CloudAid

Aggregation of Linked USDL Cloud Services using Multi-Criteria Methods

Master Thesis

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Summary

- Introduction
- Objectives & Solutions
- CloudAid Prototype Architecture
- Prototype Demo
- Conclusion

Motivation

- **90%** say that cloud is in agenda
- **31%** consider cloud critical for business
- **1st** reason is cost reduction
- **70%** say that cloud surpassed expectations

[27] Cisco Cloudwatch Summer 2012

+ Providers
+ Functionality

} Which are the best alternatives?

Need for tools to help this search and decision process

Problem & Objectives

Aggregation

1 User Needs

2 Service Description

Many alternatives

Cloud Service | Cloud Service | … | Cloud Service

3 Complex dynamic pricing

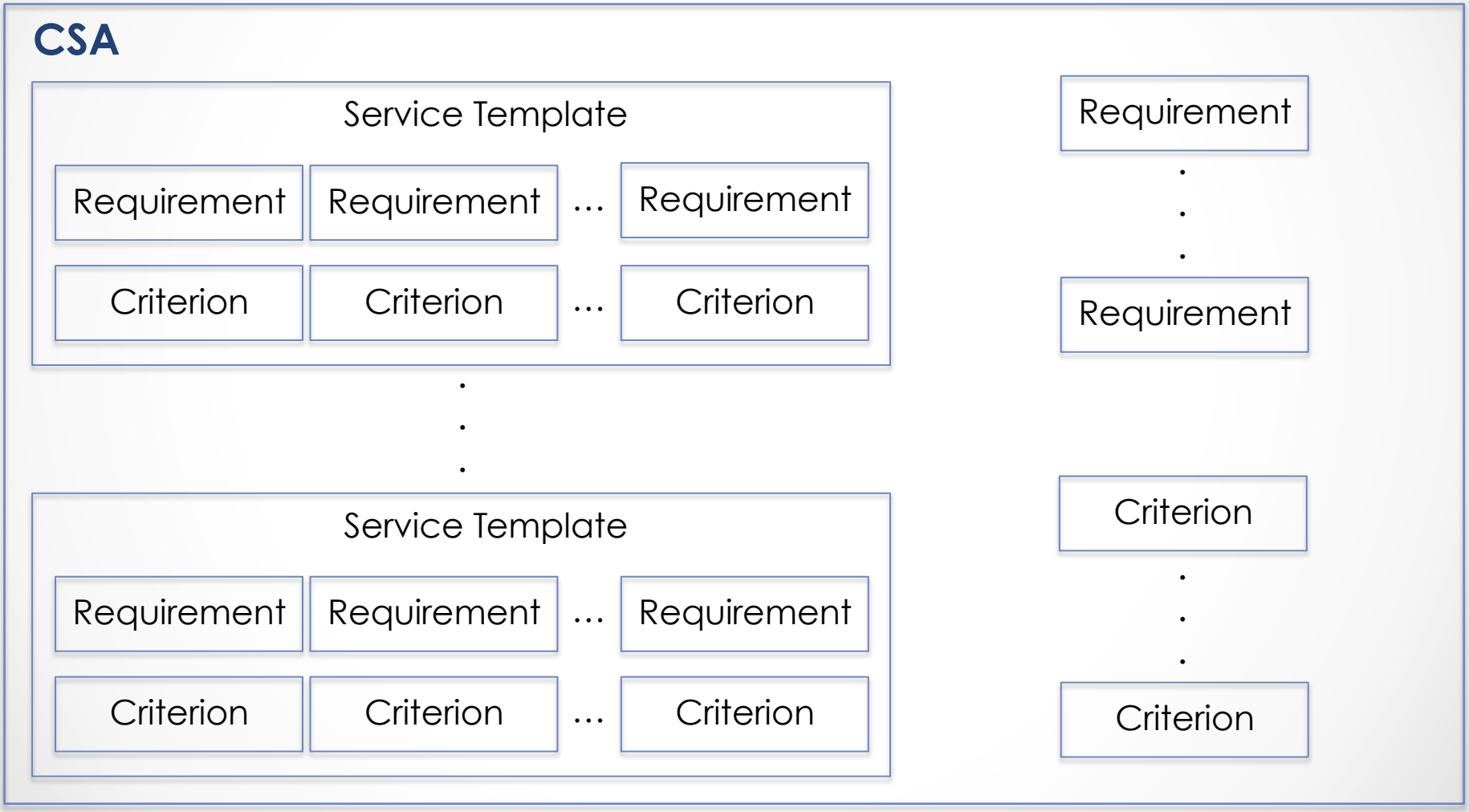
4 Best aggregated solution?

Cloud Service | Cloud Service | … | Cloud Service

Search & Decision Problem

Composite Service Architecture Data

Objective 1



Service Description

Objective 2

- > 100 cloud concepts

Pricing

On-Demand Instance Prices

Region: US East (N. Virginia)

	Linux/UNIX Usage
Standard On-Demand Instances	
Small (Default)	$0.060 per Hour
Medium	$0.120 per Hour
Large	$0.240 per Hour
Extra Large	$0.480 per Hour
Second Generation Standard On-Demand Instances	
Extra Large	$0.500 per Hour
Double Extra Large	$1.000 per Hour

- 18 Instance Types * 6 Operating Systems
- 5 Utilization Models
- 8 Regions

4320 Different Prices

Linked USDL Pricing Module

Objective 3

Pay-per-Use Model

- Variability
- Complexity

Simplicity → 80% of the cases

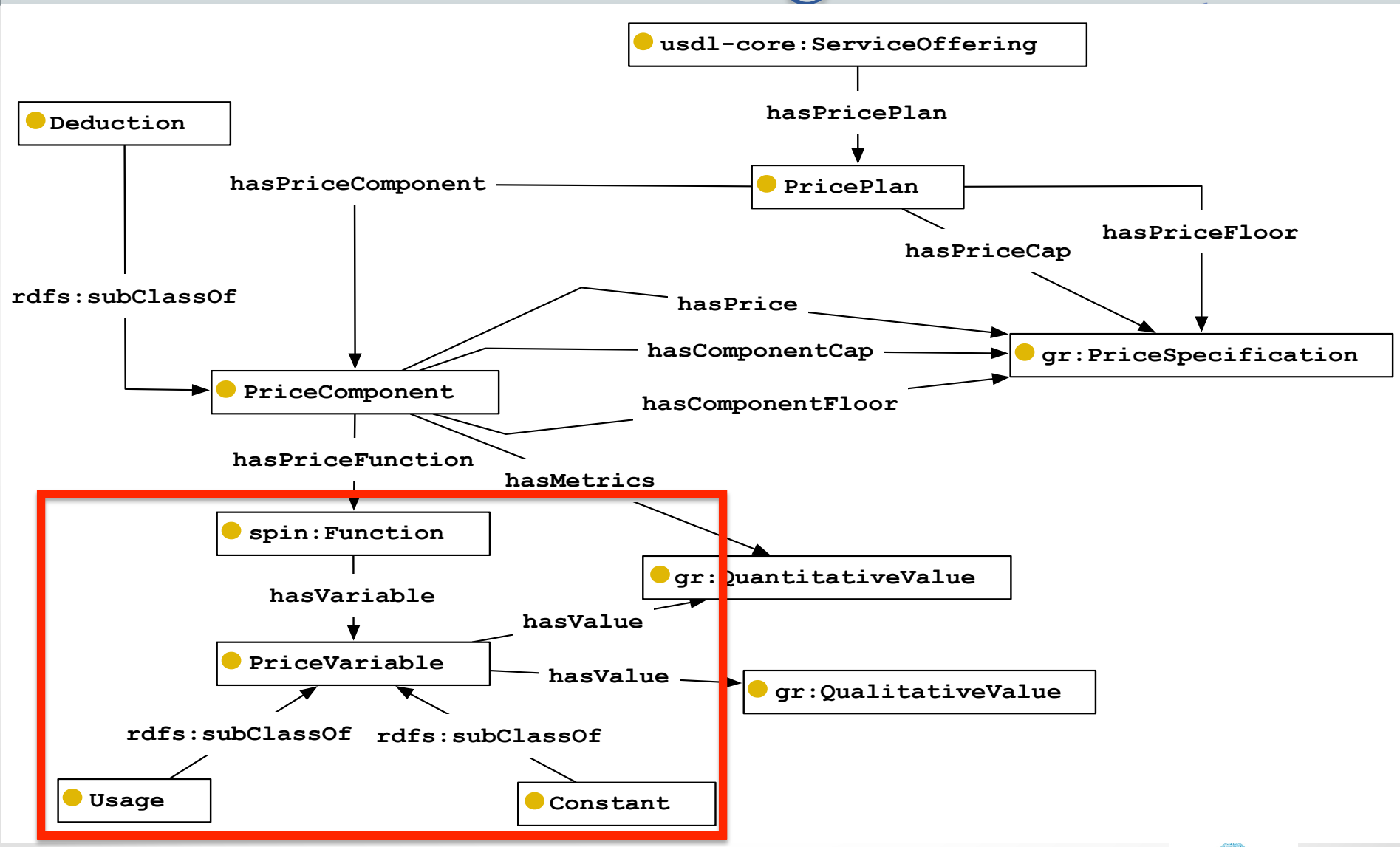
Use-Case Driven → Weekly iterative discussion and revision → 4 Months

Collaboration with

KMi
The Knowledge Media Institute

SAP
SAP Research

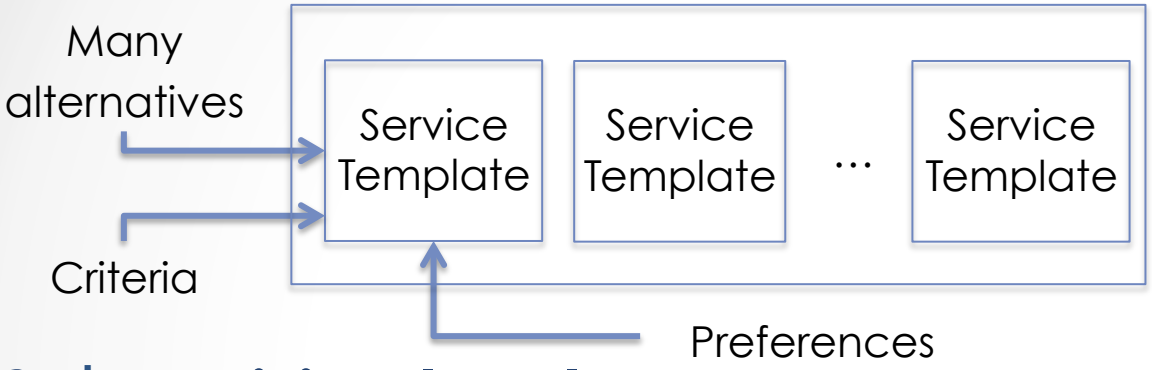
Linked USDL Pricing Module



Decision Process: 2-Level Decision

1st Decision level

Objective 4

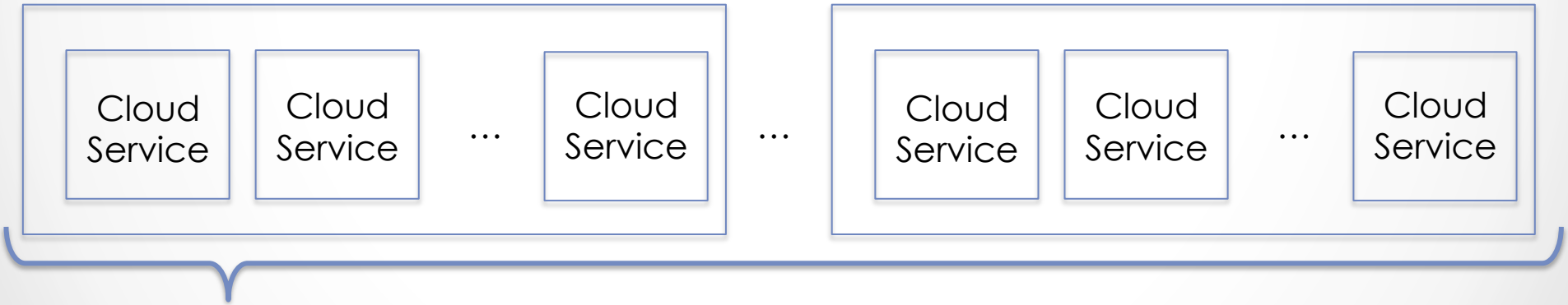


2 Decision Methods

- Simple Additive Weighting (SAW)
- Analytic Hierarchy Process (AHP)

Third Party

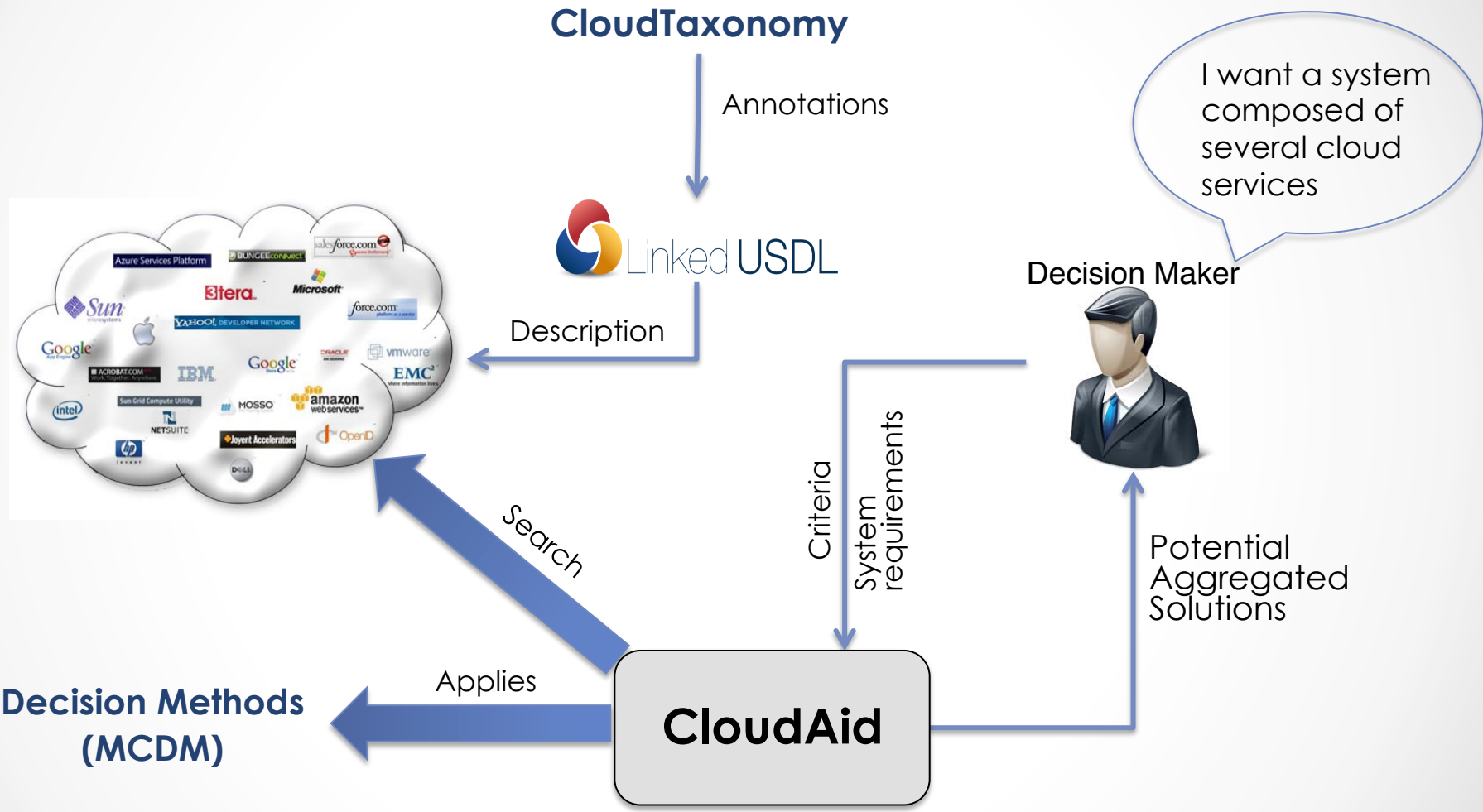
2nd Decision level



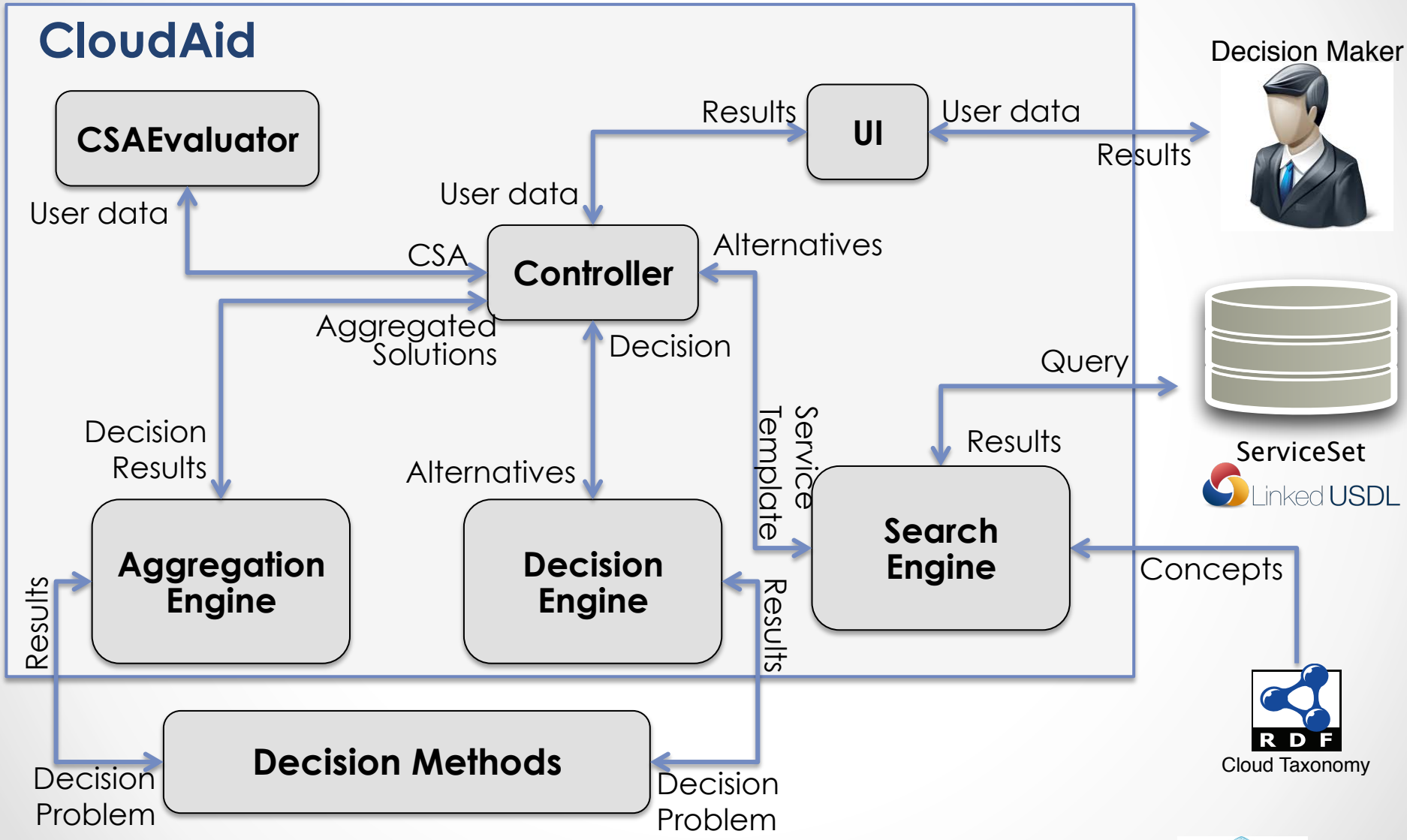
- Admissibility
- Best solutions

→ **Admissible Solutions Algorithm**

CloudAid Solution



CloudAid Prototype - Architecture



CloudAid Prototype - Demo

Search Process

Service Template

- Requirements:
  - StorageCapacity > 500Gb
  - Price < 4000€
  - Availability > 99%
- Criteria:
  - StorageCapacity
  - Price

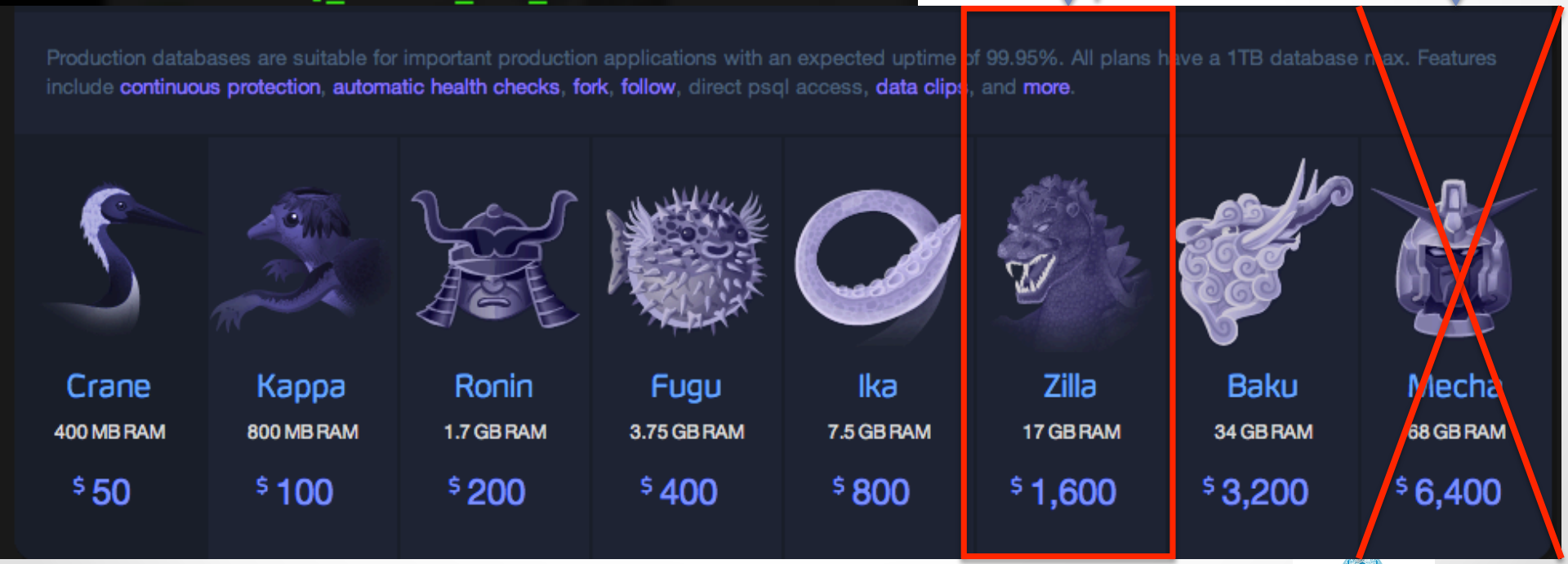
CloudAid Prototype - Demo

Search Process

```
Number of alternatives found:7
SYSTEM - Offering_Heroku_Crane_Database = 50.0
SYSTEM - Offering_Heroku_Zilla_Database = 1600.0
SYSTEM - Offering_Heroku_Fugu_Database = 400.0
SYSTEM - Offering_Heroku_Kappa_Database = 100.0
SYSTEM - Offering_Heroku_Baku_Database = 3200.0
SYSTEM - Offering_Heroku_Ronin_Database = 200.0
SYSTEM - Offering_Heroku_Ika_Database = 800.0
```

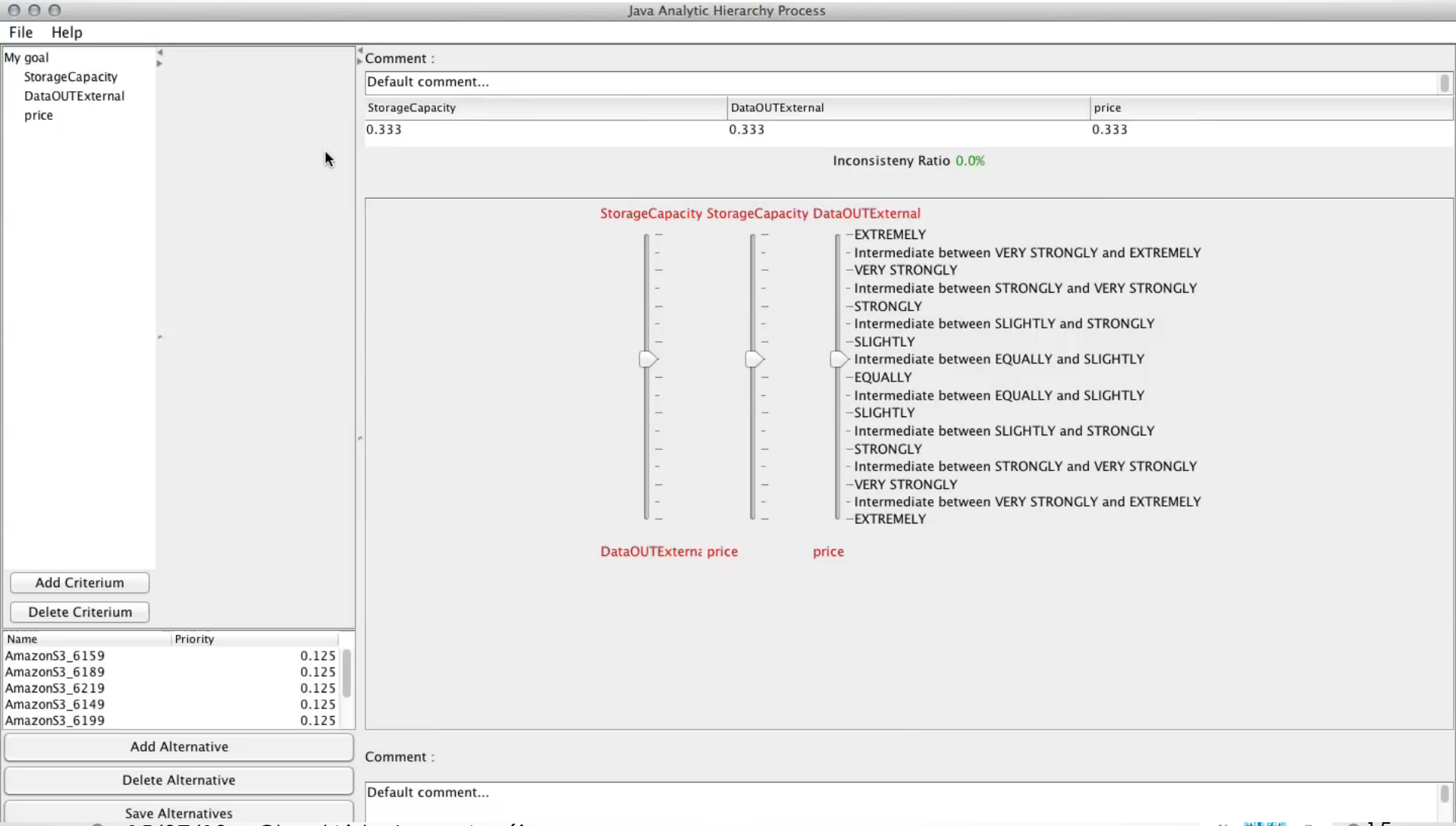
```
- Attributes
  - price = 1600.0
  - StorageCapacity = 1024.0
```

Price < 4000€



CloudAid Prototype - Demo

Decision Process – 1st Level



CloudAid Prototype - Demo

Decision Process – 2nd Level

Performance

```
CSA RESULTS:
SERVICE TEMPLATE: Comp0
    ALTERNATIVE1:AmazonS3_6159--->1.0
SERVICE TEMPLATE: Comp1
    ALTERNATIVE1:Analytics_service_5560--->0.6835443377494812
SERVICE TEMPLATE: Comp2
    ALTERNATIVE1:AmazonEC2_xlarge_m1_4284--->0.8469387888908386
SERVICE TEMPLATE: Comp3
    ALTERNATIVE1:AmazonEC2_xlarge_c1_2360--->1.0
SERVICE TEMPLATE: Comp4
    ALTERNATIVE1:Heroku_Addons_Mail_Service_34--->0.4278438687324524
SERVICE TEMPLATE: Comp5
    ALTERNATIVE1:SMS_Service_7441--->0.8533333539962769
```

One alternative for each Service Template

Price < 1000€

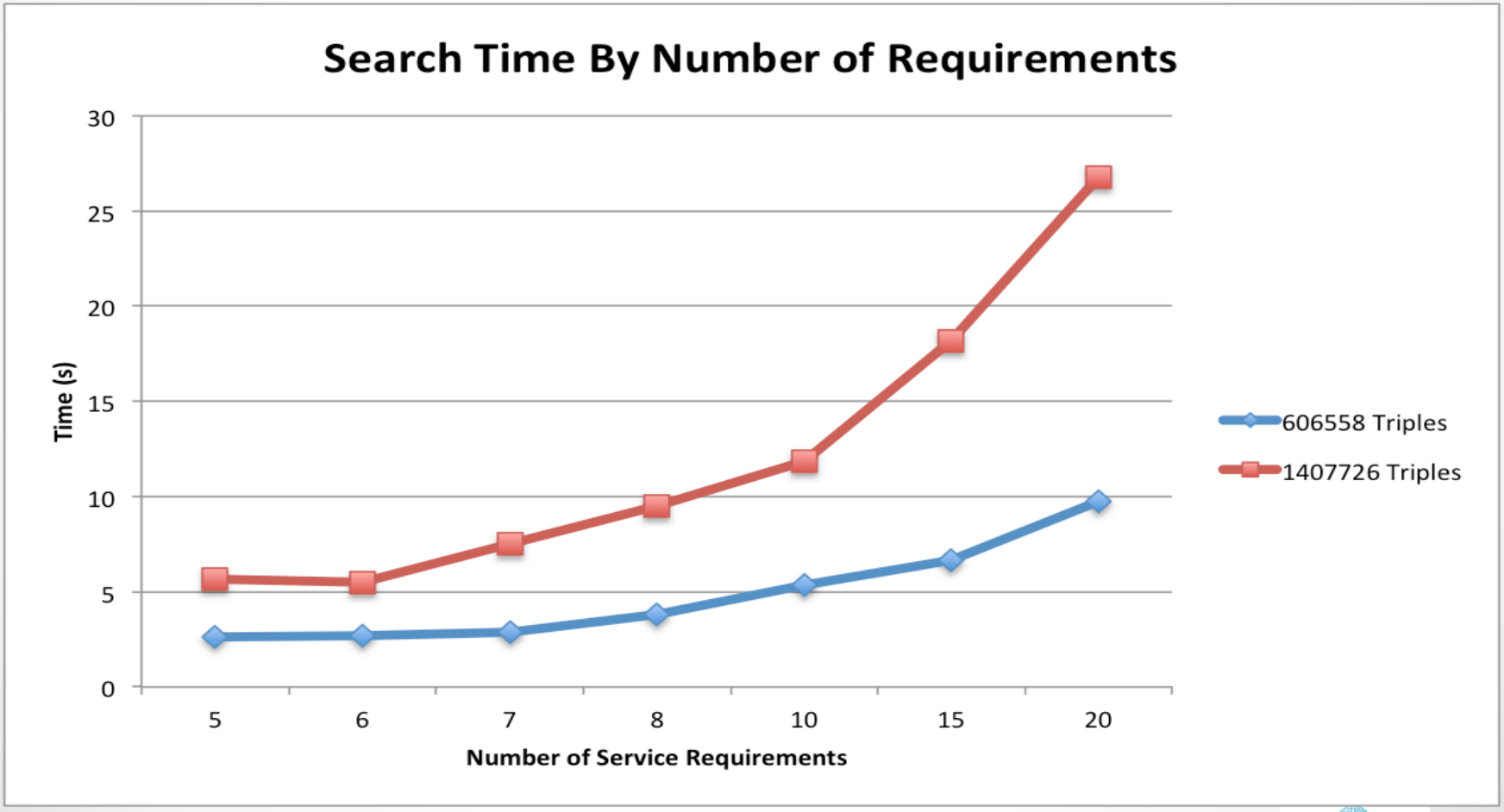
Evaluation

Prototype complexity → **> 5000 code lines**

- Unit testing → During development
- Reliability tests → Manual tests
- Performance tests → 4 service sets
  - → > 2000 algorithm tests

Evaluation

Triple store size and number of requirements influence the search time



Conclusions

- Data structure to capture user needs and preferences
- Semantic approach for service description & discovery
- Pricing description
- Cloud Taxonomy
- Multi-criteria decision methods
- Admissible Solutions Algorithm

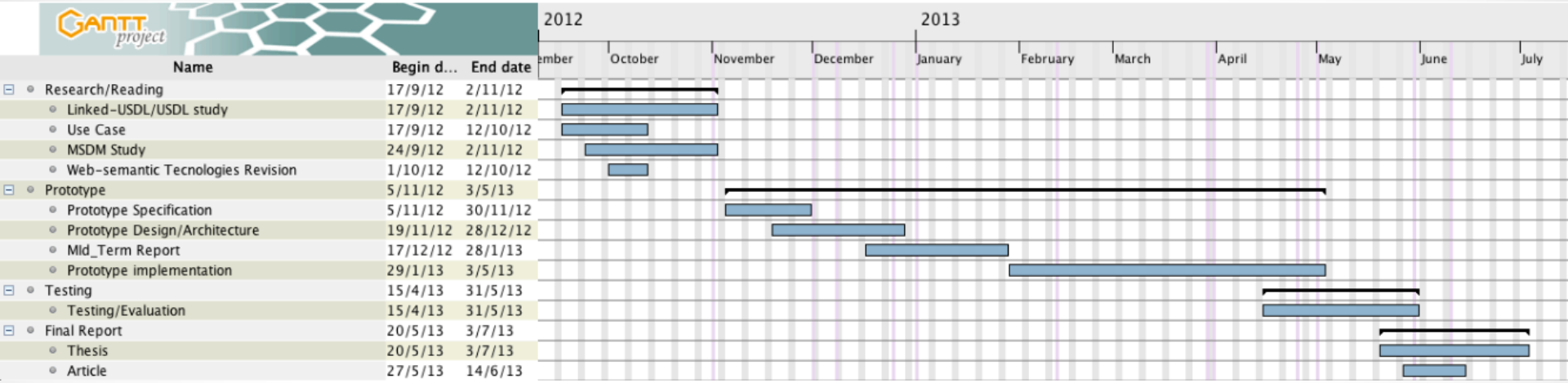
CloudAid Prototype

Future Work

- User interface
- Persistent service set
- Test different decision methods
- Admissible Solutions Algorithm testing in cloud platform
- Papers preparation

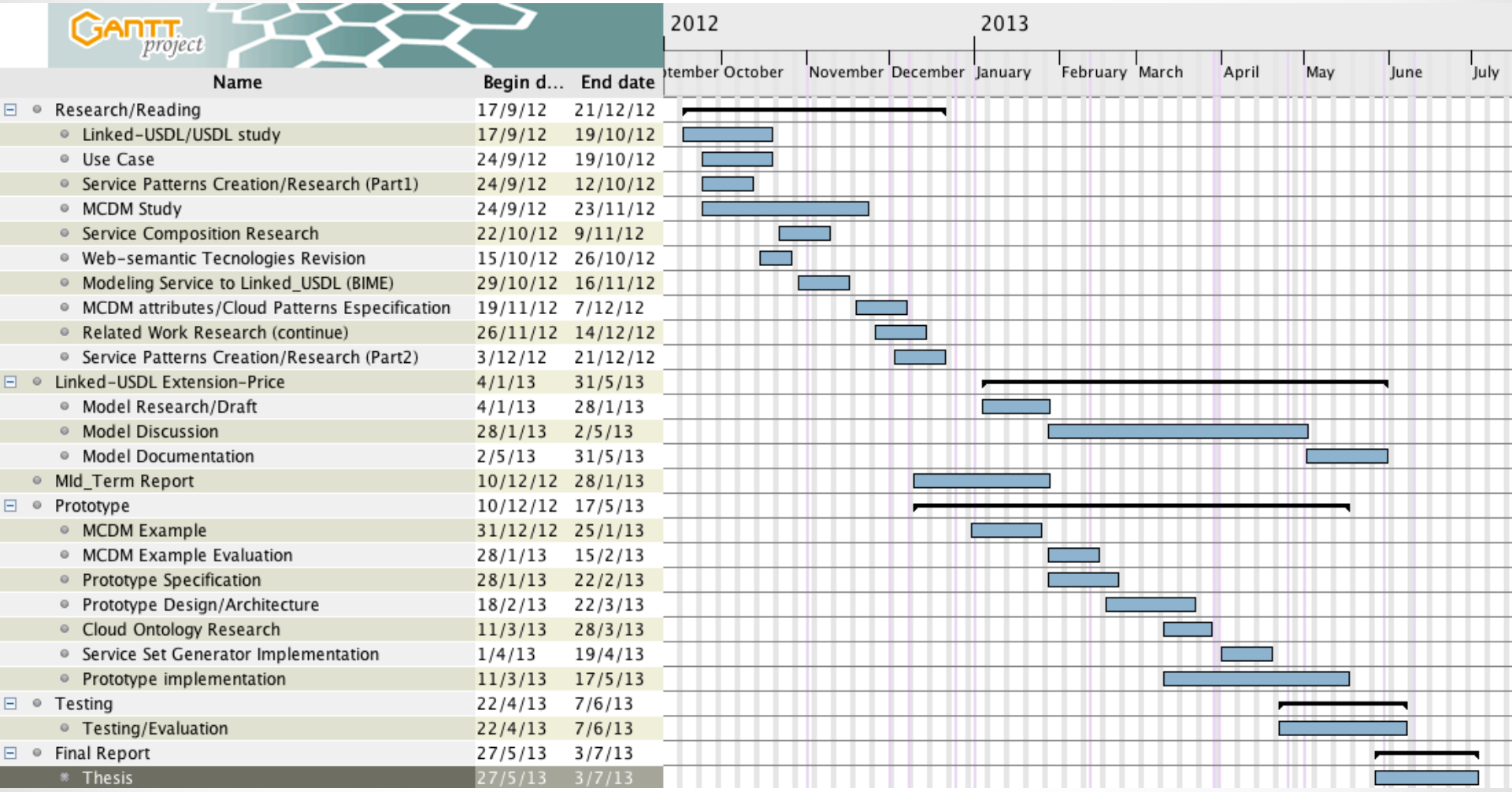
Questions?

Initial Plan



Name	Begin d...	End date
Research/Reading	17/9/12	2/11/12
Linked-USDL/USDL study	17/9/12	2/11/12
Use Case	17/9/12	12/10/12
MSDM Study	24/9/12	2/11/12
Web-semantic Tecnologies Revision	1/10/12	12/10/12
Prototype	5/11/12	3/5/13
Prototype Specification	5/11/12	30/11/12
Prototype Design/Architecture	19/11/12	28/12/12
Mid_Term Report	17/12/12	28/1/13
Prototype implementation	29/1/13	3/5/13
Testing	15/4/13	31/5/13
Testing/Evaluation	15/4/13	31/5/13
Final Report	20/5/13	3/7/13
Thesis	20/5/13	3/7/13
Article	27/5/13	14/6/13

Final Plan



Name	Begin d...	End date
Research/Reading	17/9/12	21/12/12
Linked-USDL/USDL study	17/9/12	19/10/12
Use Case	24/9/12	19/10/12
Service Patterns Creation/Research (Part1)	24/9/12	12/10/12
MCDM Study	24/9/12	23/11/12
Service Composition Research	22/10/12	9/11/12
Web-semantic Tecnologies Revision	15/10/12	26/10/12
Modeling Service to Linked_USDL (BIME)	29/10/12	16/11/12
MCDM attributes/Cloud Patterns Especification	19/11/12	7/12/12
Related Work Research (continue)	26/11/12	14/12/12
Service Patterns Creation/Research (Part2)	3/12/12	21/12/12
Linked-USDL Extension-Price	4/1/13	31/5/13
Model Research/Draft	4/1/13	28/1/13
Model Discussion	28/1/13	2/5/13
Model Documentation	2/5/13	31/5/13
Mid_Term Report	10/12/12	28/1/13
Prototype	10/12/12	17/5/13
MCDM Example	31/12/12	25/1/13
MCDM Example Evaluation	28/1/13	15/2/13
Prototype Specification	28/1/13	22/2/13
Prototype Design/Architecture	18/2/13	22/3/13
Cloud Ontology Research	11/3/13	28/3/13
Service Set Generator Implementation	1/4/13	19/4/13
Prototype implementation	11/3/13	17/5/13
Testing	22/4/13	7/6/13
Testing/Evaluation	22/4/13	7/6/13
Final Report	27/5/13	3/7/13
Thesis	27/5/13	3/7/13

CloudAid Analysis

Rapid Application Development (RAD)

- Flexibility
- Quick testable prototypes

Iterative discussion and revision

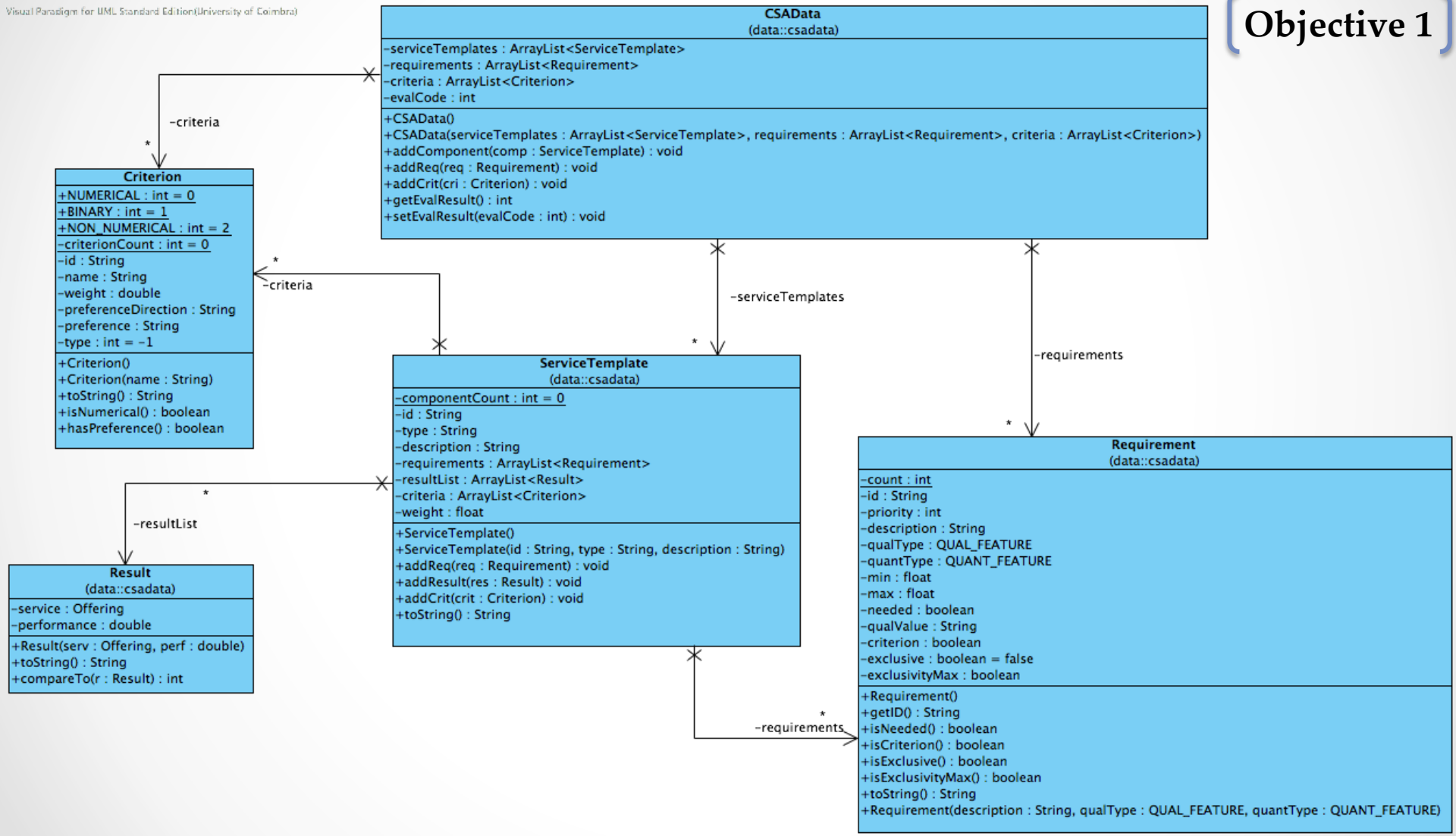
Requirement Analysis

- FURPS+
- MoSCoW

ID	Name	Priority
CSA Data		
FR1	Add a ServiceTemplate to the CSA (Composite Service Architecture)	**MUST**
	Description: The user should be able to insert data about a ServiceTemplate and add it to the his Composite Service Architecture. These ServiceTemplates will be the building blocks of the aggregated solution.	

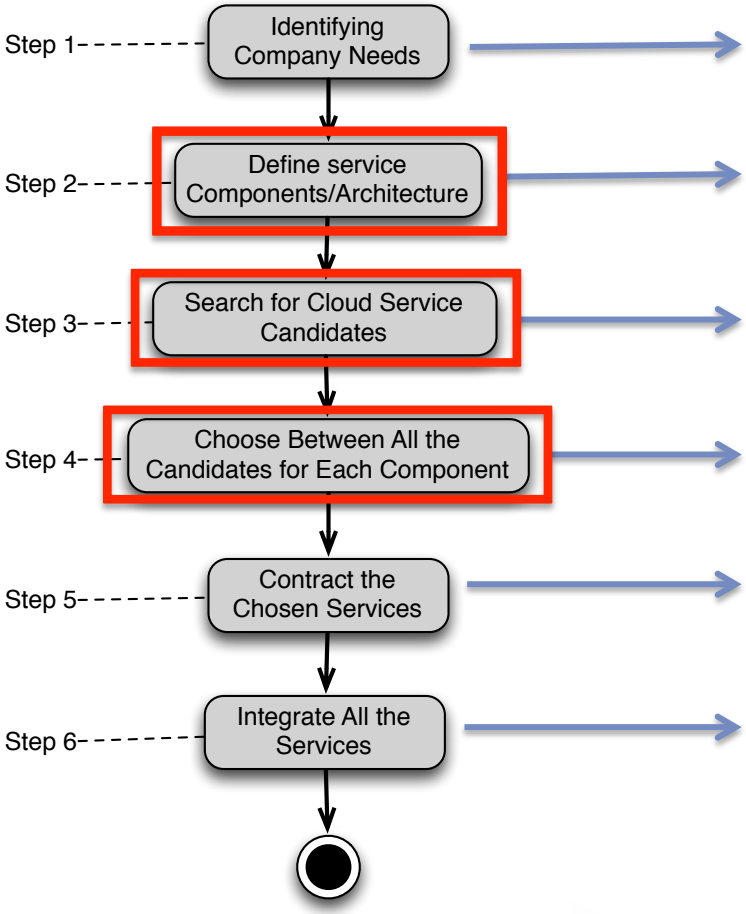
CSA Data

Objective 1



Problem Description

Contracting a Composite Service



Final Composite Service Solution

Requirements elicitation process (mostly a manual process)

Decide which components will be migrated to the cloud, and their constraints (manual process)

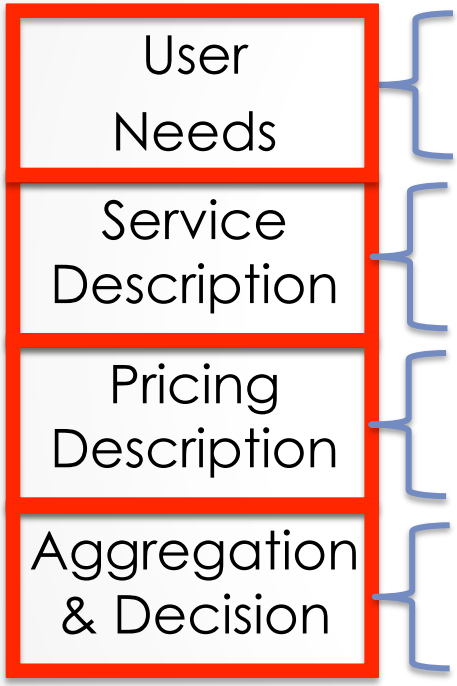
Which cloud services can fulfill the requirements/ constraints (manual process)

Compare the found services and decide which to use (manual process)

Contact the provider or register online for service contracting (manual process)

Integrate and configure all the services to the target environment (developer's team task)

Objectives



Objective 1: Capture all the Composite Service Architecture elements: Service Templates, Requirements, and Criteria

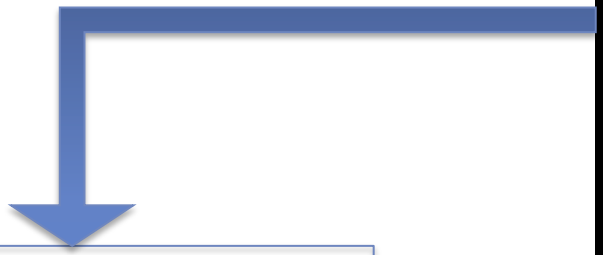
Objective 2: Achieve a uniform publishing and description of the service, capable of enhancing service discovery and comparability

Objective 3: Allow a pricing description that can cope with cloud services pricing plans

Objective 4: Provide a mechanism able to compare and recommend the best services based on a list of Criteria.

CloudAid Prototype - Demo

Interface



Service Template

- Requirements
  - StorageCapacity > 500Gb
- Criteria
  - StorageCapacity
  - Price

```
CSA DATA:
1 - New Service Template
2 - New Requirement
3 - New Criterion
0 - DONE!!!
1
SERVICE TEMPLATE DATA:
1 - Insert Service Template Data
2 - New Requirement
3 - New Criterion
0 - DONE!!!
1
Please specify the Service Template Type:
Database
Please specify the Service Template Description:
This is an example database
SERVICE TEMPLATE DATA:
1 - Insert Service Template Data
2 - New Requirement
3 - New Criterion
0 - DONE!!!
2
Please specify the Requirement Type from the list of Cloud Concepts, o
r write 'Price' for a Price requirement:
StorageCapacity
Does this requirement has a limit value? (Y/N)
y
Please specify the limit:
500
Is it a minimum or maximum limit? (min/max)
min
Please specify a requirement description:
at least 500gb of storage
Will this requirement also be decision criterion? (Y/N)
y
SERVICE TEMPLATE DATA:
1 - Insert Service Template Data
2 - New Requirement
3 - New Criterion
0 - DONE!!!
3
Please specify the Criterion Type from the list of Cloud Concepts:
price
Do you want to maximize the Criterion value? (Y/N)
n
```

Implications & Innovation

Consumer:

- Facilitate cloud service discovery based on service properties (requirements)
- Facilitate provider agnostic cloud service aggregation
- Providing decision mechanisms to evaluate the best solutions based on the enterprise needs

Provider:

- Allowing providers to test their own service possible
- aggregations
- Evaluate the consumers expectancy