Dynamic Execution of a Business Process via Web Service Selection and Orchestration

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Title: Dynamic Execution of a Business Process via Web Service Selection and Orchestration

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Dynamic Execution of a Business Process...

Outlines

- Introduction
- Related Work
- Semantic BP Execution Engine
- Conclusion and Perspectives

ICCS 2015

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• Business Process
  – “A workflow system automates a business process, in whole or in part, during which documents, information, or tasks are passed from one participant to another for action, according to a set of procedural rules” Papazoglou

• Modeling Notations
  – Business Process Modeling Notation (BPMN), Workflow, Petri Net, Unified Modeling Language (UML) and Business Process Modeling Language (BPML)
### Business Process Modeling Notation (BPMN)

- Proposed by *Business Process Management Initiative (BPMI)* is used to model business process within a workflow.
- Comprise of various graphical components to model the specification of a business process. There is a mapping between each of the BPMN notation and the implementation and execution languages.

### Fundamental Building Block: SOA

- According to the Zap survey about 50% of enterprises build their solution on SOA, while more than 25% planned to use it within the near future.
• Dynamic Execution of BP
  – challenging and elusive task especially when the service task has to be executed based on user requirements at the runtime.
  – via Web Service Selection and Orchestration

• Two Approaches for BP execution
  – Direct call within BP
  – Via Intermediate Class/Method
• Web service selection
  – is a hard task when there is a list of pertaining services with similar functionalities that fulfil user requirements.
  – It becomes more challenging when we know our requirements at runtime

• *Service Orchestration*
  – deals with the mechanism in which the involved web services are under control of a single endpoint central process (another web service)
  – invoked web services neither know that they are involved in a composition process
Approaches for Dynamic Execution of Business Process

- Direct call within BP
  - Complex, manual interface
  - No Dynamic Execution
  - Fast
  - Not flexible, hard code
  - Change in service leads to Change in BP

- Via Intermediate Class
  - Simple & middle layer
  - Allows Dynamicity
  - Slow
  - Flexible, change in class
  - Change in service leads no Change in BP

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Dynamic Execution

Via Intermediate Class/Method
Dynamic Execution of a Business Process... ICBS 2015

Dynamic Execution

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Via intermediate class or method
FITMAN Project

- **Mission**
  - Build industry-led use case trials in the Smart, Digital and Virtual Factories
  - Test and Assess FI-WARE Generic Enablers

- **Our Partner**
  - Plastic industry SME: APR

  **Applications Plastiques du Rhone**
• Current situation:
  – Paper based tracking for Order lifecycle
  – Lack of traceability throughout the interaction lifecycle
  – Lack of added value interaction with customers
  – Time consuming and tedious task of validation

• Solution
  – Dynamic Execution of Business Process
• Closest works
  – Casati et al. proposed an adaptive and dynamic service composition in EFlow platform for the static workflow generation. They formulated a graph for the composite services that includes services, decisions and events and also captured the order of execution inside the graph.
  – Schuster et al. designed enterprise processes by modeling and composing services in their Polymorphic Process Model (PPM). The interesting feature in PPM is that they model service as a state machine which encapsulates various possible states of a service and their order of execution. For the service composition, they perform reasoning on the state machine based on its transitions.

FITMAN Project

Related work
Semantic-Based Business Process Execution Engine
Steps Required

- BP parser that gets input process and deploys it for the execution.
- Service task annotator is responsible to analyze and annotate the service task with the semantic information.
- Implement an ontology-based match making algorithm for the invocation of desired web service.
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BP Create Order

**Customer**
- Demand Order
- Register Demand

**Sales Assistant**
- Validate Customer Profile
  - guarantee ok: Update Customer Profile
  - guarantee not ok: Reject Order

**Account Manager**
- Validate Order
  - quote exists: Order Approved
    - Generate Receipt
  - quote does not exist: Order Rejected
    - Notify Rejection
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User Interface
Dynamic Execution of a Business Process...

Project Ontology

- owl:Thing
  - Project_Data
    - Project_Files
      - BOM_conception
      - CAD_file
      - Plan_Document
      - Project_Package
      - Quote_Request
      - Specification_File
    - Project_Information
      - Delivery_Date
      - Designation
      - Index
      - Plan_Code
      - Project_Reference
      - Quantity
    - Project_Delivery
      - Extra_Speddy
      - Immediate
      - Regular_Delivery
    - Project_Size
      - Big
      - Medium
      - Mini
      - Small
  - Client_Info
    - ContactPerson_Information
      - ContactBy
        - Email
        - Fax
        - Phone
      - Name
        - FirstName
        - LastName
        - MiddleName
      - Position
    - Company_Information
      - Address
      - Code_APE
      - N_Siret
      - Title
      - TVA
    - Customer_Status_Information
      - Customer_Security_Info
        - Faulty
        - NoParticular_Status
        - Trustworthy
    - CustomerType
      - ordinary
      - Regular
      - VIP
### Semantic Rules in SWRL

<table>
<thead>
<tr>
<th>Example</th>
<th>Semantic Repository based on SWRL Rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Project</td>
<td>Project(?x) ∧ hasOrderQuantity(?x, ?y) ∧ LessThan(?y, 8) → Small_Project(?x)</td>
</tr>
<tr>
<td>Big Project</td>
<td>Project(?x) ∧ hasOrderQuantity(?x, ?y) ∧ greaterThan(?y, 20) → Big_Project(?x)</td>
</tr>
<tr>
<td>Immediate Delivery</td>
<td>Project(?x) ∧ DeliveryDate(?x, ?yMonth) ∧ ReceptionDate(?x, ?zMonth) ∧ subtract(?zMonth, ?yMonth, ?wMonth) ∧ LessThan(?wMonth, 2) → Immediate_Delivery_Project(?x)</td>
</tr>
<tr>
<td>Regular Delivery</td>
<td>Project(?x) ∧ DeliveryDate(?x, ?yMonth) ∧ ReceptionDate(?x, ?zMonth) ∧ subtract(?zMonth, ?yMonth, ?wMonth) ∧ greaterThan(?wMonth, 6) → Regular_Delivery_Project(?x)</td>
</tr>
<tr>
<td>Special Type Project</td>
<td>Project(?x) ∧ OrderedBy_Customer(?x, ?y) ∧ CustomerType(?y, VIP) → Special_Project(?x)</td>
</tr>
<tr>
<td>Faulty Customer</td>
<td>Customer(?x) ∧ CreditDue(?x, ?y) ∧ GuaranteeAmount(?x, z) ∧ LessThan(?z, 5000Euro) → Faculty_Customer(?x)</td>
</tr>
<tr>
<td>Regular Customer</td>
<td>Customer(?x) ∧ DeliveredOrder(?x, ?o) ∧ greaterThan(?o, 2) → Regular_Customer(?x)</td>
</tr>
</tbody>
</table>
Dynamic Execution of a Business Process ...

Semantic BP Execution Engine

Service Monitor and Reasoner

1. Annotate semantic info
   - Analyze task
   - Annotate semantics
   - Synonyms from WordNet

2. Select appropriate service

3. Execute service
   - Invoke web service
   - Complete task
   - Bundle result

Monitor and Reasoner

Web Service Selector
   - Ontology match making
   - Ontology based Reasoning
   - Select Best Service

Seman-tic BP Execu-on Engine

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Conclusion and Perspectives
• Web service selection is a hard task when there is a list of pertaining services with similar functionalities that fulfil user requirements.

• Ontology Driver Architecture can facilitate the desired objectives
  – SWRL based Semantic Rules help in decision making
  – Semantic match making to choose optimal web services accordingly or compose different services fulfilling individual requirements and attributes that carry out parts of complex business process or workflow.
References

- J. Saat and S. Discher. Economic Justification of SOA, Joint SAP, University of St. Gallen Research Study
- I. Horrocks et al., SWRL: A Semantic Web Rule Language Combining OWL and RuleML. http://www.w3.org/Submission/SWRL/
Thank you for your attention.