# From the Decision Support on the **Ground** to the Decision Support in the **Cloud**

Aida Omerovic, SINTEF ICT

Valencia, Spain

May 29th 2013

# Outline

- Why decision support
- What we have on the ground
- What we need in the cloud
- What we propose

# Why model-based decision support on the ground?

- Make informed decisions
- Handle changes
- Handle complexity
- Exchange knowledge
- Reduce risk
- Make requirements, risk, quality and cost explicit
- Foresee implications
- Models as means of specifying, reasoning and communicating

# Outline

- Why decision support
- **What we have on the ground**
- What we need in the cloud
- What we propose

# We have…

PREDIQT (model-based **quality** prediction)

- Language
- Process
- Tool

CORAS (model-based **risk** analysis)

- Language
- Process
- Tool

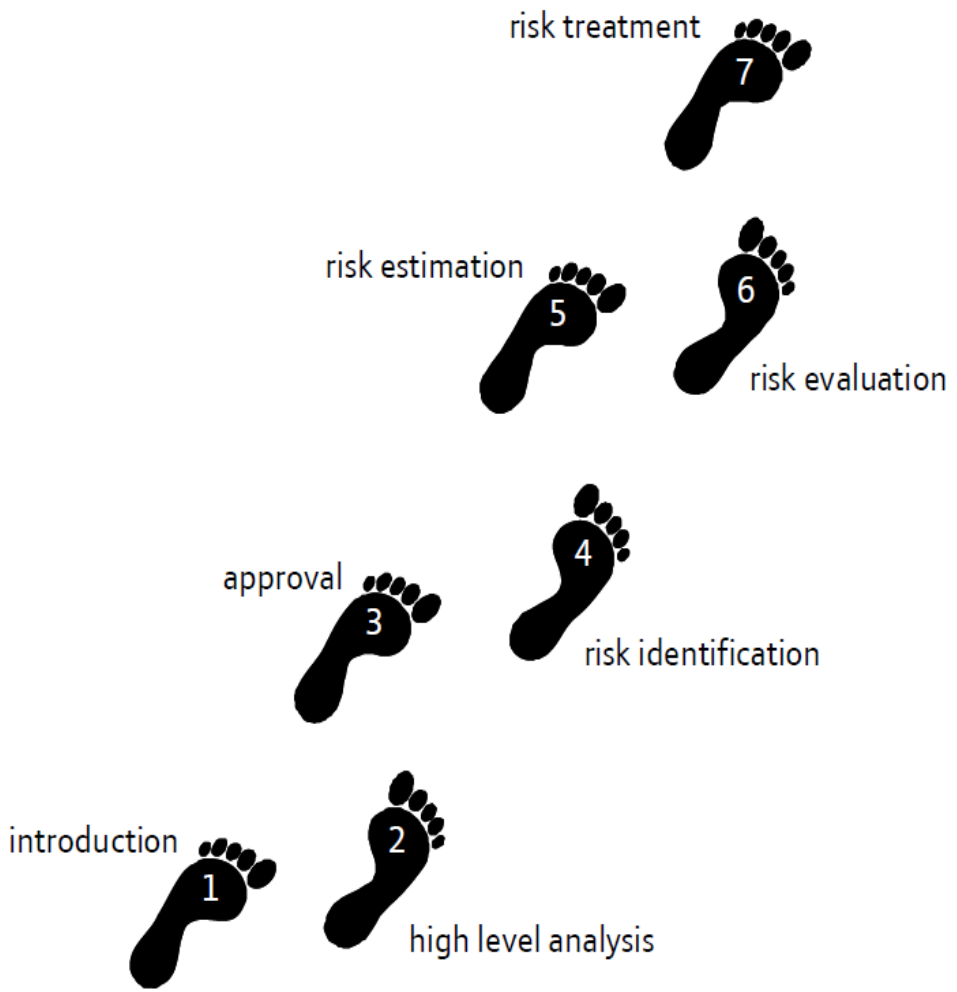
**AND MUCH MORE**

# We have…

## PREDIQT process

- **Phase 1:** Target modeling
  - **Sub-phase 1:** Characterization of the target and the objectives
  - **Sub-phase 2:** Development of Quality Models
  - **Sub-phase 3:** Mapping of Design Models
  - **Sub-phase 4:** Development of Dependency Views
- **Phase 2:** Verification of prediction models
  - **Sub-phase 1:** Evaluation of prediction models
  - **Sub-phase 2:** Fitting of prediction models
  - **Sub-phase 3:** Approval of the final prediction models
- **Phase 3:** Application of prediction models
  - **Sub-phase 1:** Specification of a change
  - **Sub-phase 2:** Application of the change on prediction models
  - **Sub-phase 3:** Quality prediction

## CORAS process

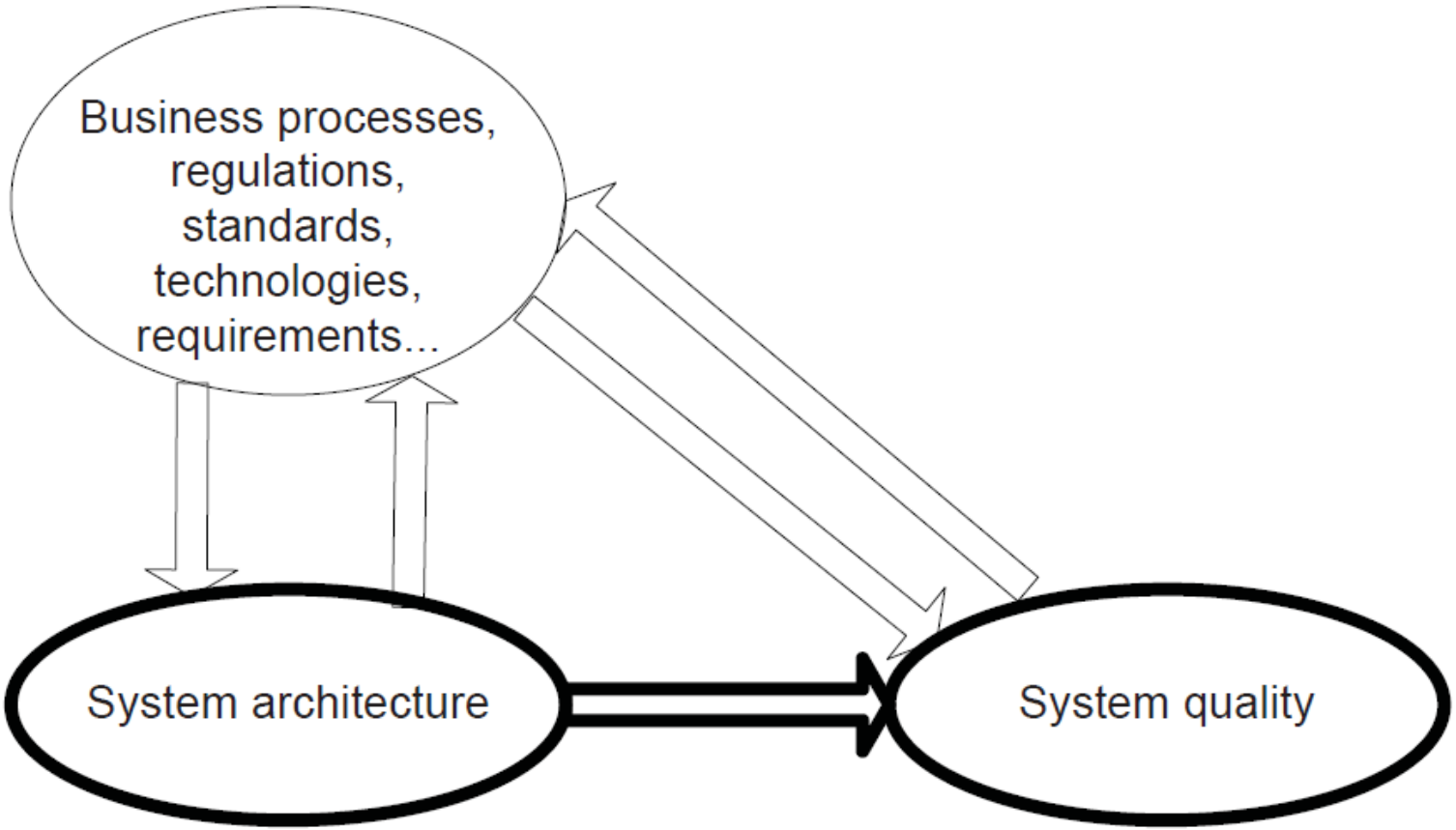


# Model-based quality prediction – the PREDIQT approach

# Motivation

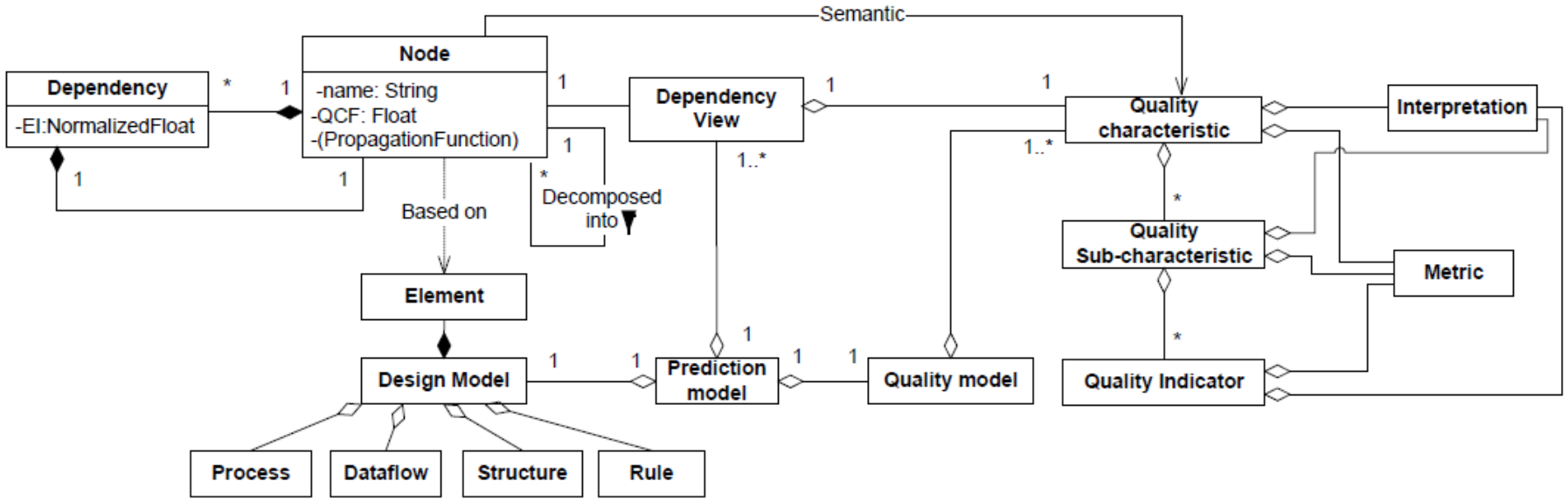
- Many design alternatives towards a quality goal
- A design alternative may impact several quality characteristics (e.g. security, performance, scalability, availability...) in the different directions
- Need decision-making support which facilitates the analysis of effects of architectural adaptations, on the overall quality of a system

# Focus

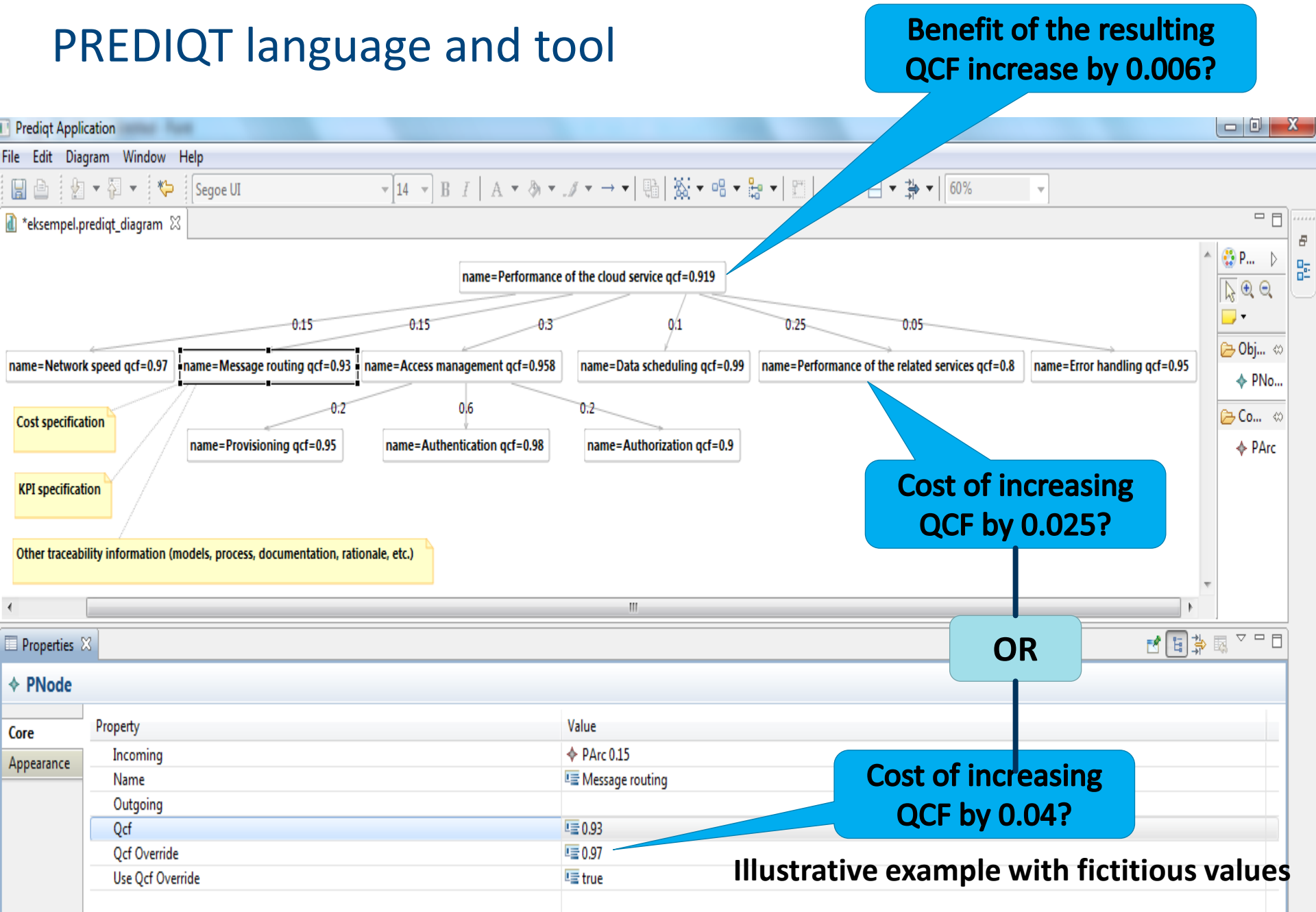

Business processes,
regulations,
standards,
technologies,
requirements...
System architecture
System quality

# Prediction models

- Quality models
- Architecture models
- Dependency views



# PREDIQT language and tool

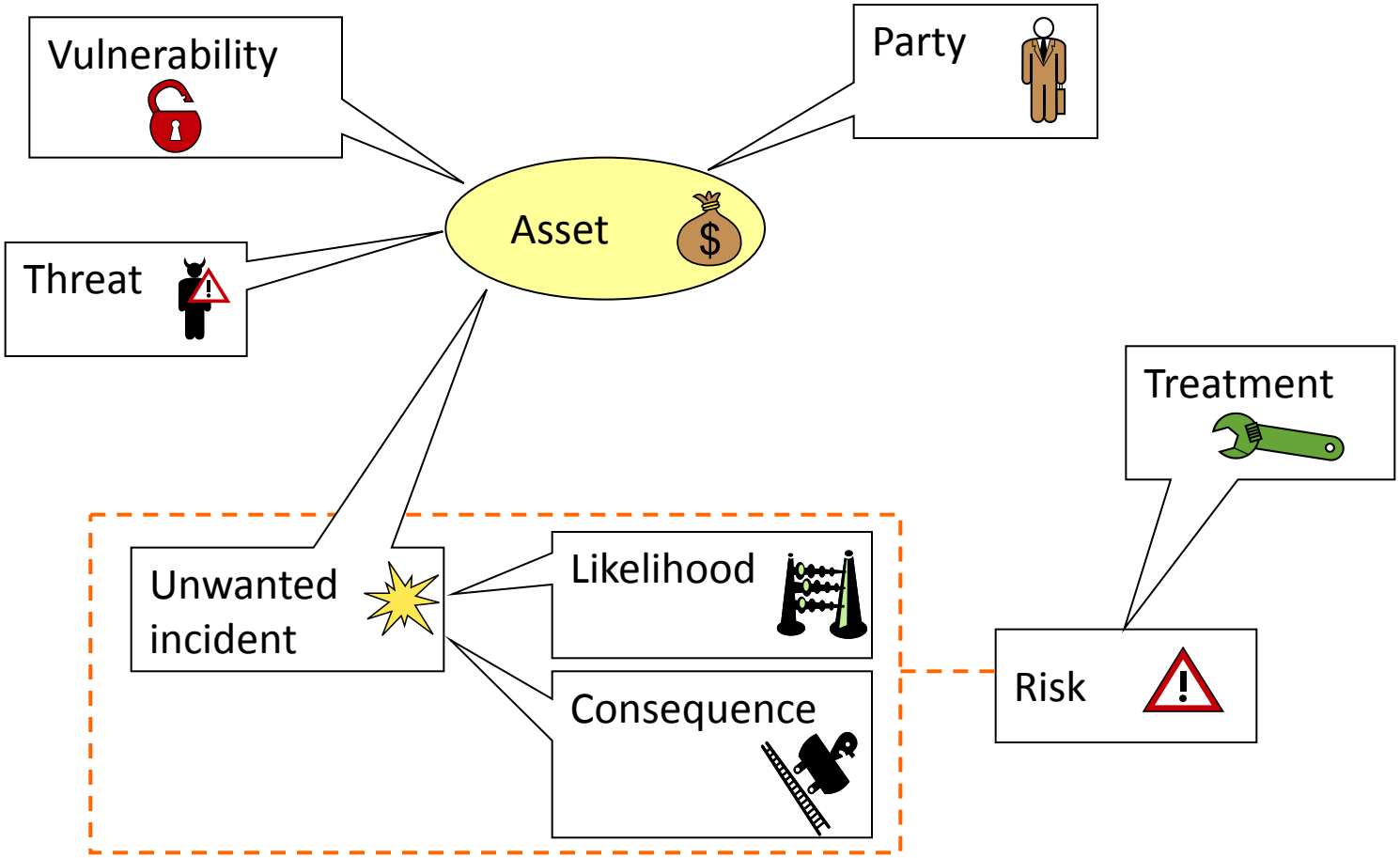


# Model-Driven Risk Analysis – The CORAS Approach

# What is risk?

- Many kinds of risk
  - Contractual risk
  - Economic risk
  - Operational risk
  - Environmental risk
  - Health risk
  - Political risk
  - Legal risk
  - Security risk

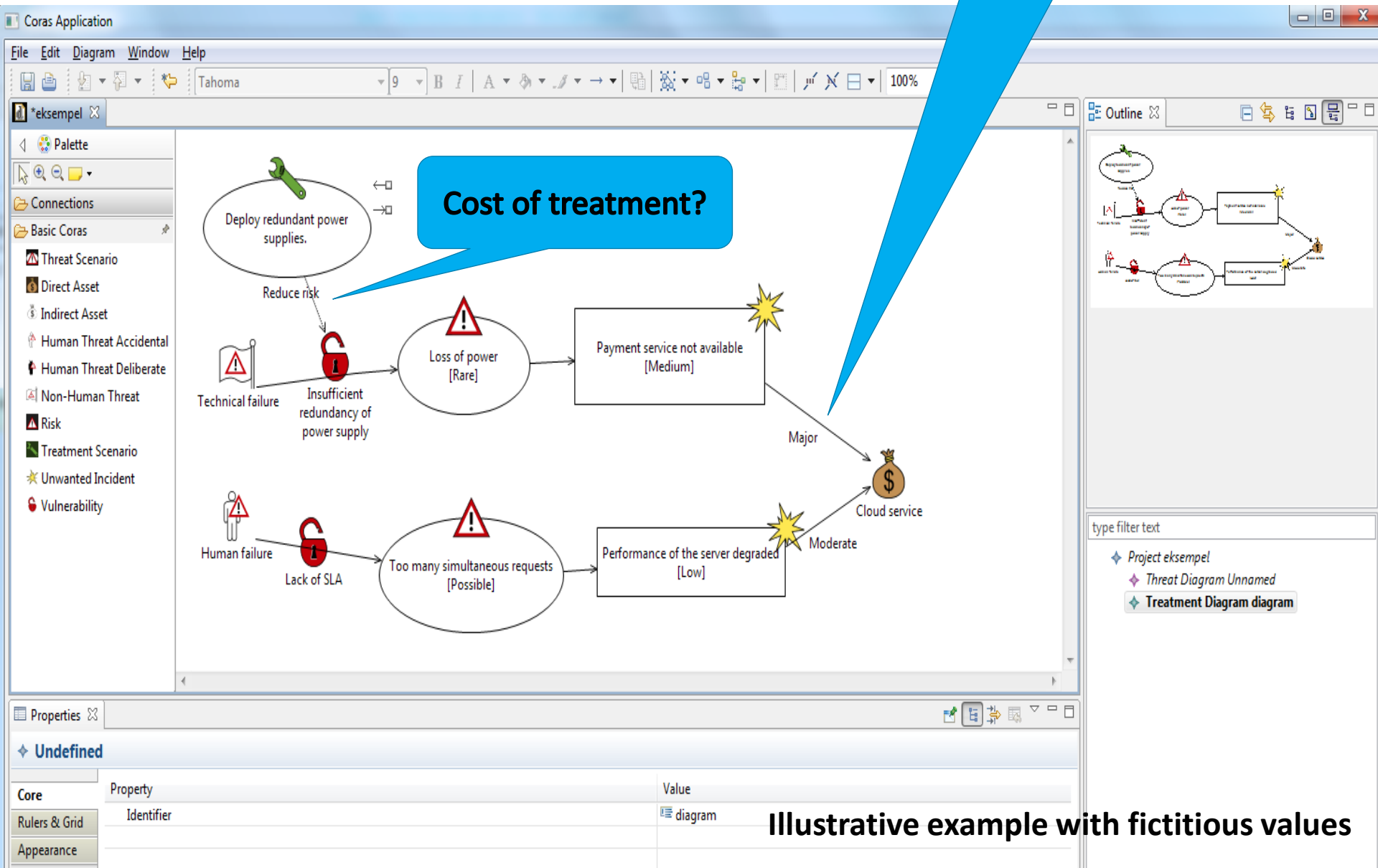
# Main concepts



# Risk modeling

- The CORAS language consists of five kinds of diagrams
  - Asset diagrams
  - Threat diagrams
  - Risk diagrams
  - Treatment diagrams
  - Treatment overview diagrams
- Each kind supports concrete steps in the risk analysis process
- In addition there are three kinds of diagrams for specific needs
  - High-level CORAS diagrams
  - Dependent CORAS diagrams
  - Legal CORAS diagrams

# CORAS language and tool



# Outline

- Why decision support
- What we have on the ground
- **What we need in the cloud**
- What we propose

# Needs in the cloud

- Cloud technologies as an enabler – business models, quality levels, capabilities…
- Similar services available from several providers – replaceability, redundancy of services
  - Risk of vendor lock-in reduced, quality may improve
- Challenges:
  - Services vary w.r.t. functionality, quality, cost, value
  - Lack of transparency w.r.t. cost and quality
  - Dynamics
  - Dependencies

# Needs in the cloud cont.

- How to choose service and provider?
  - Need a systematic, comprehensive support for decision maker
  - Dynamics of multi-clouds require light-weight processes and tools

- A model-based trade-off analysis of enterprise and software architectures
  - Easy-to-understand cost-benefit analysis
  - Merge of the aspects of risk, cost and quality in a consolidated view

# A decision support method

- By Decision Support Method (DSM) we mean: process, language and tool for decision support
- The DSM process is undergone while developing, verifying and applying the decision support models
- Four types of actors are involved:
  - Analyst
  - Decision maker
  - Domain expert
  - Cloud management service

# Objectives of the DSM stakeholders

- **Analyst**
  - Usefulness of the method, cost-effective method, expressive models
- **Decision maker**
  - Useful method for making informed decisions, cost-effective method
- **Domain expert**
  - Improved knowledge management, comprehensible method
- **Cloud measurement service**
  - Relevant, practically feasible, accurate and precise

# The challenge of designing a DSM

Balance between:

- Scalability in a real-life setting
- Expressiveness of the models
- Accuracy and validity of the models

and

- Comprehensibility
- Practical feasibility within limited resources
- Support for dynamics through a light-weight method

# Preliminary success criteria for a DSM

1. DSM facilitates the making of informed decisions
   - The method assists in making informed and trustworthy decisions
   - The method is useful in the design time

2. DSM can be applied in real-life setting within limited resources
   - In an industrial setting, an analysis is conducted during a specified number of workshops and with a pre-defined budget
   - The method can cover the scope of a realistic analysis

3. DSM is cost-effective
   - It is well worth using the method
   - The cost of resources needed is not higher than using comparable other approaches

# Preliminary success criteria cont.

4. DSM is sufficiently comprehensible to the stakeholders
   - The stakeholders (who are not necessarily experts in the domain or the DSM) can gain a common understanding of the process and the models
   - The models can be approved based on a common interpretation
   - They demonstrate the understanding by actively participating in the analysis and applying the results

5. The models of the DSM are sufficiently expressive, complete and certain
   - The models can express the aspects needed and cover the scope of the analysis
   - Certainty of the contents is acceptable for the intended purpose

6. DSM facilitates knowledge management and documenting of the decision process
   - Consolidation of the knowledge, origination from the different sources
   - Traceability of the decision process and selection criteria

# We lack in the cloud… ?

- Merge of risk analysis and quality prediction
- Value-based approach: notion of cost and utility
- Run-time dynamics
  - light-weight process, short cycles
  - KPI identification, aggregation and measurement in real-time
- Easy-to-understand method
- Standardized interfaces for negotiations among cloud services w.r.t. risk, quality and cost
- Support for variation of usage profile and quality/risk/cost definitions
- Prediction of quality/risk/cost variation over time
- Process guidance in the tool

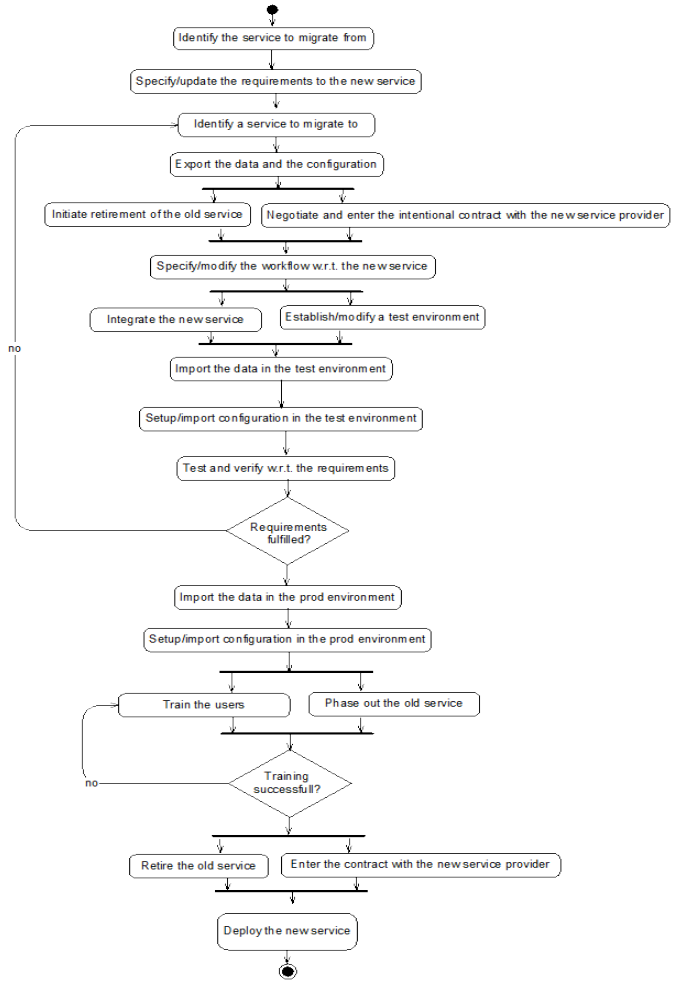
# Outline

- Why decision support in cloud
- What we have on the ground
- What we need in the cloud
- **What we propose**

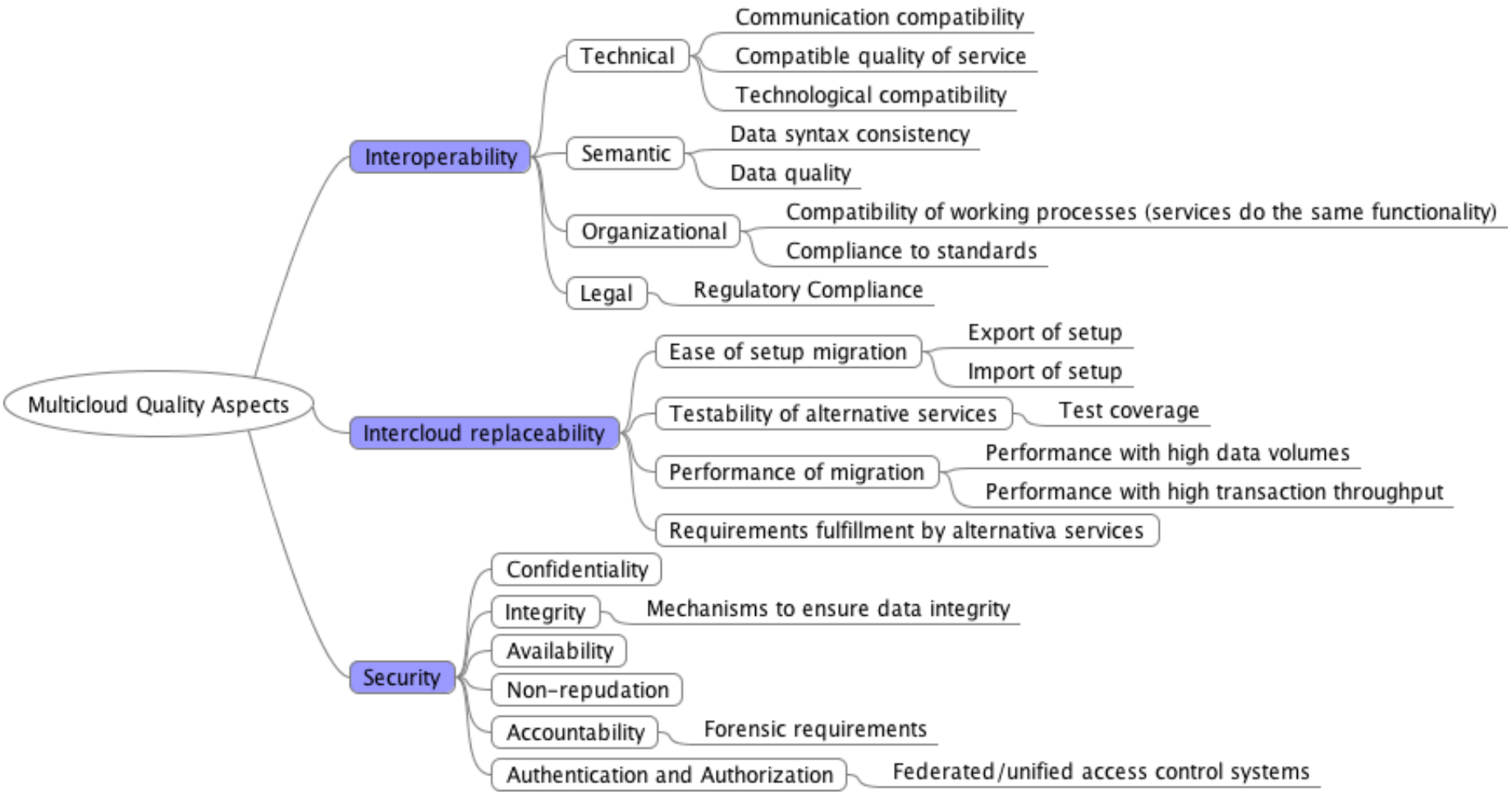
# What we propose

- As a result of the research within the **MODAClouds** project we propose a Decision Support Method (DSM)
- Migration is central
- From understanding of the migration process, we deduce the relevant quality attributes and risks
- We propose a DSM process for developing and using models for decision making with respect to quality, risk and cost in multi-clouds

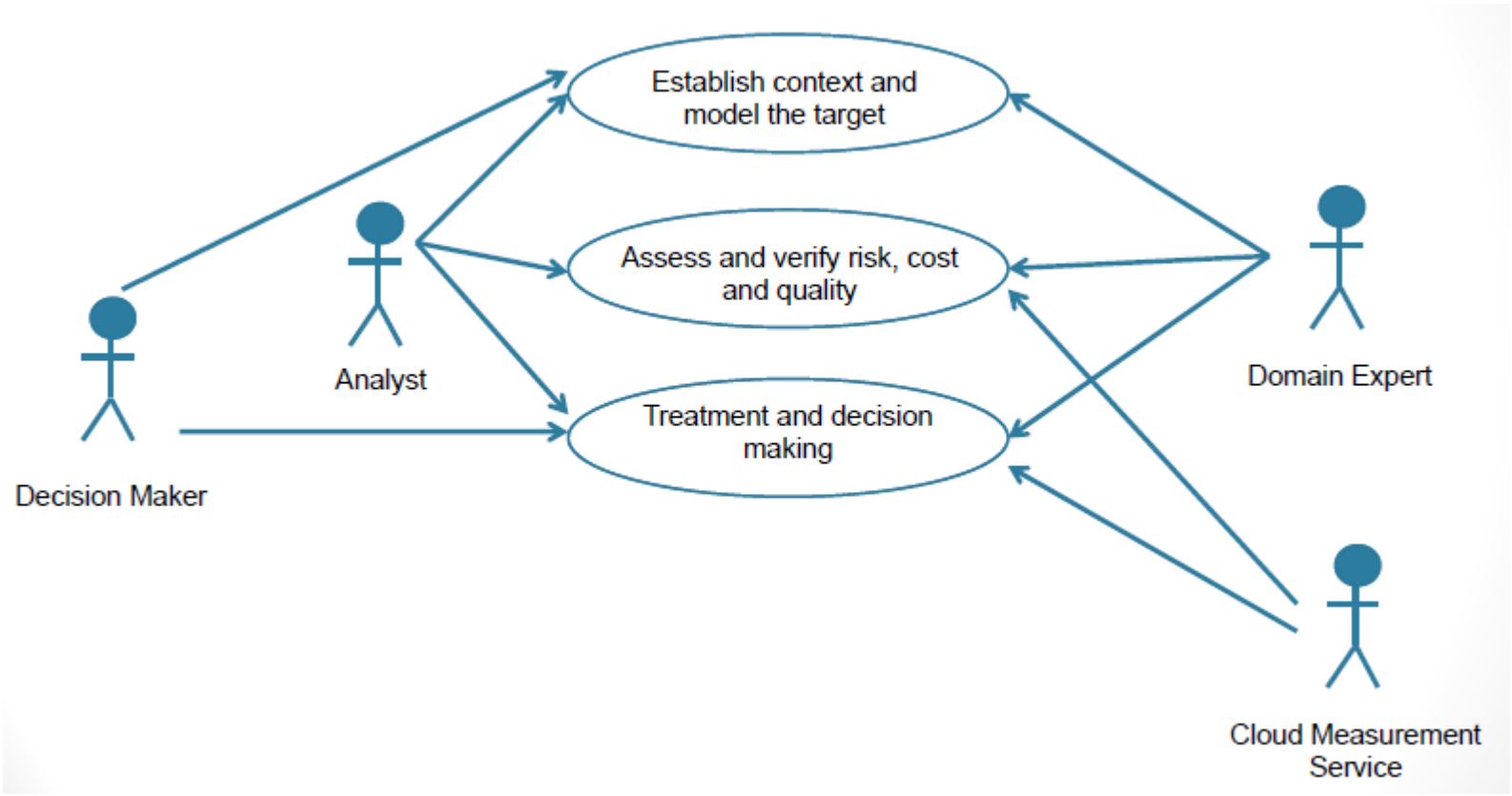
# Migration process as a starting point



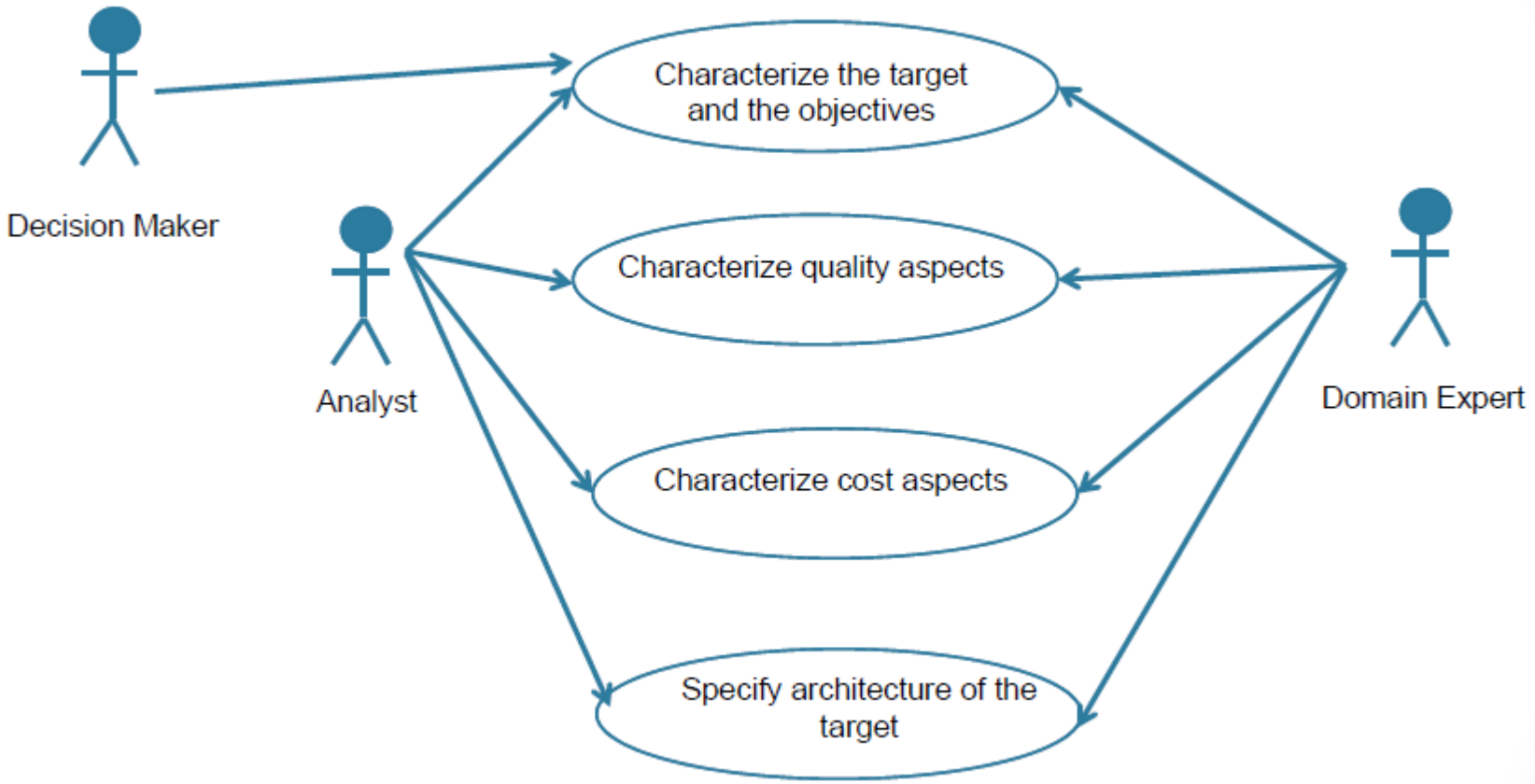
# Quality Aspects in Multi-Clouds



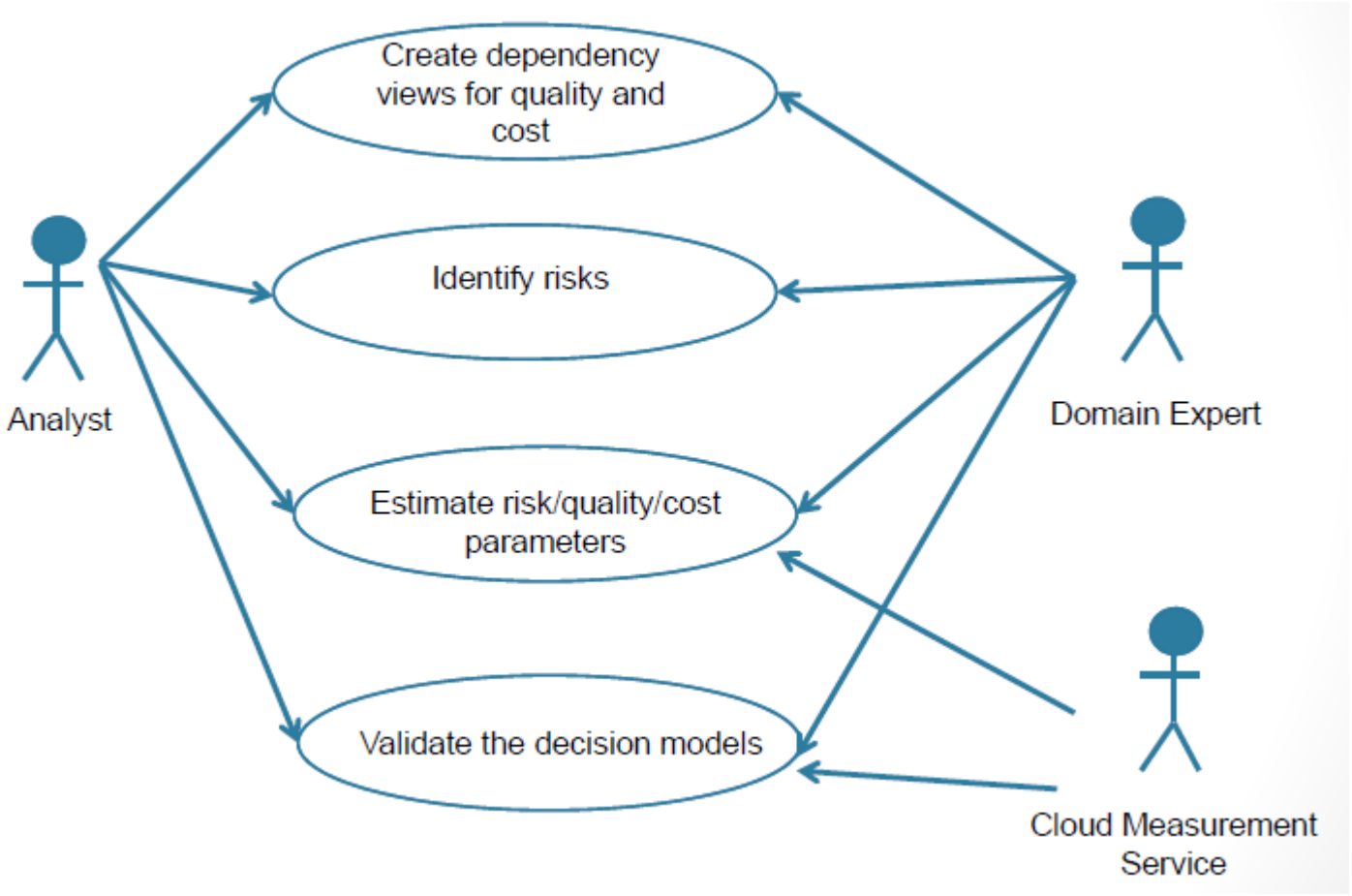
# The process of DSM – overall



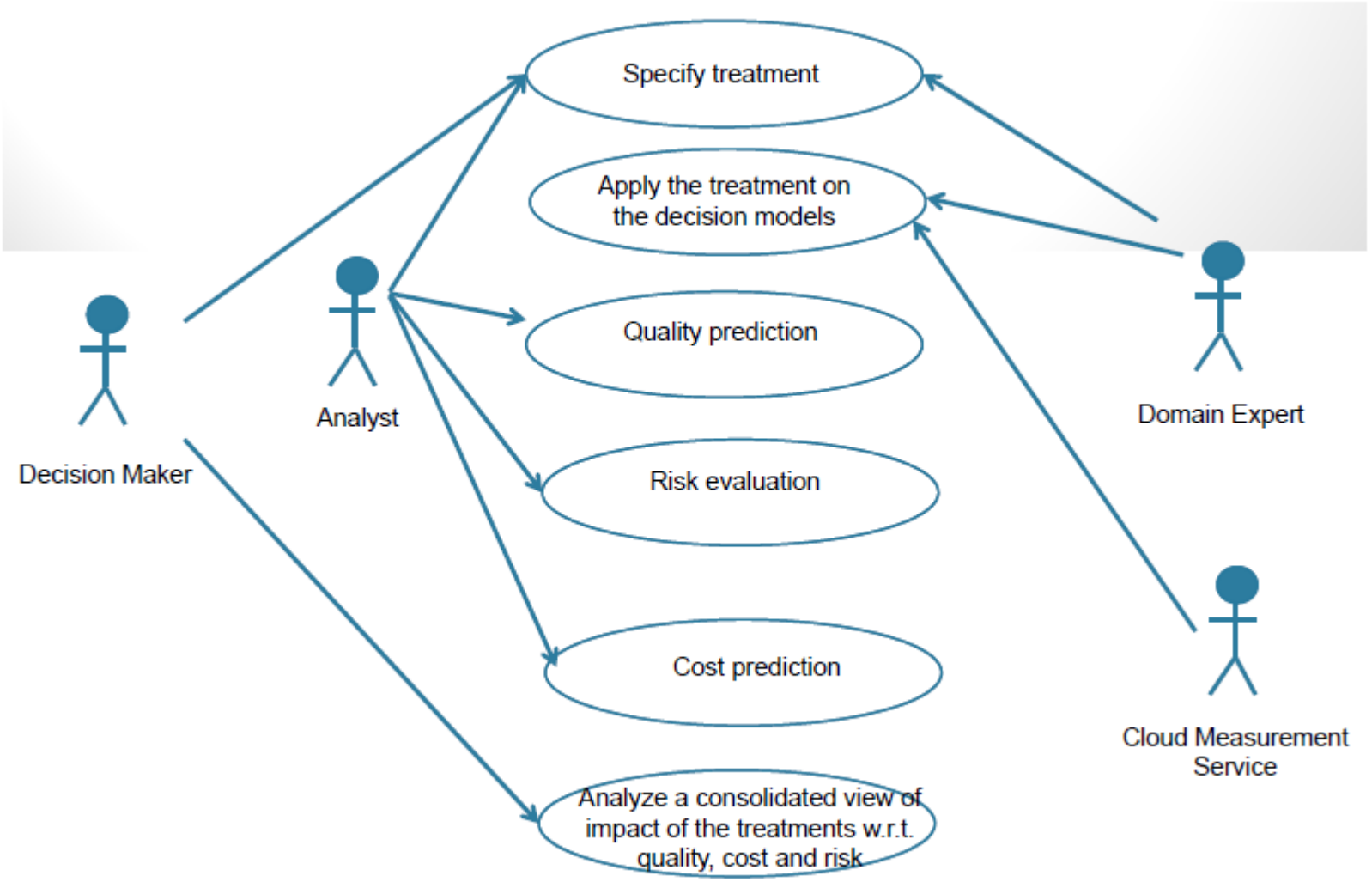
# The process of DSM – phase 1



# The process of DSM – phase 2



# The process of DSM – phase 3



# Conclusions

- A DSM to facilitate the selection of cloud services and providers in a multi-cloud environment
- We argue that risk, quality and cost are among the main factors in such a selection process
- Challenges:
  - The dynamics of multi-clouds require light-weight processes and tools
  - The decision makers depend on easy-to-understand representations
  - The notion of cost less established in the trade-off analysis of architectures
  - Merge of the aspects of risk, cost and quality in a consolidated view
- The state of the art can be leveraged

# Future work

- Case studies, evaluation, adaption/refinement of the method
- Development of the modelling languages for a consolidated model-based risk analysis, quality prediction and cost analysis.
- Easy-to-understand visualization
- A prototype tool

Questions/comments?

Thank you!

aida.omerovic@sintef.no