 C.O.P.
                          - Otherwise: P1 Cap? Y: Ship to P1 C.O.P.
                            - Otherwise: Assembly C.O.
                              - If "APJ" Y: Test APJ C.O.R.P.
                                - Otherwise: Ship APJ C.O.R.P.
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                                                                    - N: Ship NA C.O.R.P.
                                                                  - Otherwise: Ship to P2 C.O.P.
                                                                    - Otherwise: P1 Cap? Y: Ship to P1 C.O.P.
                                                                      - Otherwise: Assembly C.O.
                                                                        - If "APJ" Y: Test APJ C.O.R.P.
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                                                                              - If "APJ" Y: Test APJ C.O.R.P.
                                                                                - Otherwise: Ship APJ C.O.R.P.
                                                                              - N: Ship NA C.O.R.P.
Adaptive Process Execution

Case 1:
MCU for APJ customer, no capacity available at plant P1

Process Order
If "RFID"
Procure Wafer
Wafer Fabrication
If "CMOS"
Receive Wafer

Outside Assembly
Ship to Assembly
Ship to P2
Get Capacity

P1 Test Cap?
Ship to P1
Assembly
P1 Cap?
Ship to P2
Assembly

If "APJ"
Test NA
Test APJ

Ship NA
Ship APJ

Test NA
Test APJ

Ship NA
Ship APJ
Adaptive Process Execution

Case 1:
MCU for APJ customer, no capacity available at plant P1

Case 2:
RFID for US customer, capacity available at plant P1

Process Order
If “RFID”
Procure Wafer
If “CMOS”
Get Capacity
Receive Wafer

Outside Assembly
Ship to Assembly
If “APJ”
Test NA
Ship NA

Ship to P2
P1 Test Cap?
Ship to P1
P1 Cap?
Assembly
If “APJ”
Test APJ
Ship APJ

Ship to P2
P1 Cap?
Assembly
If “APJ”
Test APJ
Ship APJ

P1 Test Cap?
Ship to P1
P1 Cap?
Assembly
If “APJ”
Test APJ
Ship APJ

Test NA
Ship NA

Ship to P2
P1 Cap?
Assembly
If “APJ”
Test APJ
Ship APJ

Ship to P1
P1 Cap?
Assembly
If “APJ”
Test APJ
Ship APJ

Case 1: MCU for APJ customer, no capacity available at plant P1
Case 2: RFID for US customer, capacity available at plant P1
Adaptive Process Execution

Case 1:
MCU for APJ customer, no capacity available at plant P1

Case 2:
RFID for US customer, capacity available at plant P1
Adaptive Process Execution

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Adaptive Process Execution

Case 1:
MCU for APJ customer, no capacity available at plant P1

Case 2:
RFID for US customer, capacity available at plant P1

Process Order
If “RFID”

Procure Wafer
If “CMOS”

Receive Wafer
Y

Wafer Fabrication
Y

Outside Assembly
Ship to Assembly
Ship to P1
P1 Test Cap?
Y

Ship to P2
Get Capacity
P1 Cap?
Y

Ship to P2
Assembly
Y

P1 Cap?
Y

Assembly
Y

If “APJ”

Test NA
Ship NA
Ship to Assembly
Ship to P1

If “APJ”

Test APJ
Ship APJ
Ship to P1

Test NA
Ship NA
Ship APJ
Ship to P2

Test APJ
Ship APJ
Ship to P2

Ship to P1
Ship to P2
Ship to Assembly
Ship to P1
Ship to P2
Ship to Assembly

Adaptive Process Execution
Adaptive Process Execution

Case 1:
MCU for APJ customer, no capacity available at plant P1

Case 2:
RFID for US customer, capacity available at plant P1

Case 3:
RFID for US customer, capacity available at plant P1
Sub does not deliver RFID wafers
Adaptive Process Execution

Case 1:
MCU for APJ customer, no capacity available at plant P1

Case 2:
RFID for US customer, capacity available at plant P1

Case 3:
RFID for US customer, capacity available at plant P1
Sub does not deliver RFID wafers
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Sub does not deliver RFID wafers
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Case 3:
RFID for US customer, capacity available at plant P1
Sub does not deliver RFID wafers
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Case 1:
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RFID for US customer, capacity available at plant P1

Case 3:
RFID for US customer, capacity available at plant P1
Sub does not deliver RFID wafers
What happens to the explicit programming?

Must create an explicit error path

Case 1:
MCU for APJ customer, no capacity available at plant P1

Case 2:
RFID for US customer, capacity available at plant P1

Case 3:
RFID for US customer, capacity available at plant P1
Sub does not deliver RFID wafers
The Agent Value Proposition

LOWER TIME AND COST OF DELIVERY BY 65% TO 80%

Time To Market
- Initial deployment: 3-4 months
- Continuous evolution of the application
- Application always in sync with most current business requirements
- Maximum productivity from business requirement to deployment
- Extensively leverages existing IT assets

Total Cost of Ownership
- Short time to market
- Low maintenance costs
- Application robustness reduces need for manual interventions
- Application robustness reduces risk of human error and its adverse financial impact
- High scalability/performance lowers cost of hardware
- Extensively leverages existing IT assets

THE MORE COMPLEX, THE MORE COST-EFFECTIVE

THE MORE COMPLEX, THE MORE COST-EFFECTIVE

65% to 80% savings
Agent-based Process Management for SOA and WS Applications

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