Agile Services: A Reference Architecture for Creating Dynamic Processes

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Outline

- Research background and approach
- Business rules at different levels
- Kernel theory: Complex Adaptive Systems
- Towards a reference architecture
- An illustrative example
- Principles for improving flexibility and agility
- Conclusion and future research
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Research Background

• Organizations increasingly pay attention to the creation of flexible and agile business processes to
  • ensure compliance with frequently changed policy
  • to adapt to customer needs
  • enable cross-organizational cooperation
• In their attempt to improve flexibility and agility organizations are adopting Service Oriented Architecture (SOA) to accommodate their business processes in a distributed computing environment
• SOA is at the technical level, whereas many challenges are at the policy implementation level
• New semantic technologies (RDF, OWL, RIF, …)
Research Domains and Issues

Knowledge representation
Patterns
End-user services

Multi-agent System
Messaging services
Technical web services

Law implementation
Law making
Legislation

Business Rule
Process creation

Service Delivery Network
Policy deployment
Operational processes

Implementation of operation

Organization A
Organization B

Focus on service delivery network

Challenge the future
Thesis objective

• The goal of this thesis is to develop a reference architecture that improves the flexibility and agility of business processes.
• The focus is on situations within a dynamic and complex environment. The architecture is driven by SOA and business rules and centrally the service concept.
• A design science approach is followed.
Design Science*

* Based on Hevner et al. (2004)
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Business Rules

• A Business Rule (BR) is a directive intended to influence or guide business behaviours
• The core concept in BRs is the “separation of concerns”
• In SOA environment, the “separation of concerns” can be further explained as the separation of not just process and knowledge but also resource
• Use of multiple repository of business rules
• Business rules can be accessed by services
• No uniform on what constitutes a business rule
Separation of Concerns

- Resource
- Decision Service
- Process Rules
- Supportive Service
# Business Rules at Different Levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Typical Formats</th>
<th>Users</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy-making</td>
<td>Text</td>
<td>Human</td>
<td>legislation</td>
</tr>
<tr>
<td>Policy Representation</td>
<td>Ontology models, SBVR rules, RIF rules</td>
<td>Inference engine, translation component</td>
<td>cpt: sell(ppl:John bks:LeRif ppl:Mary)</td>
</tr>
<tr>
<td>Operational</td>
<td>ECA rules, Production rules, Programming languages</td>
<td>Software agent, Web Service, other software applications</td>
<td>If... then ...</td>
</tr>
</tbody>
</table>

The research challenge is how to connect these levels

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Complex Adaptive System

- Complex Adaptive Systems (CAS) are characterised as open, non-linear dynamical systems that adapt and evolve in the process of interacting with their environments – they have the potential (capacity) for adaptation and transformation.
- The systems consist of autonomous agents with the ability to adapt according to a set of rules and responding to change in the environment.
- Each agent as intelligence (modelled by business rules).
- CAS theory views that a system is made up of interacting entities: agents.
- Highly agile and flexible systems are characterized by the increased variety achieved through high modularity.
- The current SOA systems have a limitation as they have to composite services in design time or generate service composition plan in deployment time.
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Towards a Reference Architecture
The Insurance of Policy Compliance

Policy

Policy-making Level

BR Models (decision related) → BR Models (process related)

Policy Representation Level

Translation component → Inference Engine

Operational Level

Decision Service → Process Rule Manager Agent
The Need of Translation Components
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Example: Highly Skilled Migrant

- The highly skilled migrant admission legislation is introduced to enable qualified foreigners to work in the Netherlands
  - In 2007, the annual income limitation on an applicant was at least 46,541 EUR or 34,130 EUR if the applicant is under 30
  - In 2008, the income limitation for a foreign graduate that obtained a Bachelor or Master Degree at an accredited Dutch educational institution within one year before becoming employed, was changed to 25,000 EUR annually
  - In 2009, Master and PhD students who graduated in the Netherlands or at a university listed in the top 150 of two internationally recognized rankings
# Services in the HSM Case

<table>
<thead>
<tr>
<th>SWS</th>
<th>Specification</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS01</td>
<td>{{Request, HSM Regular}, {Age, Income}, {Decision}}</td>
<td>Regular HSM decision service issued in HSM policy 2007.</td>
</tr>
<tr>
<td>DS02</td>
<td>{{Request, HSM Dutch Graduate}, {Income, Degree, Accredidment, Graduation_date}, {Decision}}</td>
<td>Decision service for Dutch graduate issued in HSM policy 2008.</td>
</tr>
<tr>
<td>DS03</td>
<td>{{Request, HSM Foreigner Graduate}, {ID, Income, Degree, Ranking, Graduation_date}, {Decision}}</td>
<td>Decision service for foreigner graduate issued in HSM policy 2009.</td>
</tr>
<tr>
<td>SS01</td>
<td>{{Check, Income}, {ID}, {Income}}</td>
<td>Check the income information.</td>
</tr>
<tr>
<td>SS02</td>
<td>{{Check, Institute, Accredidment}, {Institute}, {Accredidment}}</td>
<td>Check whether an institute is an accredited Dutch educational institution.</td>
</tr>
<tr>
<td>SS03</td>
<td>{{Check, Ranking}, {Institute}, {Ranking}}</td>
<td>Check whether an institute is listed in the top 150 of a certain ranking.</td>
</tr>
</tbody>
</table>
Agent Coordination
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Abstraction of the architecture: Principles

- **Principle 1**: The organization should formulate a business process using the concept of Business Service
- **Principle 2**: The ICT system should use a modular architecture, in which the modules can be easily managed independently and therefore allow the flexible composition of dynamic processes
- **Principle 3**: Use business rules to separate the management of process, knowledge and resource
- **Principle 4a**: Business rules should be usable in multiple processes
- **Principle 4b**: Business processes should be able to include business rules originated from various sources
- **Principle 5**: Policy implementation should be done in collaboration with other organizations instead of doing it individually
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Conclusion

• Flexibility and agility is still a trade-off with other system perspectives like robustness
• Principles are generic guidelines that help to create flexibility and agility
• Our architecture helps organizations to design better SOA systems which have higher flexibility and agility to deal with changes in policy and facilitate the creation of ad-hoc processes
• The research presented in this thesis has several contributions on BPM theory and CAS theory
• Organizations should essentially rethink their current IT architecture with the principles we introduced and compare their IT architecture with the reference architecture to identify the limitation of flexibility and agility
Contributions of This Research

• It identifies the limitations of current efforts to enhance flexibility and agility of business processes in SOA
• It broadens the use of business rules from decision making to dynamic process creation by making use of the autonomy, pro-activeness, dynamism, goal-oriented and rule-based behaviour agents provided
• It introduces a framework to manage the BRs from knowledge representation of policy descriptions to executable rules conducting the behaviours of software agents
• It introduces a method to measure and evaluate flexibility and agility
• It connects Semantic Web and software agent technology using RIF
• It enriches the CAS theory and its practice in the field of e-government systems by providing a case study of current practical system and simulation on further desired system
Future Research

- Extend the knowledge presentation components by involving technologies that allow knowledge acquisition from text to enhance compliance with the source of law.
- Involve cross-organization processes creation and their monitoring to evaluate its contribution in building cross-organization systems.
- Conduct extensive case studies to refine and improve the architecture.
Questions and Discussion