THESEUS
Forschungsprogramm für eine neue internetbasierte Wissensinfrastruktur

# Towards Evaluating the Core Technology Cluster of the German Research Project THESEUS


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# Outline

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- THESEUS facts & organisation
- Core Technology Cluster – CTC

- Evaluation of CTC
  - Multimedia Analysis
  - Multimedia Quality
  - Iterative System Design and Quality in Use

- Conclusions

# THESEUS Organisation

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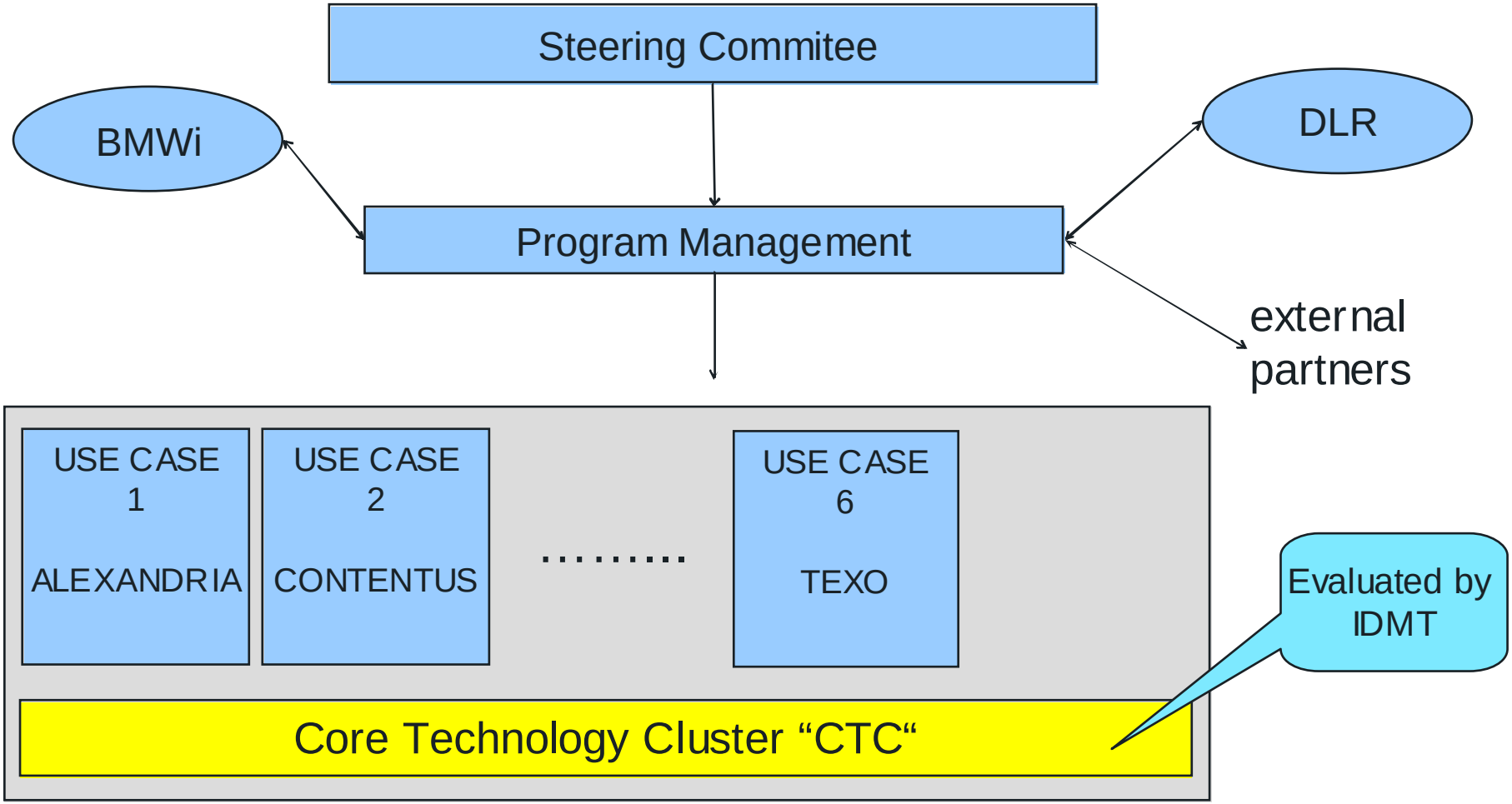

# THESEUS Facts

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## Some facts about THESEUS:

- Number of partners: 22 (30, including 9 Fraunhofer institutes)
- Start: ≈ mid 2007
- Duration: 5 years
- Budget: ≈ 180 Mio. €
- Funding: ≈ 90 Mio. €
- Web: http://theseus-programm.de

[Schäfer2007]

# THESEUS Facts & Partners


Deutsche Nationalbibliothek
Deutsche Thomson OHG (DTO)
Deutsches Forschungszentrum für Künstliche Intelligenz (DFKI GmbH)
**empolis GmbH**
Festo AG
**Fraunhofer-Gesellschaft** (FIRST, HHI, IAIS, IAO, IDMT, IIS, IITB, IGD, ITWM)
Friedrich-Alexander-Universität Erlangen
FZI Forschungszentrum Informatik
Institut für Rundfunktechnik GmbH (IRT)
intelligent views gmbh
Ludwig-Maximilians-Universität (LMU)
LYCOS Europe
m2any GmbH
moresophy GmbH
ontoprise GmbH
**SAP AG**
**Siemens AG**
Technische Universität Darmstadt
Technische Universität Dresden
Technische Universität München
Universität Karlsruhe (TH)
Verband Deutscher Maschinen- und Anlagebau e.V. (VDMA)

[Schäfer2007]

# CTC Overview

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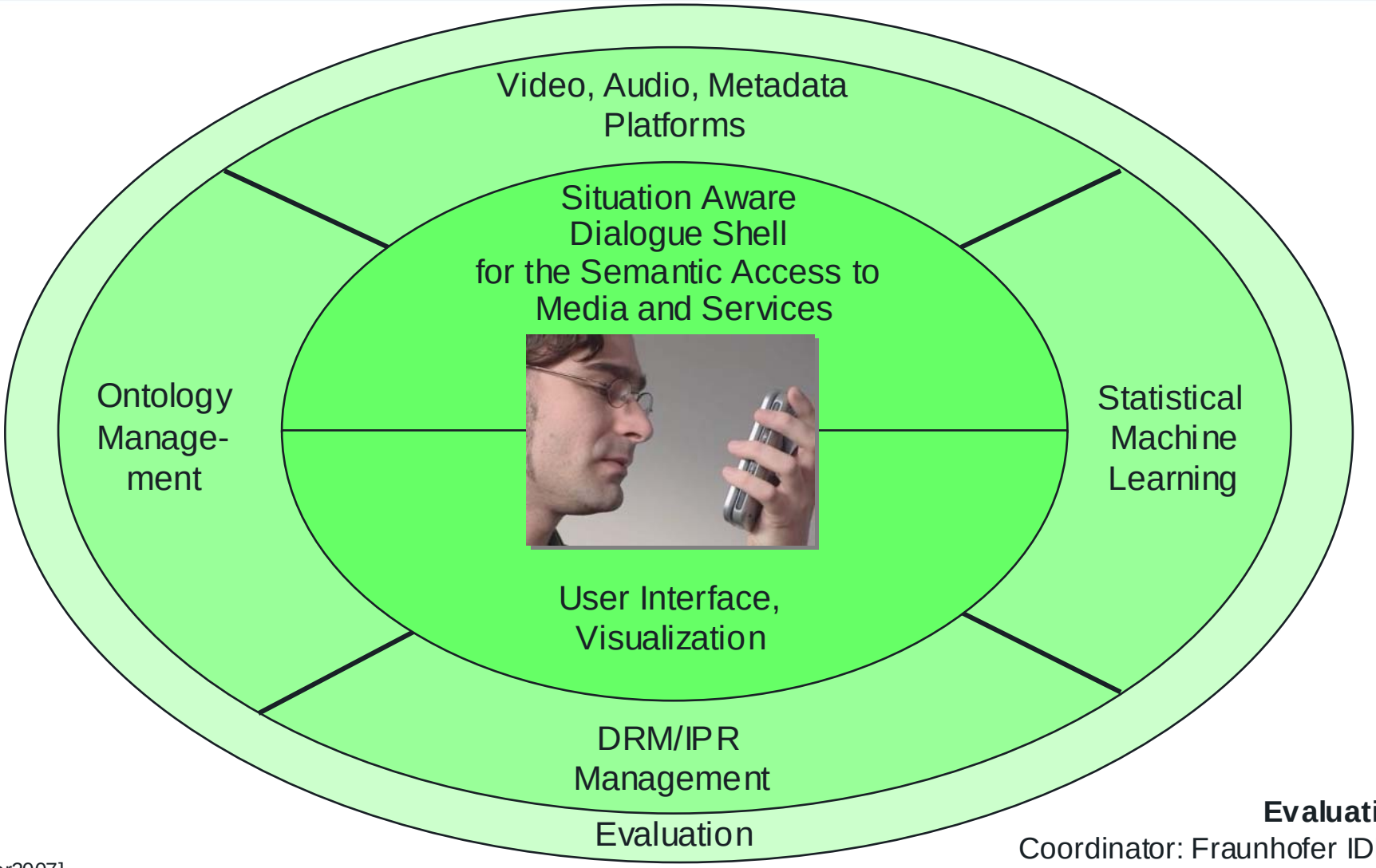


**Evaluation**
Coordinator: Fraunhofer IDMT

[Schäfer2007]

# CTC WP8 Evaluation

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**CTC WP8: Evaluation**

Coordinator: Fraunhofer IDMT

- Task 8.1: Databases
- Task 8.2: Text Analysis
- Task 8.3: Media Data Analysis
- Task 8.4: Picture Analysis
- Task 8.5: Audio Quality
- Task 8.6: Picture Quality
- Task 8.7: Iterative System Design and Quality in Use
- Task 8.8: Privacy&Security
- Task 8.9: Field Testing (FhG FIRST)

# 8.1 Databases

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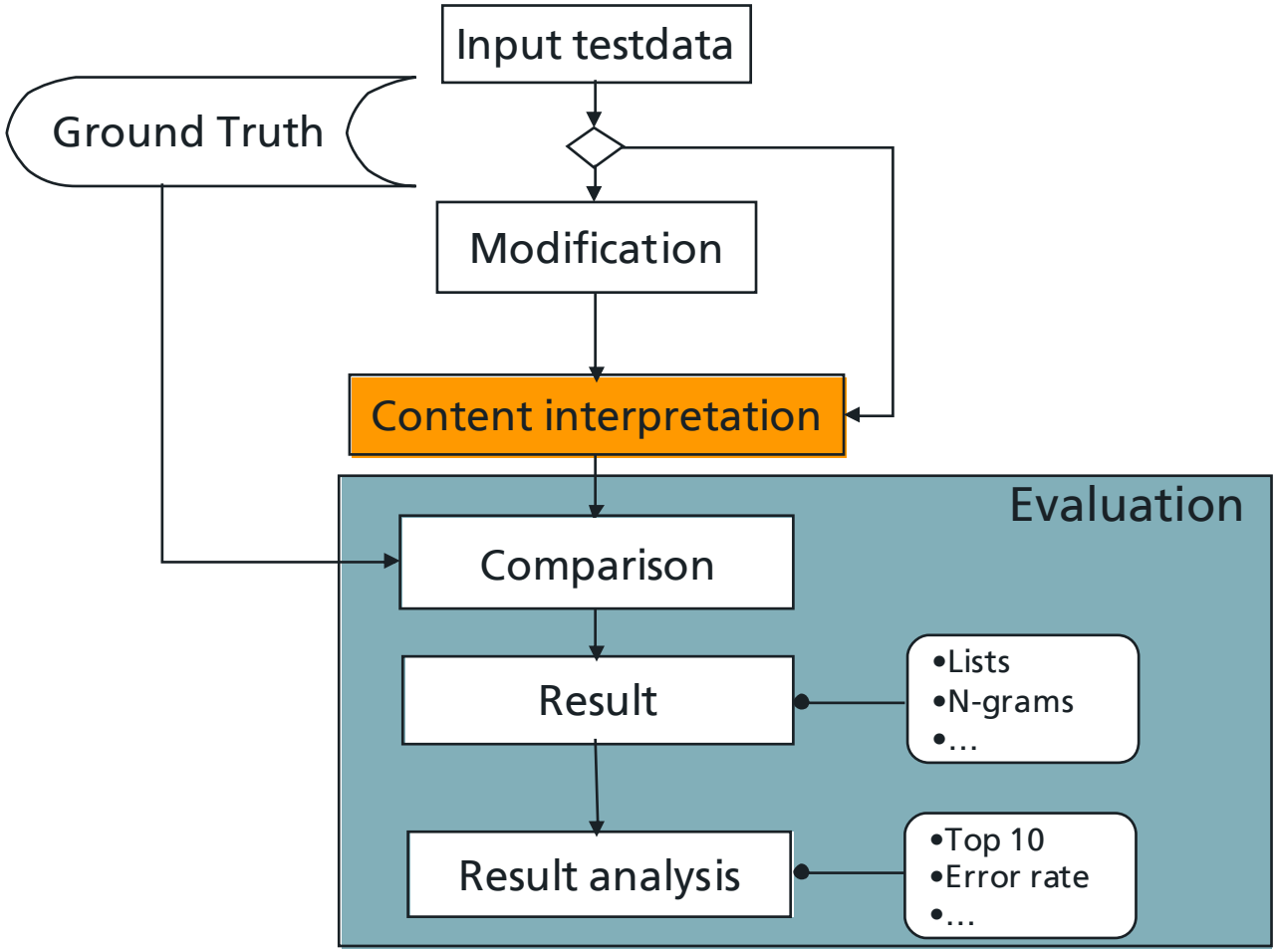
- **Starting Point**
  - Reliable evaluation needs
    - Manifold testdata
    - Defined standard distortions
    - Defined test environments
- **Task**
  - Collection of multimedia test data
  - Collection of standard distortions
  - Annotation of test data
  - Documentation of origin and rights of use
  - (Distribution of training database to other CTC Tasks)

# 8.2 Text Analysis



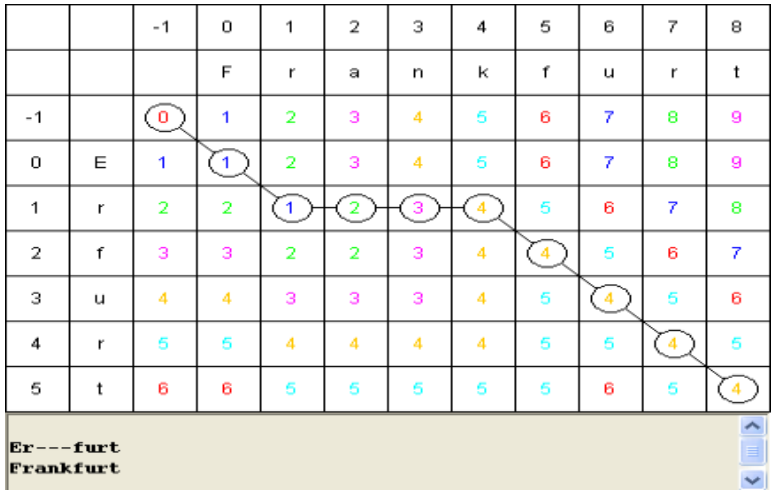
» **Workflow**



# 8.2 Text Analysis



- **Input test data**
  - Generation of test data sets from unused/unlabeled data
  - Distortion/modification of the data
- **Result analysis**
  - Calculation of recognition / error rates of the system
  - Similarity analysis, sequence comparison




[http://www-igm.univ-mlv.fr/~lecroq/seqcomp/node2.html]

$$\text{recognition\_rate} = \frac{\text{recognized\_results}}{\text{all\_truthed\_results}}$$

$$\text{error\_rate} = \frac{\text{incorrect\_recognized\_results}}{\text{all\_truthed\_results}}$$

# 8.3 Media Data Analysis

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» **Starting Point**

» Watermarking :
  » Process of embedding information into multimedia signals
  » Used for protection of copyrights

» Important :
  » Reproduction-, encoding- and transmission process should not influence the detectability of watermark

» **Evaluation Task**

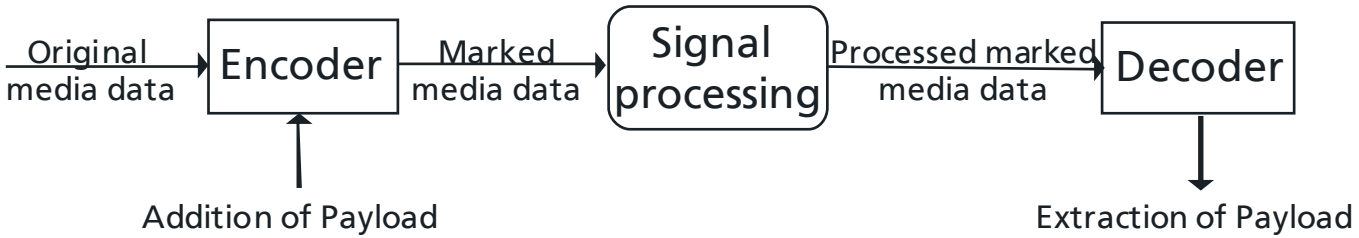
» Evaluation of robustness of watermarking technologies

# 8.3 Media Data Analysis



» **Evaluation Procedure**

- » Embedding watermark/label in data (supporting medium)
- » „Manipulation" of the supporting medium
  - » Reproduction of signal processing like mastering, on air broadcasting, down-mixing, equalization (user-performed enhancements) and data reduction
  - » Signal processing adjusted an adopted to the special needs of the Theseus project
- » Measurement of detect ability of watermark/label after signal processing



# 8.4 Picture Analysis

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» **Starting Point**

- » Various kinds of CTC algorithms and approaches
  - » Shot/Subshot/Scene Detektion
  - » Video Genre Classification
  - » Image and Video Identification
  - » Video Analysis and Understanding
  - » Video Event Detection
  - » Machine Learning Algorithms for Optimization of various Technologies
  - » Still Image and Spatio-Temporal Segmentation
  - » Image Classification and Fast Indexing
    - » New Image Representations
    - » New Classification Schemes
    - » New Indexing Methods
  - » Face Detection

# 8.4 Picture Analysis



» **Evaluation Procedure**

A generic evaluation framework will be developed to handle and measure various Image and Video Analysis Technologies

The key features of the framework are:

- easy extension to new formats and measures
- storing previous test results for comparison and measurement of improvements
- sophisticated visualizations for interactive reviewing and generation of descriptive test results.

# 8.4 Picture Analysis

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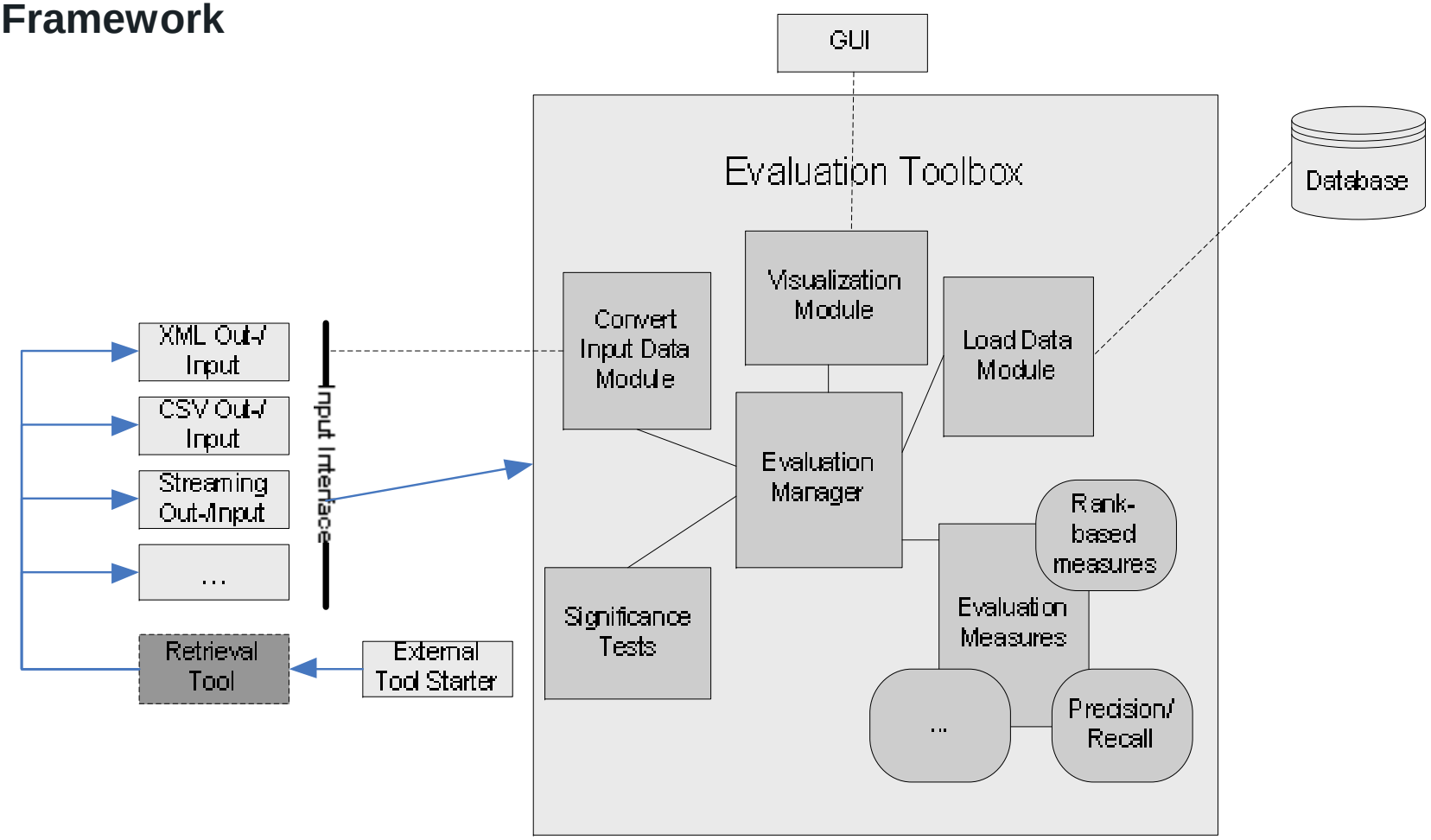
» **Framework**



# 8.5 Audio Quality

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- **Starting Point**
- **Evaluation Task**
  - Watermark should be inaudible
  - Common measurement methods:
    - Detection and analysis possible
    - Influence of the perceptual quality impossible
- **Evaluation Procedure**
  - Evaluation of perceived quality of watermarked content
  - Subjective listening tests according to standardized test procedures
    - ITU-R BS.1116 „Methods for the Subjective Assessment of Small Impairments in Audio Systems Including Multichannel Sound Systems“
    - ITU-R BS.1534 „MUlti Stimulus test with Hidden Reference and Anchor “
    - A-B-X Method

# 8.6 Picture Quality

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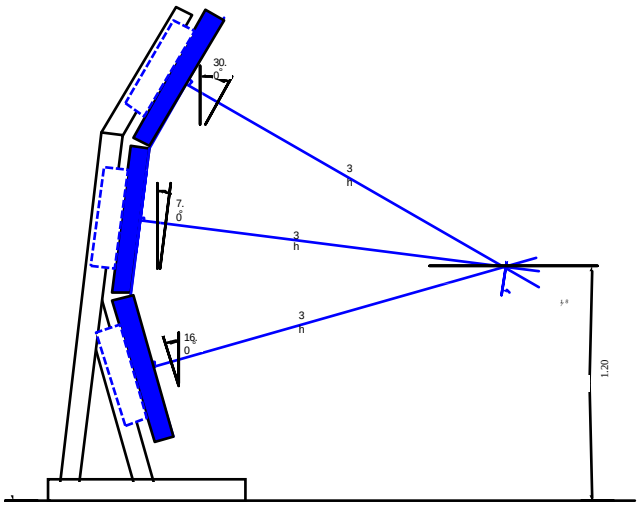
- **Starting Point**
  - Watermark/label should be invisible
  - Picture/Video Compression:
    - High data reduction desired
    - Perceptible quality lost
- **Evaluation Tasks**
  - Measurement of Quality
    - Objective methodes are not precise as subjective
    - Subjective methods time consuming
  - Evaluation of perceived quality of coded, watermarked or labeled content and
  - Comparison of objective measurement with subjective methods

# 8.6 Picture Quality

» **Evaluation Procedure**




[ITUR08]

» Picture/Video Quality:
  » Subjective visual tests according to standardized test procedures
    » ITU-R BT.500 „Methodology for the subjective assessment of the quality of television pictures“
    » TSCES „Triple Stimulus Continuous Evaluation Scale Method“
    » SAMVIQ „Subjective Assessment Methodology for Video Quality“
» Measurement of Quality:
  » Performance of visual tests according to standardized test procedures
    » Full reference methods
    » No reference methods
  » Performance of measurements with same testdata
  » Comparison of results

# 8.8 – Privacy & Security

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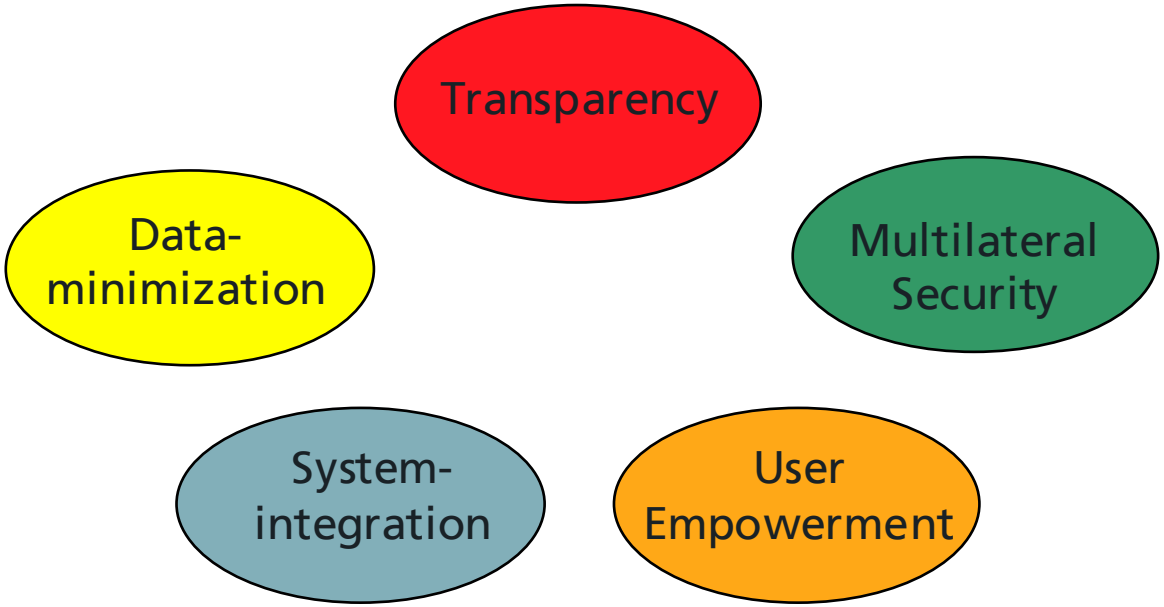
- Privacy & Security Evaluation:
  - Combination of
    - Legal, Technical
    - Economic & Organizational aspects
  - Analysis of Data flow / Data traces
  - Privacy-Criteria:



# 8.8 – Privacy & Security

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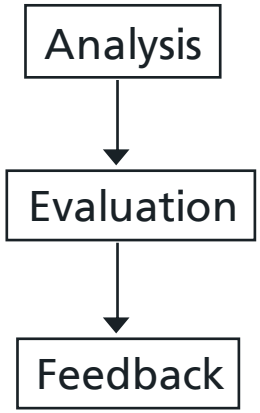
1. Analysis
- Figure out system-modules / create component diagram
- Produce UseCase chart
- Create activity diagram
- Determine all data flows / create sequence diagram
- Optional: create class charts
- Analyse all data traces of the system and communication flows




2. Evaluation
- Evaluate the system / model by defined privacy criteria

3. Feedback Mechanisms
- Feedback will given within defined procedures after finishing the evaluation

Furthermore:
- Select adequate “Privacy Enhancing Technologies”
- Recommend organizational and technical methods for Privacy Enhancement

# THESEUS WP8: Evaluation
# CTC-Task 8.7:
# Iterative system design and quality in use

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# Task 8.7: Iterative system design and quality in use

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»This task refers to the evaluation of the partners' developments towards:

- » certain ***Evaluation criteria*** depending on the particular task and the ***Context of use***
- » determined ***References***

»by following an ***Evaluation process*** that involves:

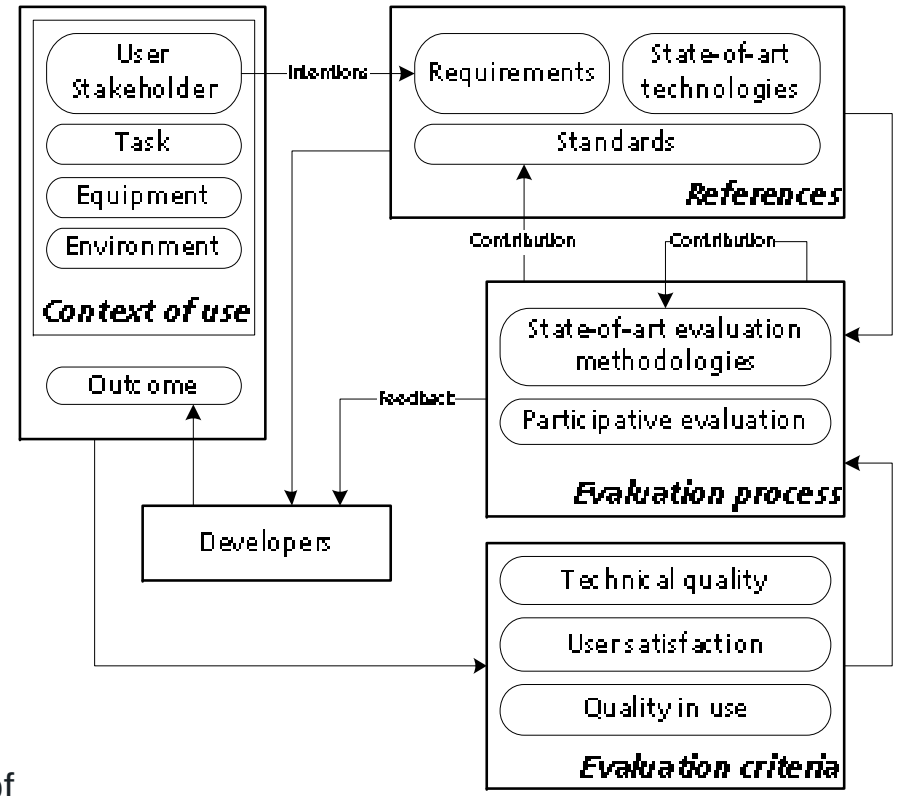
- » State of the art methodologies
- » Participative evaluation

»***References*** include:

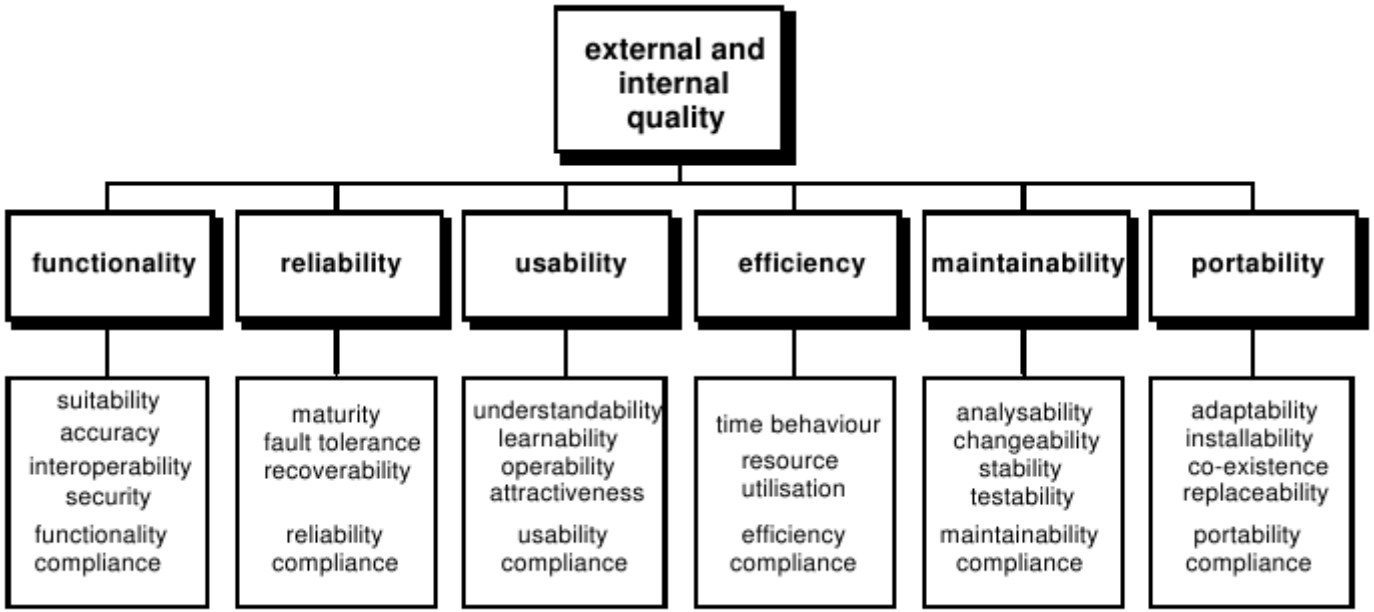
- » Standards and recommendations
- » State-of-the-art technologies
- » Requirements specified by the Use Cases

»***Evaluation process*** will provide:

- » Feedback to developers to be considered in the next iterative stage of the system design
- » Contribution to standards, and state-of-art developments



- **References for the evaluation**
  - The references will include:
    - Standards for: User-Centred Design, Software Quality, Accessibility
    - Initiatives (WAI, OAEI), Campaigns, Conferences (MUC)
  - Use of external or quality in use measures [ISO9126]:



# Task 8.7: Iterative system design and quality in use

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- **Ontology Management**

- Infrastructure for handling ontologies and semantic meta data
- **Ontology design** and **evolution** evaluation:
  - Technical performance criteria
    - Speed, scalability (ability to store and work with big ontologies)
  - Pragmatic criteria: possibility of collaboration

- **Ontology Mapping** evaluation:
  - Use of a “gold standard” to compare to the mapping result
  - Precision, Recall and F-measure
  - Ontology Alignment Evaluation Initiative Campaign (OAEI)

- **Ontology Reasoning** evaluation
  - Reasoning used for validation and deduction
  - Correctness, Performance (execution time, memory consumption, scalability)
  - Use of different data, ontologies, queries, reasoners

# Task 8.7: Iterative system design and quality in use

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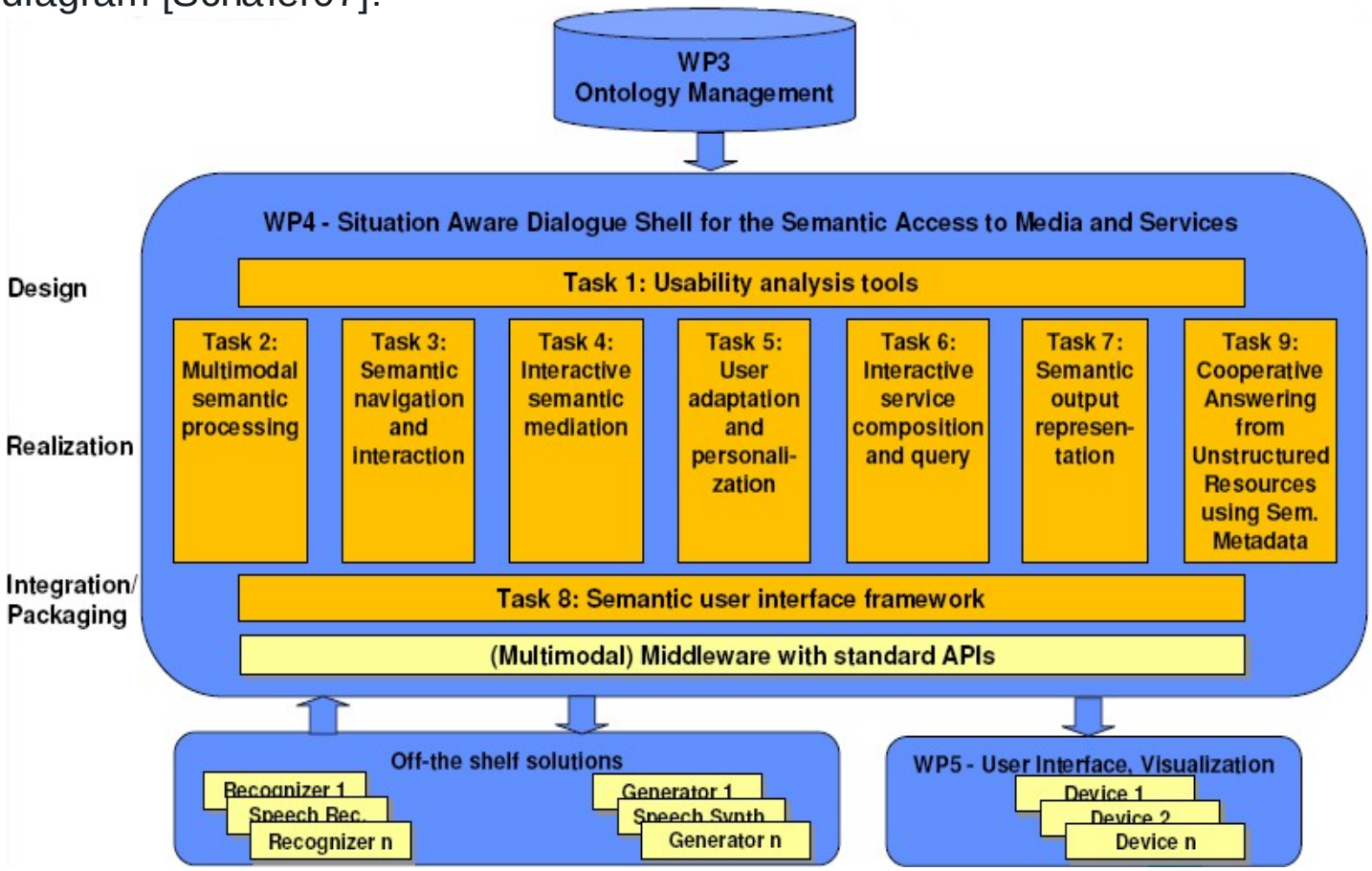
- **Situation Aware Dialogue Shell for the Semantic Access to Media and Services**
- Tasks evaluated unitarily, and also end-to-end evaluation
- Overview diagram [Schäfer07]:



# Task 8.7: Iterative system design and quality in use

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- **Situation Aware Dialogue Shell for the Semantic Access to Media and Services**

- Goals for the design and evaluation of dialogue systems [ISO9241-110]:
  - Suitability for the task, controllability, error tolerance, etc.

- Multimodal semantic processing & Semantic navigation and interaction evaluation:
  - Response time
  - Mutual disambiguation rate (error handling)
  - Possible interaction types
  - Easy-to-use end device adaptation (mobile, desktop, etc.)

- User adaptation and personalization evaluation:
  - Scalability (number of user profiles)
  - Adequate inference of user preferences
  - Privacy issues (authentication, restrictions)

# Task 8.7: Iterative system design and quality in use

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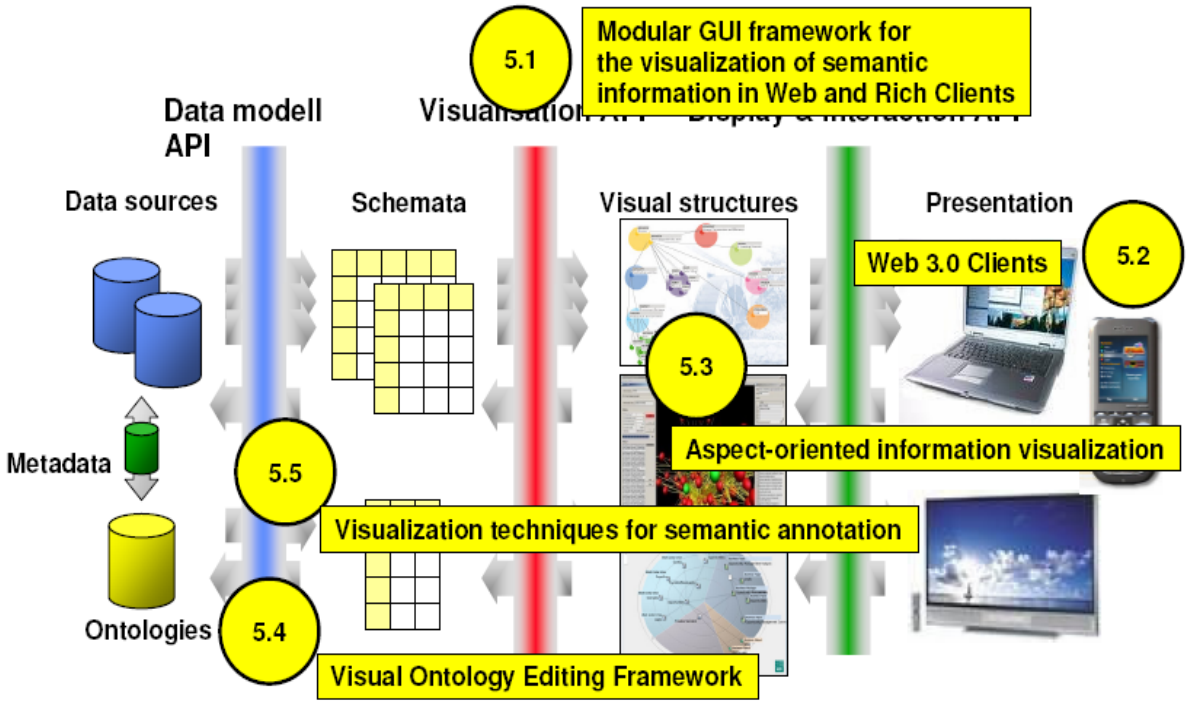
» **User Interfaces and Visualization**

» Appropriate and intuitive interface to the user
» Overview diagram [Schäfer07]:



# Task 8.7: Iterative system design and quality in use

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- **User Interfaces and Visualization**

- **Semantic information visualisation** evaluation based on:
  - Scalability
  - Appropriate use of interaction and navigation techniques [Hearst1999]
  - Usability( efficient navigation, user satisfaction), accessibility
  - Personalisation, collaboration, role views

- **Ontology editing framework** evaluation:
  - Ontology schema and instance editing
  - Versioning system (change management)

- **Visualisation techniques for semantic annotation** evaluation:
  - Support several document formats for annotation: HTML, XML, images, etc.
  - Use of automation (or semi-automation)
  - Support for privileges, trust, access rights

# Task 8.7: Iterative system design and quality in use

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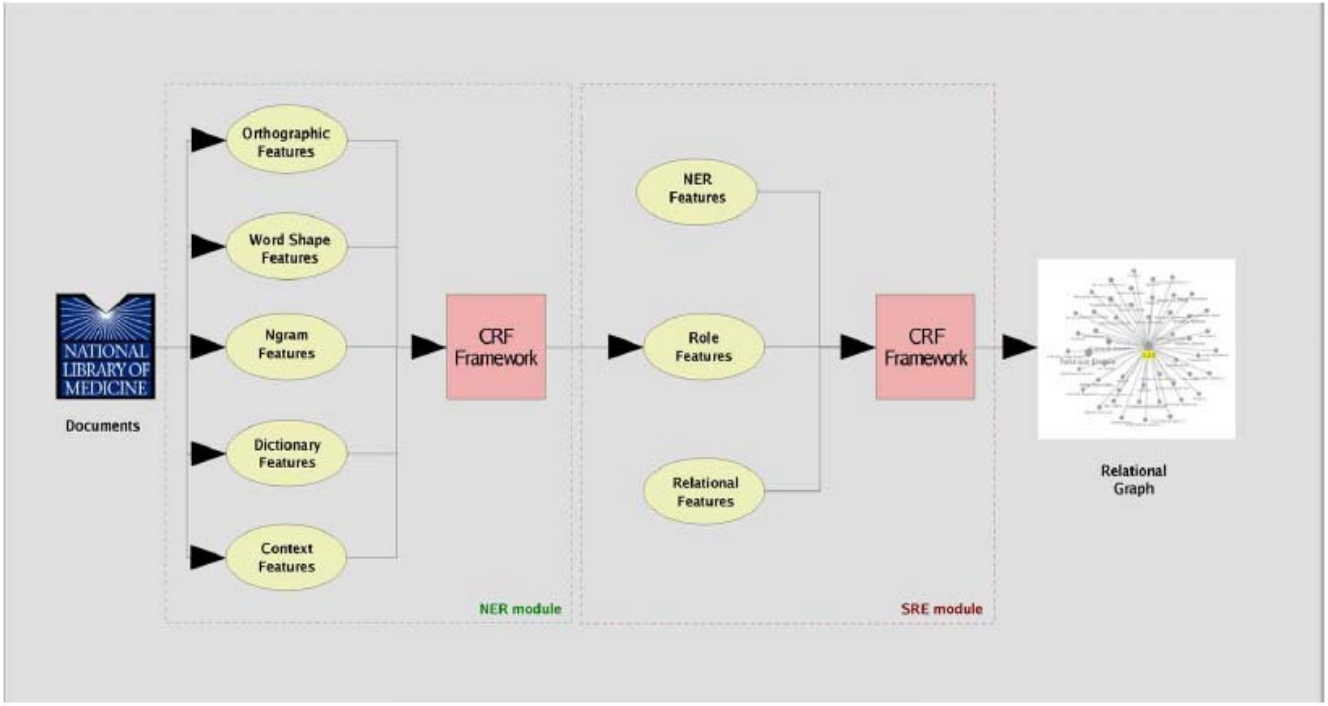
- **Statistical Machine Learning**

- **Learning with Relational Data and Ontologies** evaluation based on:
  - Extraction of ontology from text data
  - Scalability
  - Ontology evaluation [Brewster2004][Navigli2004]:
    - Quantitative: performance of the algorithms (precision, recall or F-measure)
    - Expert evaluation: assess the relations discovered between concepts

- **Learning Semantic Annotation in Textual Data and Web Services**
  - Text format predominant on the web
  - Ontology based semantic annotation approaches [Diallo2006] or [Khelif2004]:
    - ontology instantiation: Detect terms considered as instances of ontology concepts and relations
    - annotation generation: Extract relevant information for describing the content

- **Statistical Machine Learning**

- **Learning Semantic Annotation in Textual Data and Web Services**
  - Use of Named Entity Recognition and Semantic Relation Extraction
  - Possible cascaded Workflow [Bundschus2008]:



# Task 8.7: Iterative system design and quality in use

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- **Statistical Machine Learning**

- **Learning Semantic Annotation in Textual Data and Web Services** evaluation:
  - Precision, Recall, F-measure, ROC, AUC score [Huang2005]
  - Possible human based evaluation (to validate the annotations)

- Importance of the degree of matching required [Tsai2006]:
  - left match, right match, partial match, approximate match, etc.

- The CBE (Cost-Based Evaluation) model [Sassone1987], stems from the economics field:
  - flexible with the different possible requirements from different users
  - complex definition of weights (can be simplified)
  - used in [Olsson2002], and [Maynard2005]

# Task 8.7: Iterative system design and quality in use

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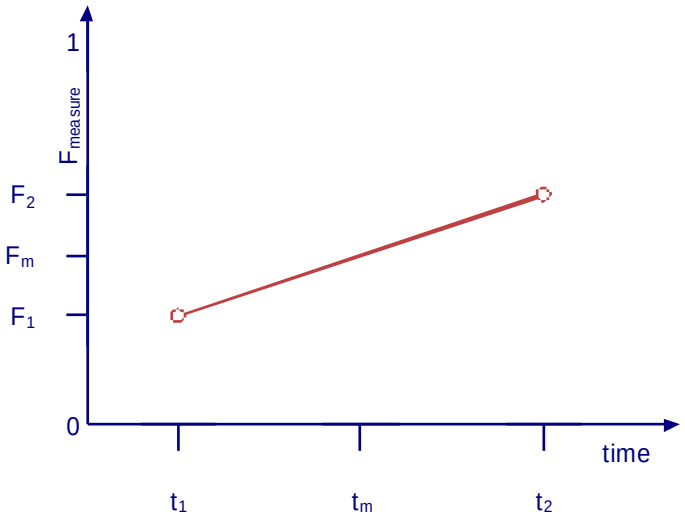
- **Statistical Machine Learning**

- **Large-Scale Self-Learning Textual Archives**

- New machine learning techniques for information extraction from textual documents
- Information visualization components will also be developed

- Evaluation
  - Confusion matrix for each kind of structure to be identified (e.g. address) [DeSitter2004]
  - Correctness depends on the required accuracy [Freitag1998]
    - exact rule, contain rule, overlap rule
  - Partially correct results in the calculation of True Positives, weight of ½
  - Possibility of using MUC (Message Understanding Conference) scoring framework

- **Statistical Machine Learning**
- **Large-Scale Self-Learning Textual Archives**
- The information visualization evaluation:
  - Improvement rates when involving the user
  - Effectiveness: accuracy and completeness with which users achieve specified goals
    → F-measure
  - Efficiency: resources expended in relation to the accuracy and completeness




$$\text{slope} = \frac{\Delta F_{measure}}{\Delta t} = \frac{F_2 - F_1}{t_2 - t_1}$$

where:

$t_1$ is the time needed to process the document without the user involvement,
$t_2$ is the time needed to process the document with the user involvement,
$F_1$ is the F-measure achieved without the user involvement,
$F_2$ is the F-measure achieved with the user involvement

# Conclusions

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- Why evaluation in THESEUS is important [Schäfer2007]:
  - Goals must be defined precisely
  - Developers can experiment and validate their ideas, and keep only those leading to improvements
  - Continuous evaluation over 5 years to measure the improvements and project success
  - Continuous feedback to developers to improve quality
- Research and development on new evaluation technologies
  - Planned contribution to state-of-the-art evaluation technologies
- Evaluation tests not yet started
  - Work on test specifications and corpora aggregation
  - Dynamic adaption of evaluation plan if needed within 5 years period

# The End

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Thank you




http://theseus-programm.de/

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