Goal and Variability Modeling for Service-oriented Systems: Integrating i* with Decision Models

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Research Context

- Multi-Stakeholder Distributed System (MSDS) [Hall-2002]
  - Nodes are designed, developed, and operated by distinct stakeholders
  - Stakeholders have limited knowledge about nodes developed by other stakeholder groups
  - Changes to system nodes are uncontrollable and likely lead to conflicts between stakeholders’ requirements

- Example: Networks of web services
  - Provider of payment service has incentive to sell personal data about customer behavior
  - Web portal insists to ensure her privacy
Framework for MSDS Requirements Engineering

Stakeholder Needs
(Interests, Values, Goals, Conflicts, Agreements)

Analysis Monitoring

Architecture Prescription
(Service and Component Specifications)

Payment Service Provider: “Maximize benefit”

Payment Service
Flight Booking Service

Solution Architecture
(SELECTED SERVICES AND COMPONENTS, CONFIGURATION)

Payment Service CheatCard
Flight Booking Service Amadeus

Open System
(Runtime Components and Services)

Customer: “Ensure privacy of personal data”

CheatCard deployed at URL someurl.com

Example

- Understand variability at different levels/views
  - Deal with different levels of abstraction
  - Model dependencies between views

Architecture prescription  Solution architecture

Runtime configuration

Stakeholder needs
Dealing with variability

- Visualize variation points in i* models ("?")

- Complement i* with decision model
  - i* benefits
    - Visualize dependencies
    - Views for different concerns
    - Traceability
  - What is missing in i*
    - Constraints (e.g., between services)
    - Precise conditions under which services become active or inactive
    - Support for different types of decisions and cardinalities
Variation point: Travel service provider

- **Decision**: `typeOfTravelServiceProvider`
- **Alternative values**: flight, hotel, camping
- **Cardinality**: 1:3
- **Layer**: Architecture Prescription
- **i* element**: Travel services provider
- **Relevance**: always
- **Constraints**: if `typeOfTravelServiceProvider=="camping"` then `whichTravelService=Amadeus`

- **Decision**: `whichTravelService`
- **Alternative values**: Amadeus, TS
- **Cardinality**: 1
- **Layer**: Architecture Solution
- **i* element**: Travel services provider
- **Relevance**: `typeOfTravelServiceProvider` does not include camping
- **Constraints**: none
<table>
<thead>
<tr>
<th>Decision</th>
<th>alternative values</th>
<th>cari* level</th>
<th>Stakeholder* element</th>
<th>relevance</th>
<th>Constrains</th>
</tr>
</thead>
<tbody>
<tr>
<td>typeOfCustomerAssistance</td>
<td>synch, asynch</td>
<td>1/2 SN</td>
<td>TA</td>
<td>Customer Assistance Provided</td>
<td></td>
</tr>
<tr>
<td>typeOfSynchronousAssistance</td>
<td>Human, Computer</td>
<td>1/2 AP</td>
<td>TA</td>
<td>Synchronous support</td>
<td></td>
</tr>
<tr>
<td>typeOfAsynchronousAssistance</td>
<td>email, SMS</td>
<td>1/2 AP</td>
<td>TA</td>
<td>Asynchronous support</td>
<td></td>
</tr>
<tr>
<td>typeOfComputerAssistance</td>
<td>skypes, MSN Messenger</td>
<td>1/2 AS</td>
<td>TA</td>
<td>Computer based assistance (role)</td>
<td></td>
</tr>
<tr>
<td>typeOfSkype</td>
<td>My skypes, hosted skylarke</td>
<td>1/2 OS</td>
<td>TA</td>
<td>Skype (agent)</td>
<td></td>
</tr>
<tr>
<td>LevelOfCustomerSupport</td>
<td>minimal, medium, full</td>
<td>1 SN</td>
<td>TA</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>LevelOfReliability</td>
<td>high, low</td>
<td>1 SN</td>
<td>TA</td>
<td>Reliability</td>
<td></td>
</tr>
<tr>
<td>typeOfIdentification</td>
<td>classical login, finger print</td>
<td>1 AP</td>
<td>TA</td>
<td>Identification means provided</td>
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<tr>
<td>typeOfLogin</td>
<td>fastLogin, secureLogin</td>
<td>1 AS</td>
<td>TA</td>
<td>Login (Management (role)</td>
<td></td>
</tr>
<tr>
<td>typeOfFingerPrint</td>
<td>cheap finger match, fast finger match</td>
<td>1 AS</td>
<td>TA</td>
<td>Finger (Management (role)</td>
<td></td>
</tr>
<tr>
<td>LevelOfSecurity</td>
<td>minimal, medium, full</td>
<td>1 SN</td>
<td>TA</td>
<td>Contracting process perceived as secure</td>
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<tr>
<td>LevelOfPrivacy</td>
<td>minimal, medium, full</td>
<td>1 SN</td>
<td>TA</td>
<td>Customer data kept isolated</td>
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<tr>
<td>typeOfTravelPayment</td>
<td>credit card, transfer, worldwide</td>
<td>1 AP</td>
<td>TSI, TA</td>
<td>Payment services provider (external actor)</td>
<td></td>
</tr>
<tr>
<td>typeOfServiceTravelProvider</td>
<td>flight, hotel, camping</td>
<td>1 AP</td>
<td>TSI, TA</td>
<td>Travel service provider</td>
<td></td>
</tr>
<tr>
<td>whichTravelService</td>
<td>Amadeus, TS</td>
<td>1 AS</td>
<td>TA</td>
<td>Travel service provider</td>
<td></td>
</tr>
<tr>
<td>whichCreditCardService</td>
<td>CheapCard, Securitas, NorbSecureCredit, FastAndCheap</td>
<td>1 AS</td>
<td>TA</td>
<td>CreditCardService</td>
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<tr>
<td>whichAmadeusService</td>
<td>Austrian, Spanish</td>
<td>1 OP</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>AustrianAmadeusAverageResponse</td>
<td></td>
<td>0P</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>SpanishAmadeusAverageResponse</td>
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<td>0P</td>
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</tbody>
</table>
Tool Support: Customizing the DecisionKing meta tool
Tool Support: Decision modeling in DecisionKing
Configuration Wizard for design-time / runtime decisions
Illustrative Scenario

Automated adaptation of runtime configurations
Summary

Current status

- Developing decision tables for TA example
  - Refining decision tables design
  - Using means-end link to describe variation points on i* models
- Focus on monitoring and adapting
  - How to use models and decision tables to react to the system changes
  - Monitoring values are decisions!

Future work

- Use of variability models in runtime service monitoring
  - Develop plug-in for ConfigurationWizard that integrates with service monitors
- Integrating tools (based on i*ML)
  - REDEPEND: i* models
  - Decision King: variability models
Thank you for your attention!

http://ase.jku.at/dopler