

SVM-WS 07, Helsinki

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

**Paul Grünbacher  
Deepak Dhungana  
Michael Quintus  
Norbert Seyff**

**Johannes Kepler University  
Linz, Austria**

**Lidia López  
Roger Clotet  
Xavier Franch  
Jordi Marco**

**Universitat Politècnica  
de Catalunya Barcelona, Spain**

# 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)*

Customer: "Ensure privacy of personal data"  
Payment Service Provider: "Maximize benefit"

Analysis

Monitoring

**Architecture Prescription**  
*(Service and Component Specifications)*

Payment Service  
Flight Booking Service

Clotet, R., Franch, X.,  
Grünbacher, P., López, L.,  
Marco, J., Quintus, M., Seyff, N.:  
**Requirements Modelling for  
Multi-Stakeholder Distributed  
Systems: Challenges and  
Techniques.** RCIS'07

**Solution Architecture**  
*(Selected Services and Components, Configuration)*

Payment Service CheatCard  
Flight Booking Service Amadeus

Synthesis

Adaptation

**Open System**  
*(Runtime Components and Services)*

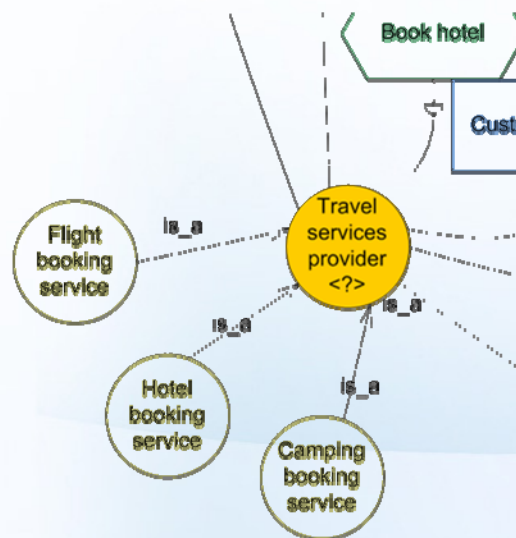
CheatCard deployed at URL someurl.com

# Example

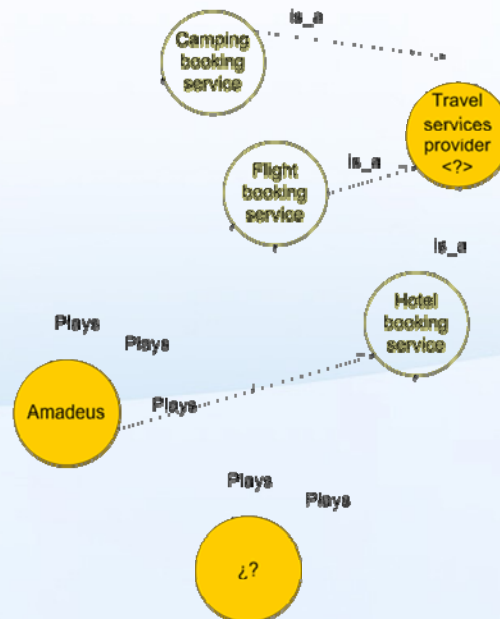
## ■ Understand variability at different levels/views

- Deal with different levels of abstraction
- Model dependencies between views

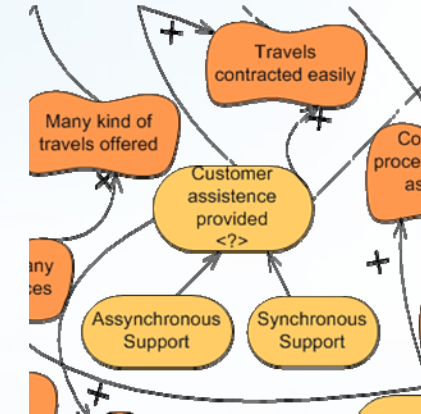
### Architecture prescription



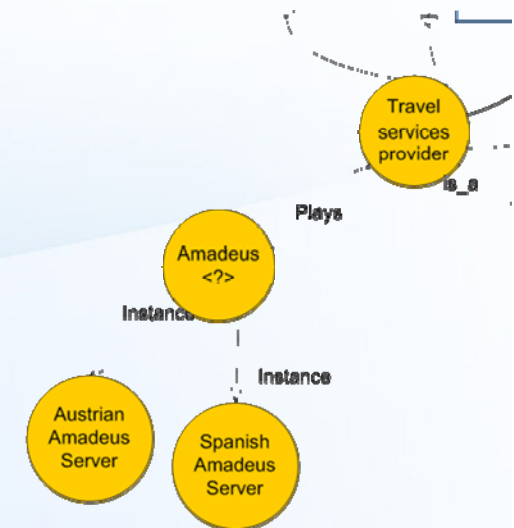
### Solution architecture



### Stakeholder needs

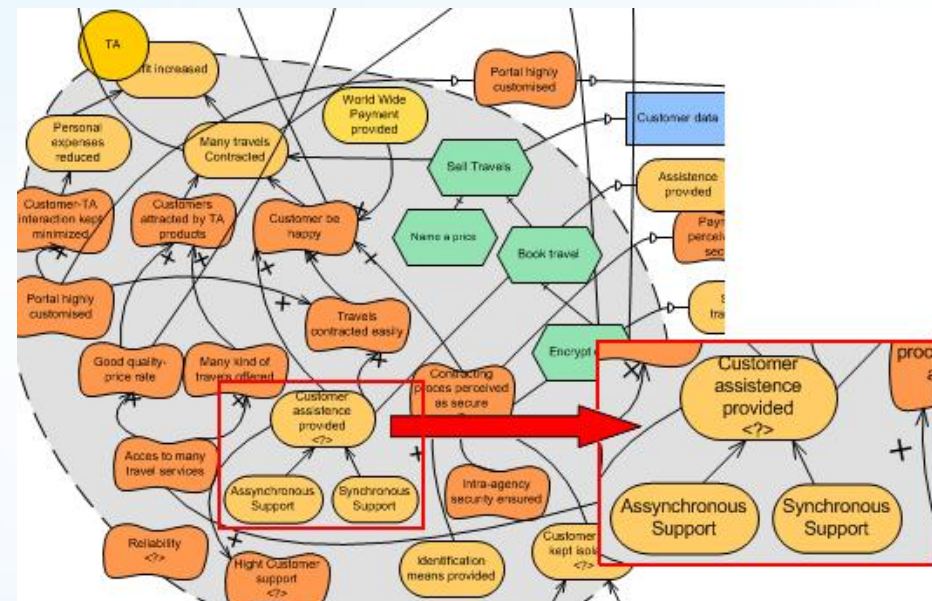


### Runtime configuration

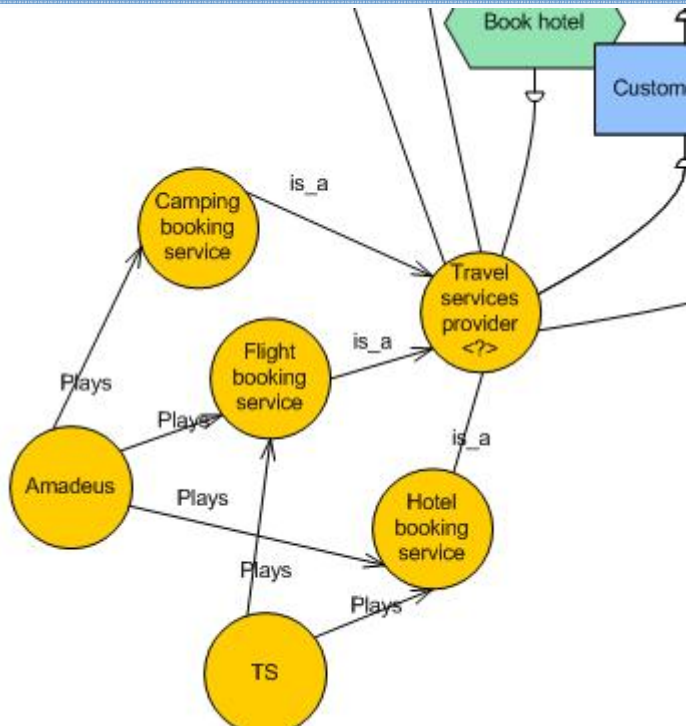


# Dealing with variability

- 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

# Complexity of decision tables → tool support

Decision	alternative values	cardinality	level	Stakeholder	element	relevance	Constrains
typeOfCustomerAssistance	synch, assynch	1:2	SN	TA	Customer Assistance Provided		
typeOfSynchronousAssistance	Human, Computer	1:2	AP	TA	Synchronous support	typeCustomerAssistance==synch	
typeOfAssynchronousAssistance	email, SMS	1:2	AP	TA	Asynchronous support	typeCustomerAssistance==asynch	
typeOfComputerAssistance	skype, MSN Messenger	1:2	AS	TA	Computer based assistance (role)	typeSynchronousAssistance==Computer	
typeOfSkype	My skype, hosted skype	1	OS	TA	Skype (agent)	typeComputerAssistance==skype	
LevelOfCustomerSupport	minimal, medium, full	1	SN	TA	¿?		if ==full then =Human and computer
LevelOfReliability	high, low	1	SN	TA	Reliability		if LevelOfReliability==high and typeOf
typeOfIdentification	classical login, finger print	1	AP	TA	Identification means provided		
typeOfLogin	fastLogin, secureLogin	1	AS	TA	LoginManagement (role)	typeIdentification==Classical login	
typeOfFingerPrint	cheap finger match, fast finger match	1	AS	TA	FingerManagement (role)	typeOfIdentification==Finger print	
LevelOfSecurity	minimal, medium, full	1	SN	TA	Contracting proces perceived as secure		if LevelOfSecurity==full then typeOfde
LevelOfPrivacy		1	SN	TA	Customer data kept isolated		
typeOfTravelPayment	credit card, transter, worldwide	1:3	AP	TSI,TA	Payment services provider (external actor)		
typeOfServiceTravelProvider	flight, hotel, camping	1:3	AP		Travel service provider		if (camping) then whichTravelService=
whichTravelService	Amadeus, TS	1	AS		Travel service provider	typeOfServiceTravelProvider does not include camping	
whichCreditCardService	CheapCard, Securitas, NorbSecureCredit, FastAndCheap	1	AS		CreditCardService		if Securitas then typeOfIdentification=
whichAmadeusService	Austrian, Spanish	1	OP				
AustrianAmadeusAverageResponseTime			OP			whichAmadeusService==Austrian	if greater than 200 milliseconds then a
SpanishAmadeusAverageResponse			OP			whichAmadeusService==Spanish	if greater than 50 milliseconds then ar

# Tool Support: Customizing the DecisionKing meta tool

The screenshot displays the DecisionKing meta tool interface for customizing a metamodel. The window title is "\*services.meta" and the main title is "Metamodel specification".

**Metamodel Specification (Left Panel):**

- Author**
- Version**
- Goal**
  - Name
  - IncludedIF
  - Description
  - requires -> Goal
- ServiceType**
  - Name
  - IncludedIF
  - Availability
  - Description
  - requires -> ServiceType
  - contributesTo -> Goal
- Services**
  - Name
  - IncludedIF
  - Availability
  - Description
  - requires -> Services
  - contributesTo -> ServiceType
- Service Instance**
  - Name
  - Description
  - IncludedIF
  - requires
  - contributesTo

**ServiceType Detail (Right Panel):**

**ServiceType**

Name:  Icon:

Description:

**Attributes**

Add new attribute:

- Name
- IncludedIF
- Availability
- Description

**Relationships**

- requires : ServiceType
- contributesTo : Goal

Metamodel



# Tool Support: Decision modeling in DecisionKing

The screenshot displays the DecisionKing software interface with the following components:

- Decisions Panel (Left):** A tree view showing a hierarchy of decision nodes. The selected node is `typeOfIdentification`, which is expanded to show its children: `typeOfFingerPrint`, `typeOfLogin`, `typeOfServiceTravelProvider`, `typeOfTravelPayment`, `whichCreditCardService`, `whichTravelService`, and `whichAmadeusService`.
- Detail of typeOfIdentification (Center):** A form for editing the selected decision.
  - Name:** `typeOfIdentification` (with a `public` checkbox).
  - Group:** -
  - Question:** `How should the users be identified by the system?`
  - Default value:** -
  - Visibility condition:** `true`
  - Validity condition:** `true`
  - Constraint:** -
  - Description:** -
- Range of variable (Center):** A section for defining the range of the variable.
  - Cardinality: `0` : `0`
  - Variables listed: `login`, `finger print`
- Where is this variable used? (Center):** A table showing the usage of the variable across different elements.
 

Element	Attribute	Value
<code>typeOfFingerPrint</code>	Visibility	contains( typeOfIdentification, {"finger print"})
<code>typeOfLogin</code>	Visibility	contains( typeOfIdentification, {"login"})
<code>Identification Mode F IncludedIF</code>		contains(typeOfIdentification, {"finger print"})
<code>Identification Mode L IncludedIF</code>		contains(typeOfIdentification, {"login"})
- Model Viewer (Right):** A tree view showing the overall model structure, including `Decisions`, `Goal`, `ServiceType`, and `Services`.
- Errors in TA.var (Bottom):** A table for reporting errors.
 

Element	Message

# Configuration Wizard for design-time / runtime decisions

ConfigurationWizard - Project: 'SrickS', User: 'admin', Customer: "

Wizard Edit Window Help

Decisions

Decision (typeOfIdentification)

Pre-Project Decisions

- ✓ Which level of customer support do you want to get? full
- ✓ Choose the level of reliability you want your system to show? high
- ✓ Choose the level of security you want your system to have? full
- ✓ Which travel service provider would you prefer to have? amadeus
- ✓ Who should support you in the synchronous activities? computer
- ✓ What kind of customer assistance do you wish to have? Choose between synchronous and as: sync
- ✓ Which forms of payment do you want to support? credit card
- ✓ Which Credit card service best matches your needs? norbSecureCard
- ✓ Where should your amadeus travel service be located in? austrian
- ✓ Which kinds of services do you require? camping
- ✓ You have chosen to have computer assistance. Which applications should be used? skype
- ✓ Choose among the types of Skype installations, that most suit your needs! my skype

How should the users be identified by the system?

- ⓘ click to choose from li...
- finger print
- login

Required assets (16)

- Amadeus Travel Service
- Austrian Amadeus Service
- Cheapcard
- Computer Assistance by Skype
- Computer Synchronous Assistance
- Full Customer Support
- Full Security Support
- High Reliability Level
- Human Synchronous Assistance
- MySkype
- NorbSecureCredit
- NorbSecureCredit
- Payment by Credit card
- Securitas
- Synchronous Customer Assistance
- Travel Service Camping
- Travel Service Hotel

Effects of answering the current decision Graphical Overview

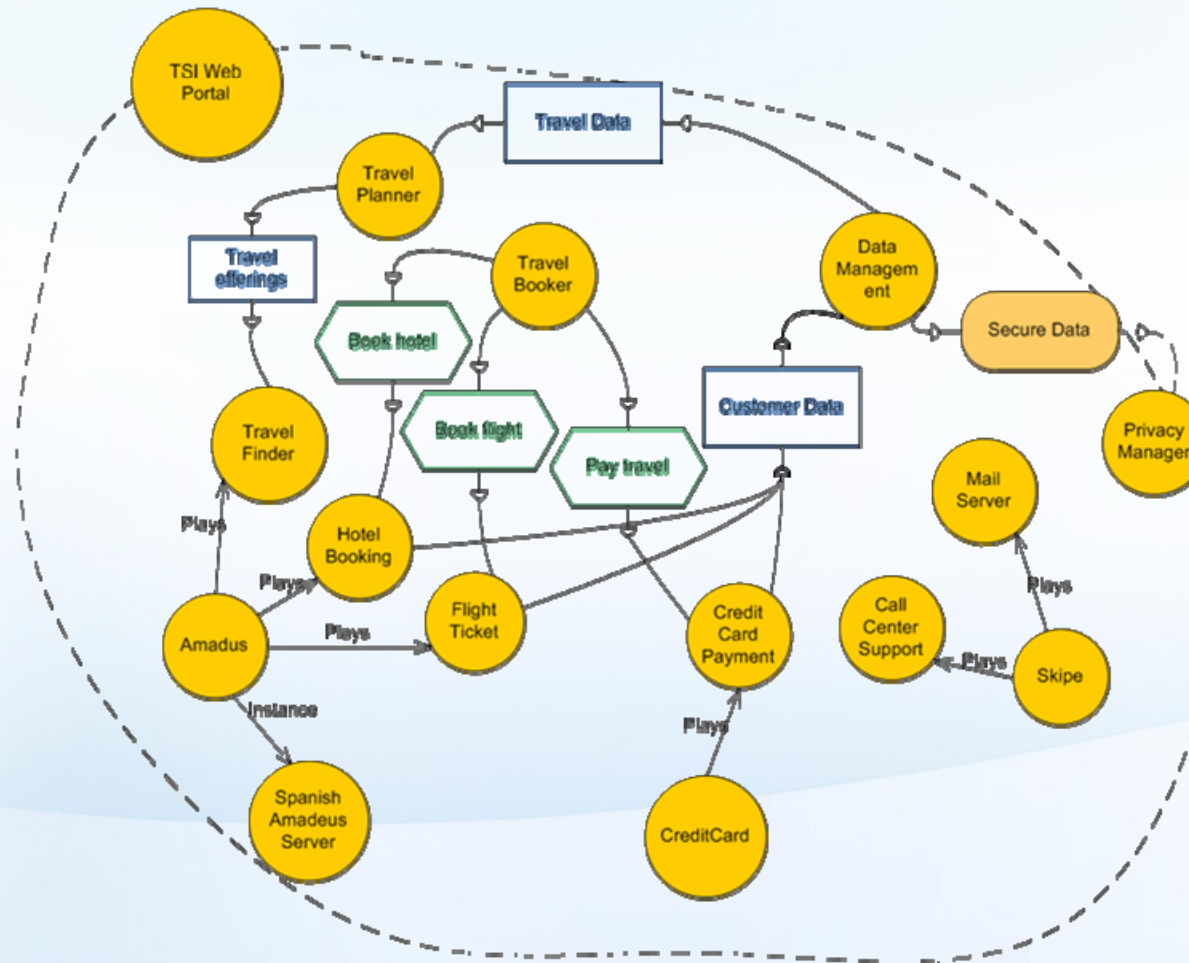
Horizontal Orientation
  Animate
 Normal Hanging  Compress  Zoomable
 V Spacing: 10 H Spacing: 10

Decisions

tomerSupport ([Ljava.lang.String;@e7fd03)
 ✓ levelOfReliability ([Ljava.lang.String;@1204425)
 ✓ levelOfSecurity ([Ljava.lang.String;@14c02d4)
 ✓ typeOfCustomerAssistance ([Ljava.lang.String;@10cec16)
 ? typeOfAssynchronousAssistance
 ✓ typeOfSynchronousAssistance ([Ljava.lang.String;@194566d)
 ✓ typeOfFingerPrint ([Lja
 ✓ typeOfComputerAssistance ([Ljava.lang.String;@387202)
 ✓ typeOfSkype ([Ljava.lang.String;@187fafc)

# 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

# End of Presentation

Thank you for your attention!

<http://ase.jku.at/dopler>

