Model Driven Dynamic Composition of Web Services Flow for Business Process Integration

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Agenda

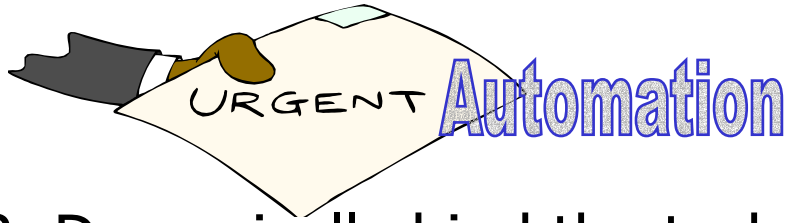
- Introduction
- Adaptive Web Services Composition Framework
  - Major Components
- Research prototype
  - Web based composition portal
  - Eclipse composition toolkit
- Summary

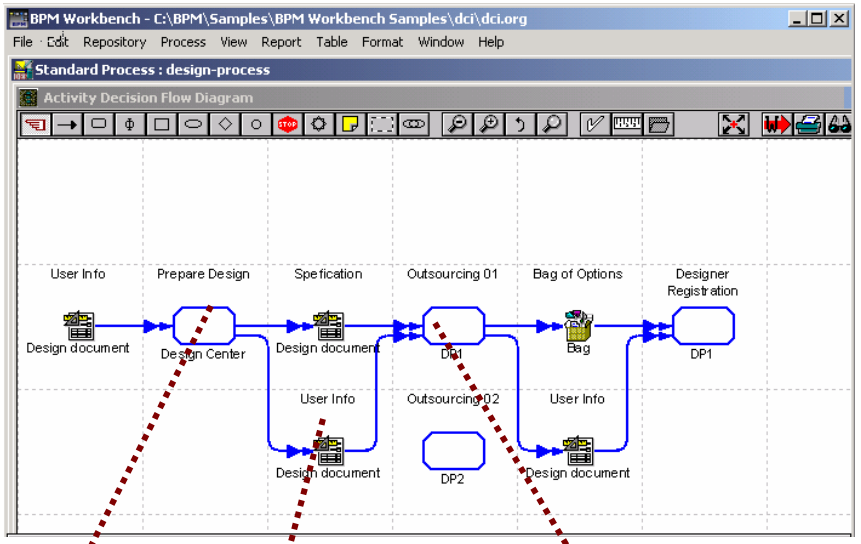
Why Need Dynamic Web Service Composition?

- A business process includes many "stateful," long-running interactions involving two or more parties. Creating business processes on demand is important for meeting changing customer requirements.
  - Companies offering new business processes composed by Web Services is a direct and effective way in which an organization can control costs, improve profits, and enhance overall responsiveness to changing market dynamics. (outsourcing)
- Selection and composition of services in a drag-and-drop manner is time-consuming manual labor. Dynamically composing the flow of Web services via discovery and selection instead of manual coding is imperative for developers.

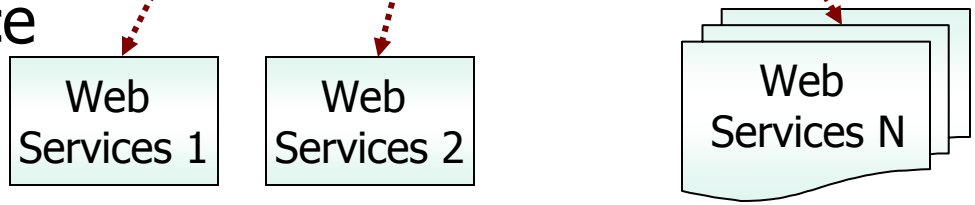
Vision

1. Automatically generate business process flow scheleton





2. Dynamically bind the tasks to specific Web services provided by multiple service providers



3. Adaptively tune the constructed business process flow on a business process engine.

Business Process Flow Languages

- BPEL4WS: Business Process Execution for Web Services
  - IBM, BEA, Microsoft
  - Convergence of WSFL and XLANG
- WSCI: Web Service Choreography Interface (message-flow oriented interface)
  - BEA Systems, Intalio, SAP AG, and Sun Microsystems

Problems to be solved

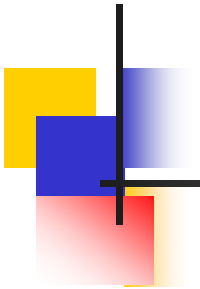
- Lack **uniformed representation** to capture customers' requirements, preferences, QoS, Web Services features, event-action mappings as well as the relationships among Web Services

- Lack an **automation mechanism** to generate search script to dynamically find appropriate Web Services for performing a specific task from UDDI registries with thousands or tons of Web Services records

Problems to be solved (cont.)

- Lack **effective service selection mechanism** to automatically construct an optimal business process using available Web Services

- Lack **efficient tooling** to support dynamic adaptation of Web Services flow to different modeling languages



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Web Services Composition for Business Process Integration

- A business process consists of multiple Web services which maybe provided by different service providers
- A framework should enable dynamic composition of Web services flow based on customer requirements (Business Process On Demand)
- Web Services Outsourcing Manager (WSOM) is an example dynamic composition framework

Adaptive Web Services Flow Composition Framework

- Major Components:
  - Requirement annotation document to describe the customer's requirement, preferences, QoS and relationships
  - Generating Search Script based on the requirement annotation document for Leveraging advanced Web Services discovery engine: First level service selection

Adaptive Web Services Flow Composition Framework (cont.)

- Using optimization algorithm for service selection (aka. service matchmaking) to configure the optimal Web services flow to satisfy customer requirements (e.g. lowest cost, shortest time): **Second level service selection**

- Final Output: WSFL or other Web Services business process languages (BPEL4WS)

Features of the Composition Framework

- Fully automate the end-to-end composition of business processes by using existing Web services.
- Bridge the gap between the informal, subjective customer requirements and the objective, machine-readable flow language, such as BPEL4WS, WSFL, and XLANG.
- Automate the generation of scripts for searching for Web services; and it automates the process of selecting Web services by using a "pluggable" optimization framework.
- Monitor and tune the composed business process so that it adapts to the new requirements at run time.

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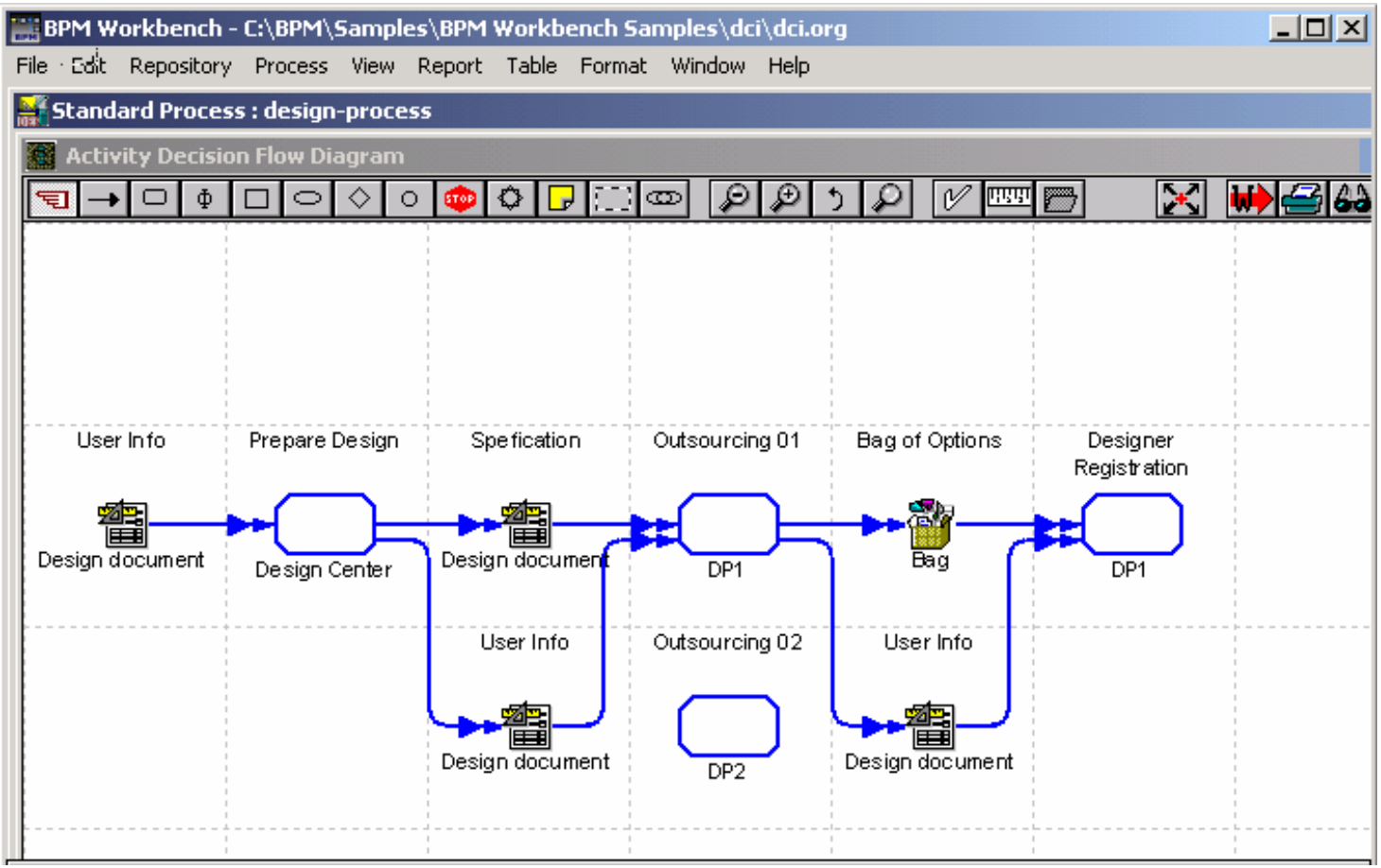
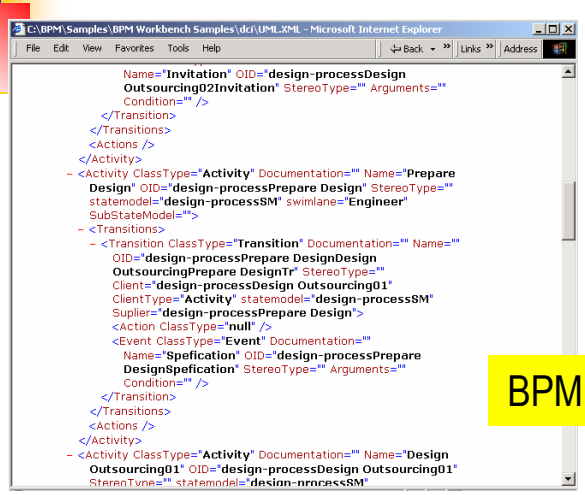
Business Process Template Creation

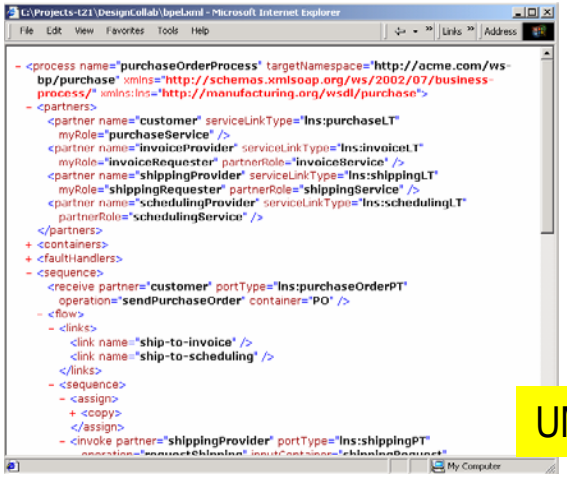


GUI based tool (e.g. HoloSofx Workbench) could be used to create a workflow template.

Internal Representation of a Flow Template

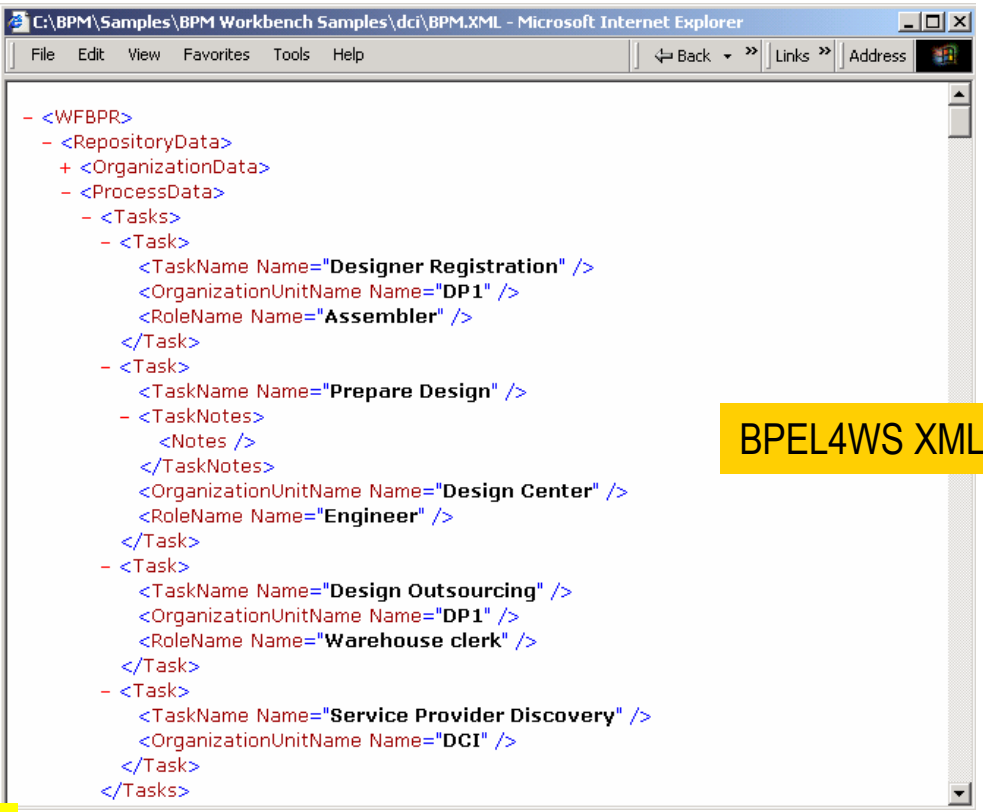


BPM XML



UML XML

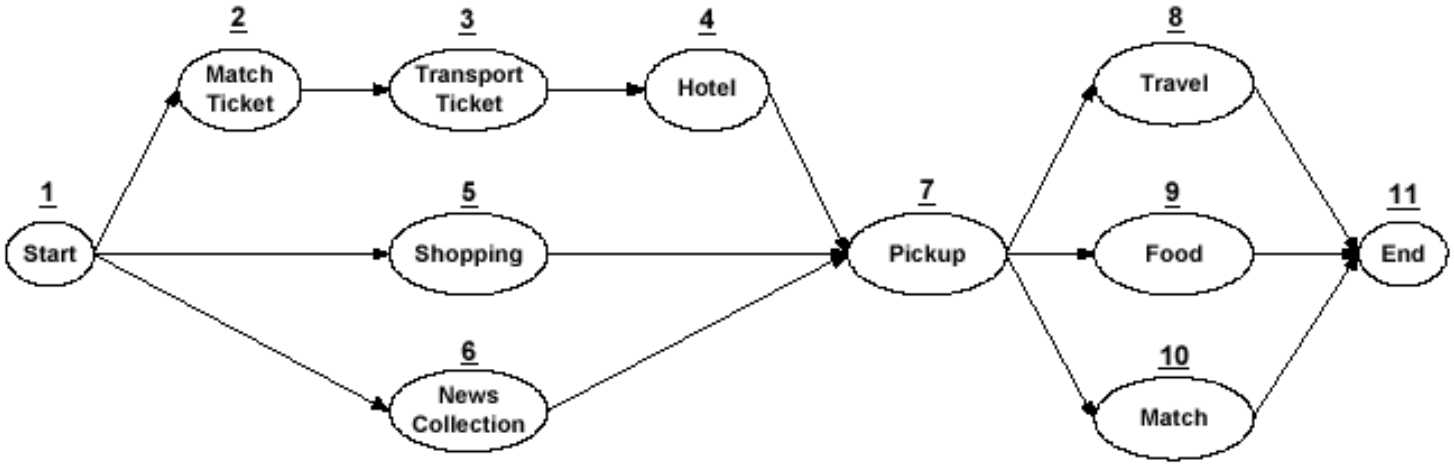
Current Capability



BPEL4WS XML

Enhanced Capability

Example: Travel Planning Process Skeleton



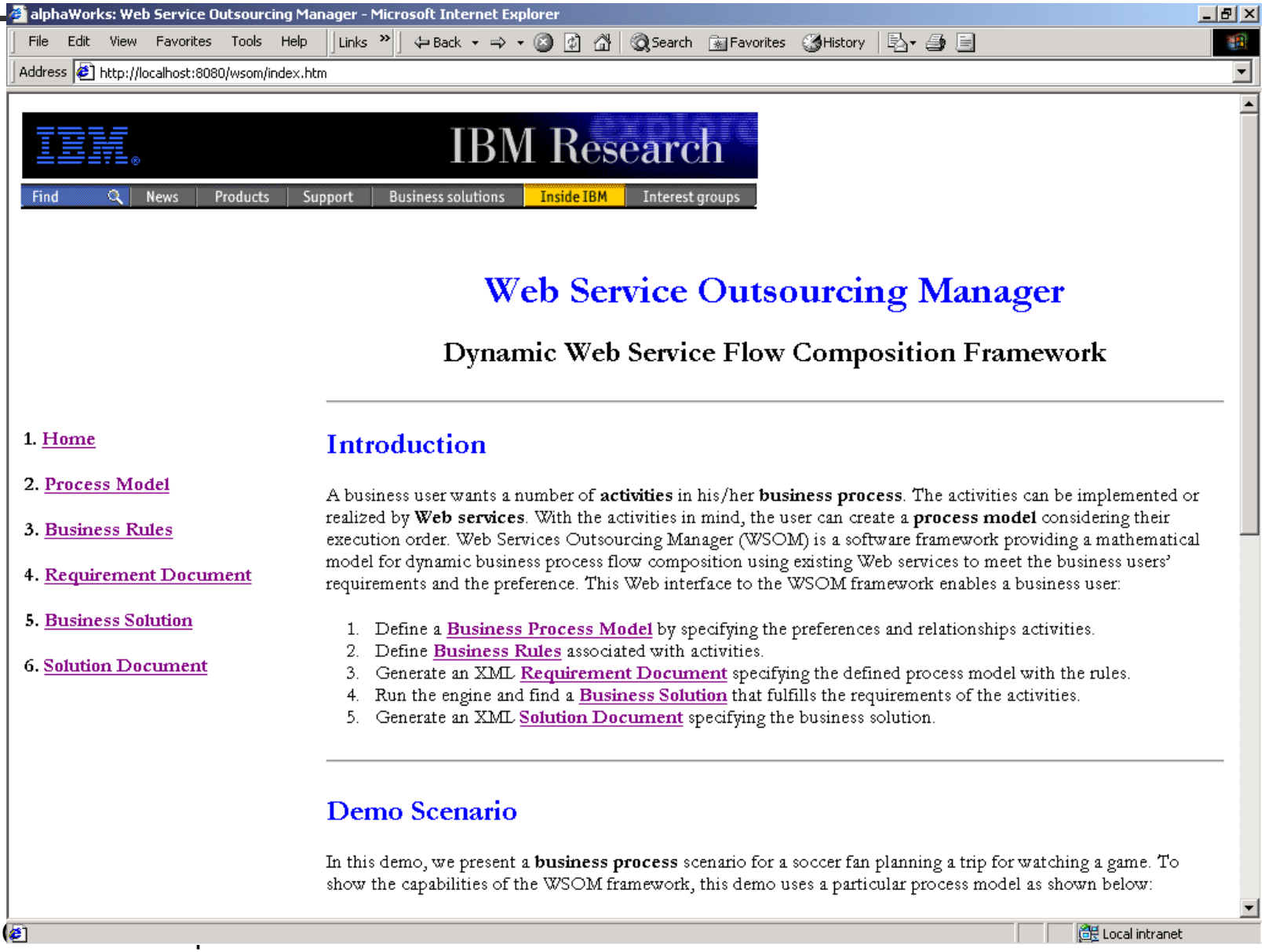
The model contains the following nine activities:

1. Start
2. Purchase a game ticket (Match Ticket)
3. Purchase transportation ticket (Transport Ticket)
4. Book a hotel room (Hotel)
5. Shop for the trip (Shop)
6. Collect news about the game (News Collection)
7. Reserve a pickup service (Pickup)
8. Make a sightseeing plan (Travel)
9. Make a restaurant reservation (Food)
10. Watch the game (Match)
11. End

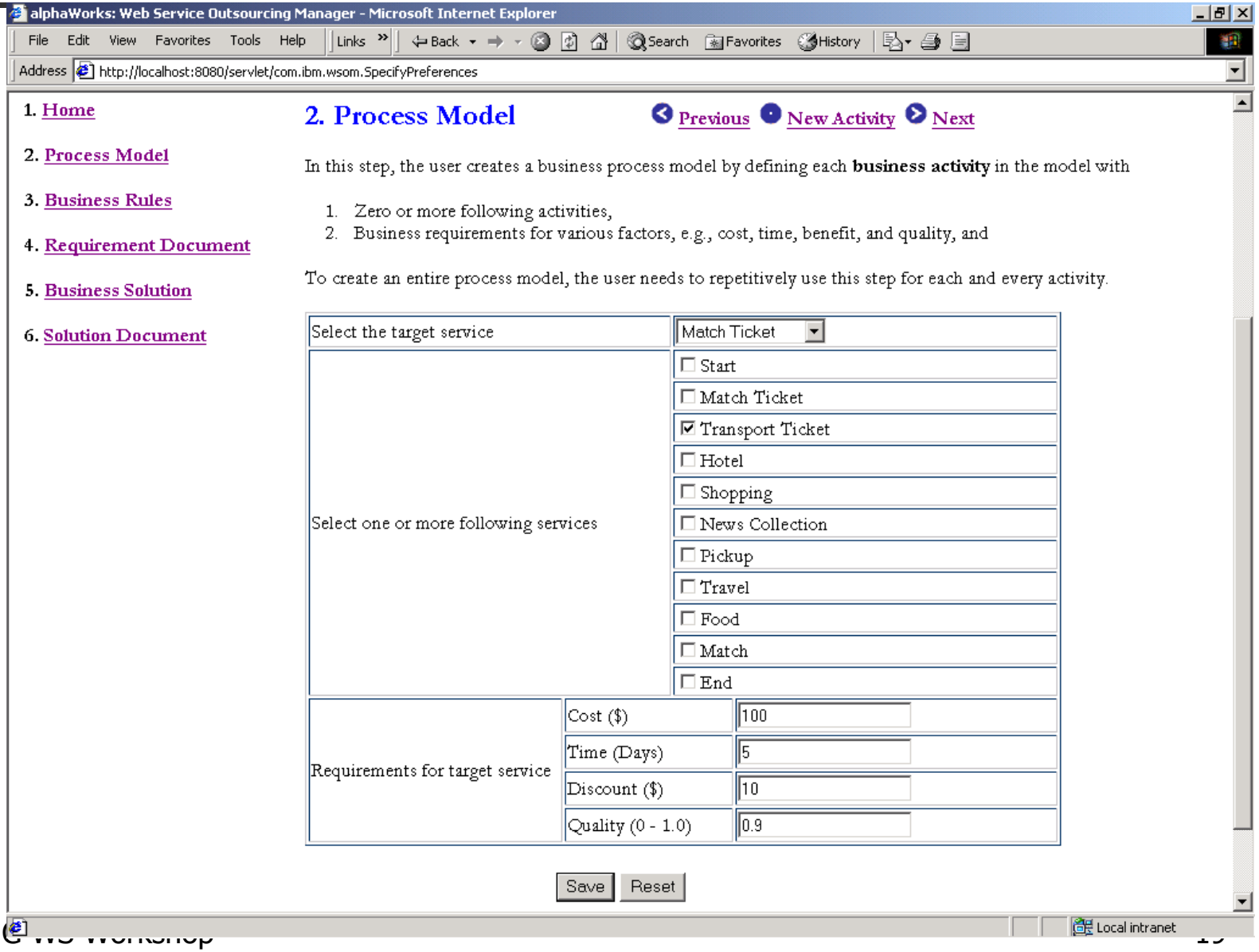
Generate Requirement Annotation Document

- Two major parts in Requirement Annotation Document
  - Flow rules
    - Parallel services
    - Sequential services
  - Customer requirements
    - Preferences (e.g. QoS)
    - Business rules
    - Relationship links
    - Event-action mappings

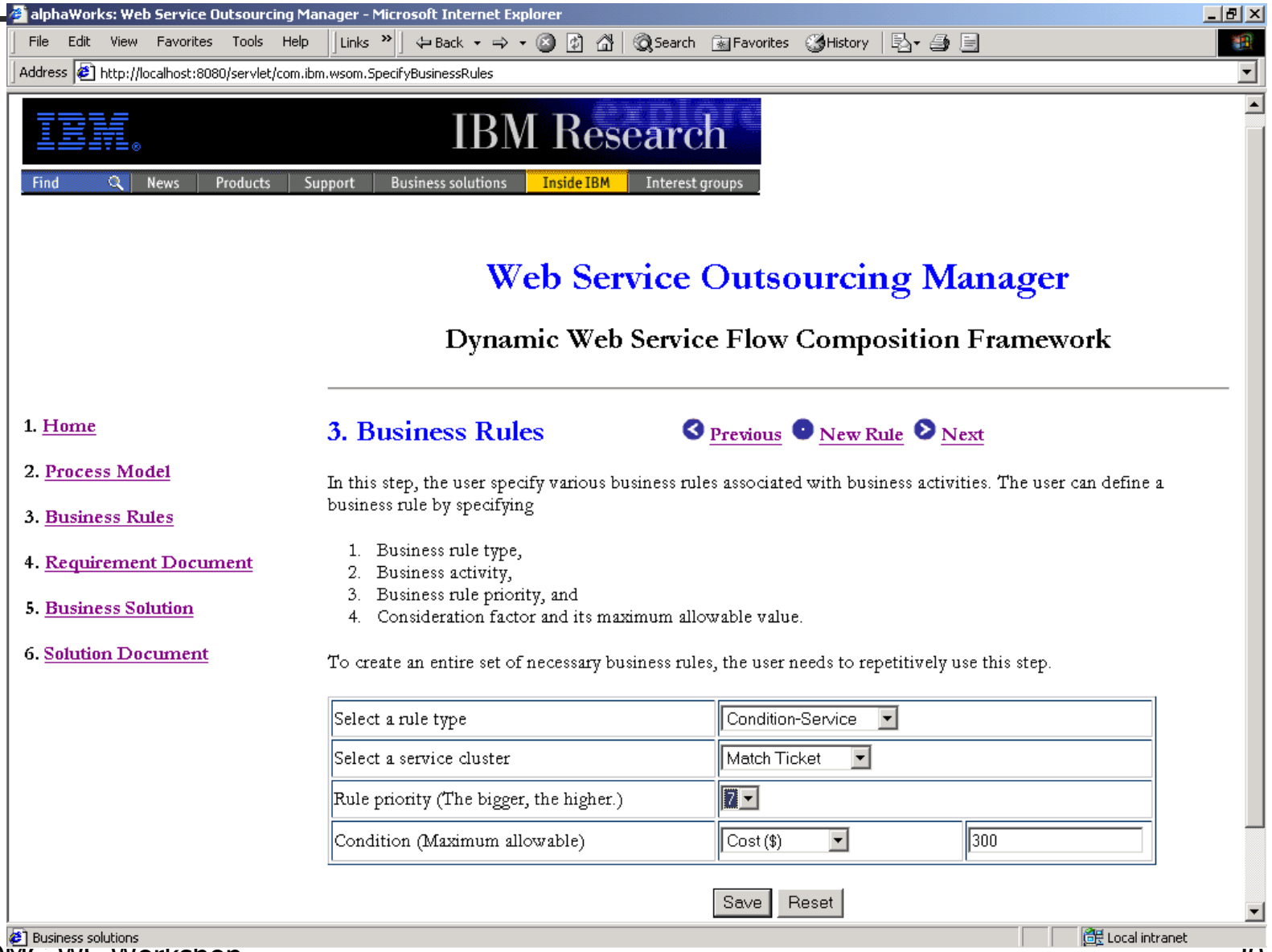
Example: WSOM Web Portal - Screens



Example: Process Model



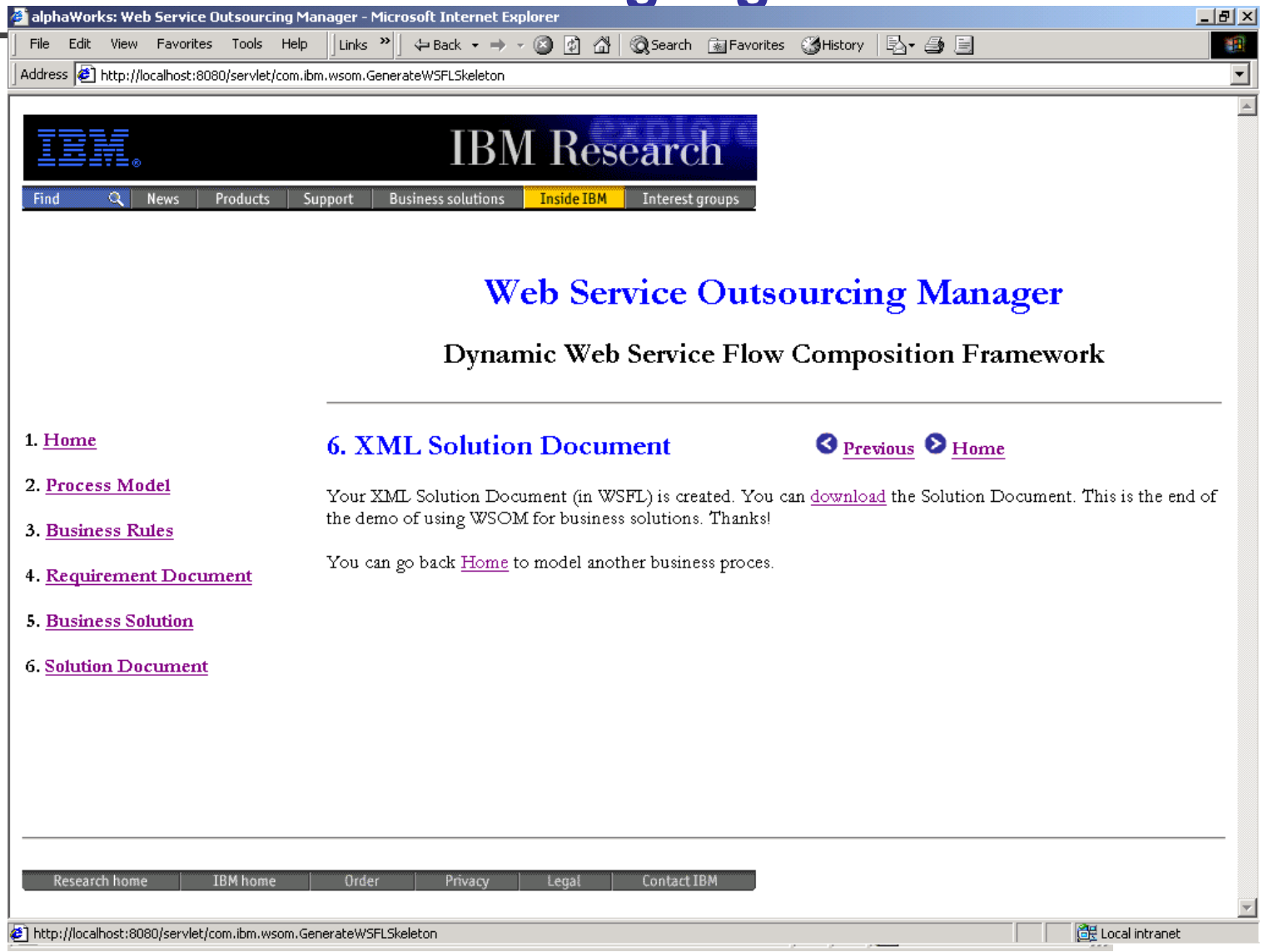
Example: Business Rules Associated with Activities



Example: Requirement Annotation Document Creation

Step 5: Create Business Solution

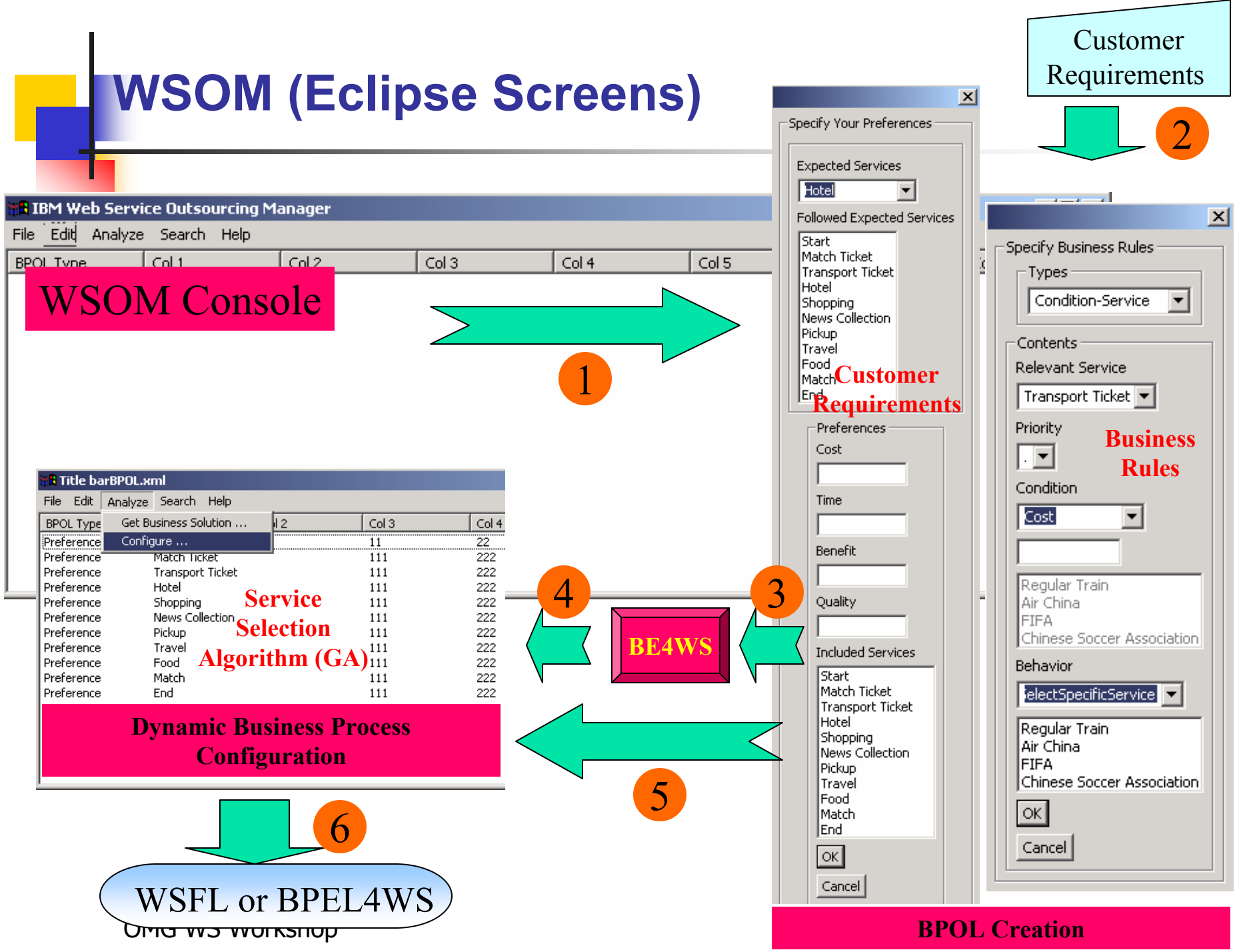
Web Services Flow Language Generation



Example: WSOM Eclipse Edition

- Capture Customer's Requirements
- Capture Business Rules
- Generate Requirement Annotation Document
- Configure Optimal Business Process
- Generate WSFL (or BPEL4WS) Skeleton

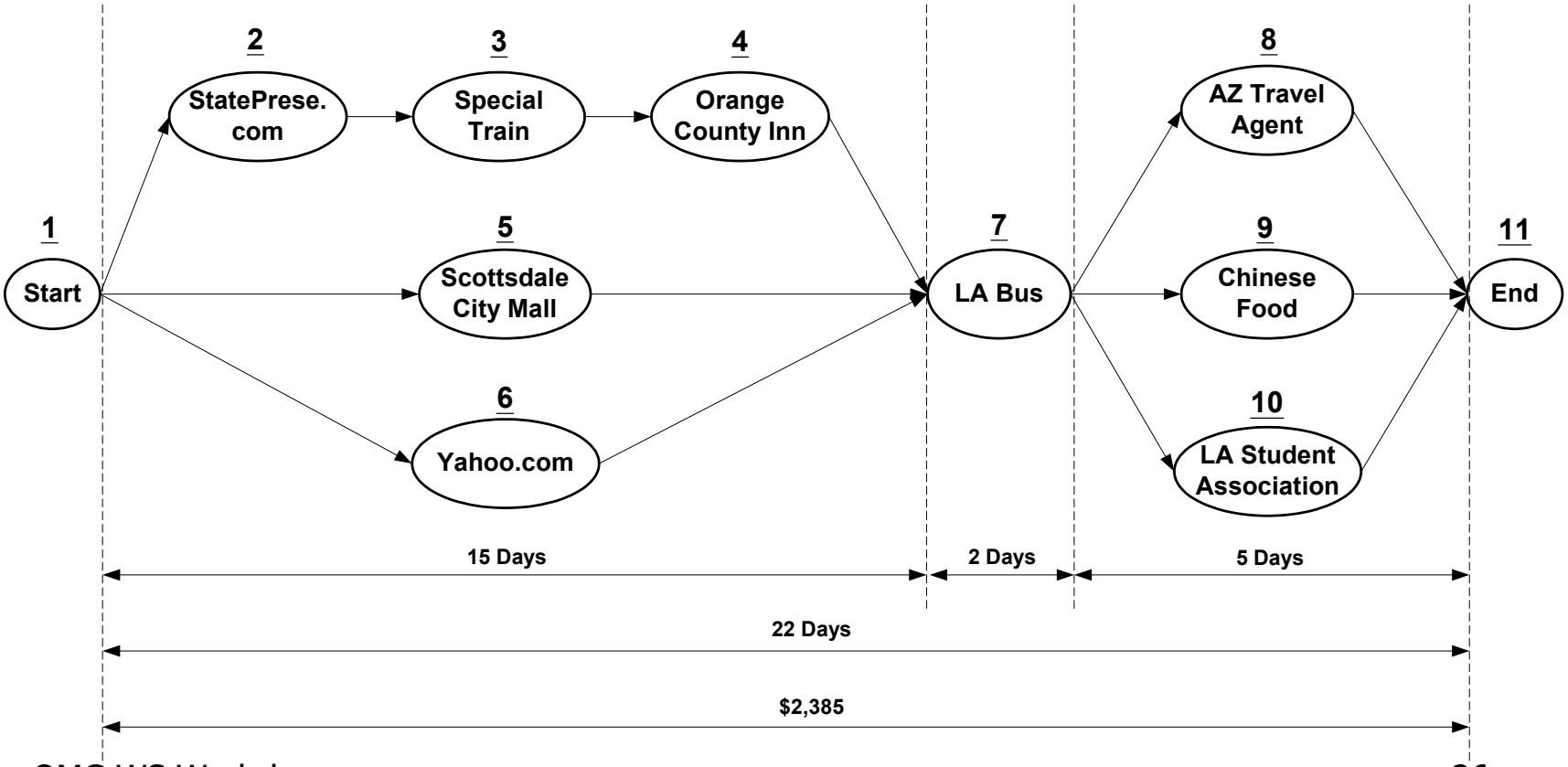
WSOM (Eclipse Screens)



Result: Trip Planning Business Process

- The final business process is constructed by the following service set.

$S^*=\{0010,001000,01,010,001,001,10,100,010\}$



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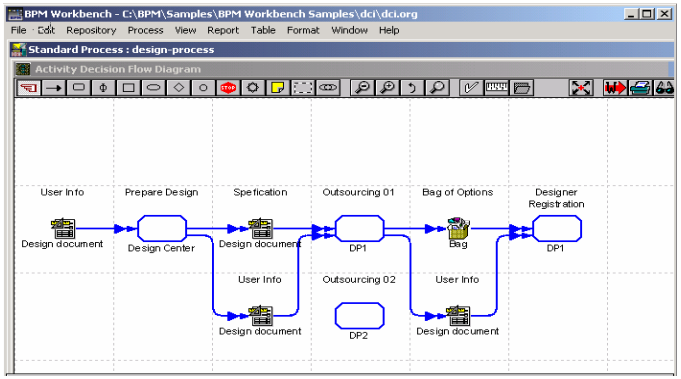
Integrating Model Driven Tool with BPEL4WS



Workflow template
(Business level)

1

BPEL4WS
--
(Abstract Level)

Requirement Annotation

BPEL4WS
Web Services Flow

2

Dynamic Finding
and Binding of
Web Services

3

BPEL4WS
Executable XML
With Real WS Bindings

WSOM

Summary

- A framework that enables dynamic composition of Web services flow
  - Using requirement annotation document to capture customers' requirements for Web services outsourcing (Skeleton based)
  - Automatic search script generation
  - Optimal business process configuration to match customer's requirements
- WSOM can be extended to support **Grid Services Composition**

Resources

- Business Process Execution Language (BPEL4WS)
  - www-106.ibm.com/developerworks/webservices/library/ws-bpel/
- Web Services Outsourcing Manager
  - http://www.alphaworks.ibm.com/tech/WSOM
- Web Services Toolkit
  - http://www.alphaworks.ibm.com/tech/webservicestollkit
  - BE4WS (http://www.alphaworks.ibm.com/tech/be4ws)
  - WSIL Explorer
- Conference Invitation
  - **2003 International Conference on Web Services (ICWS'03)**
    - http://tab.computer.org/tfec/icws03
    - June 23 - 26, 2003, **Las Vegas, Nevada, USA**