Web Engineering

Requirements Analysis

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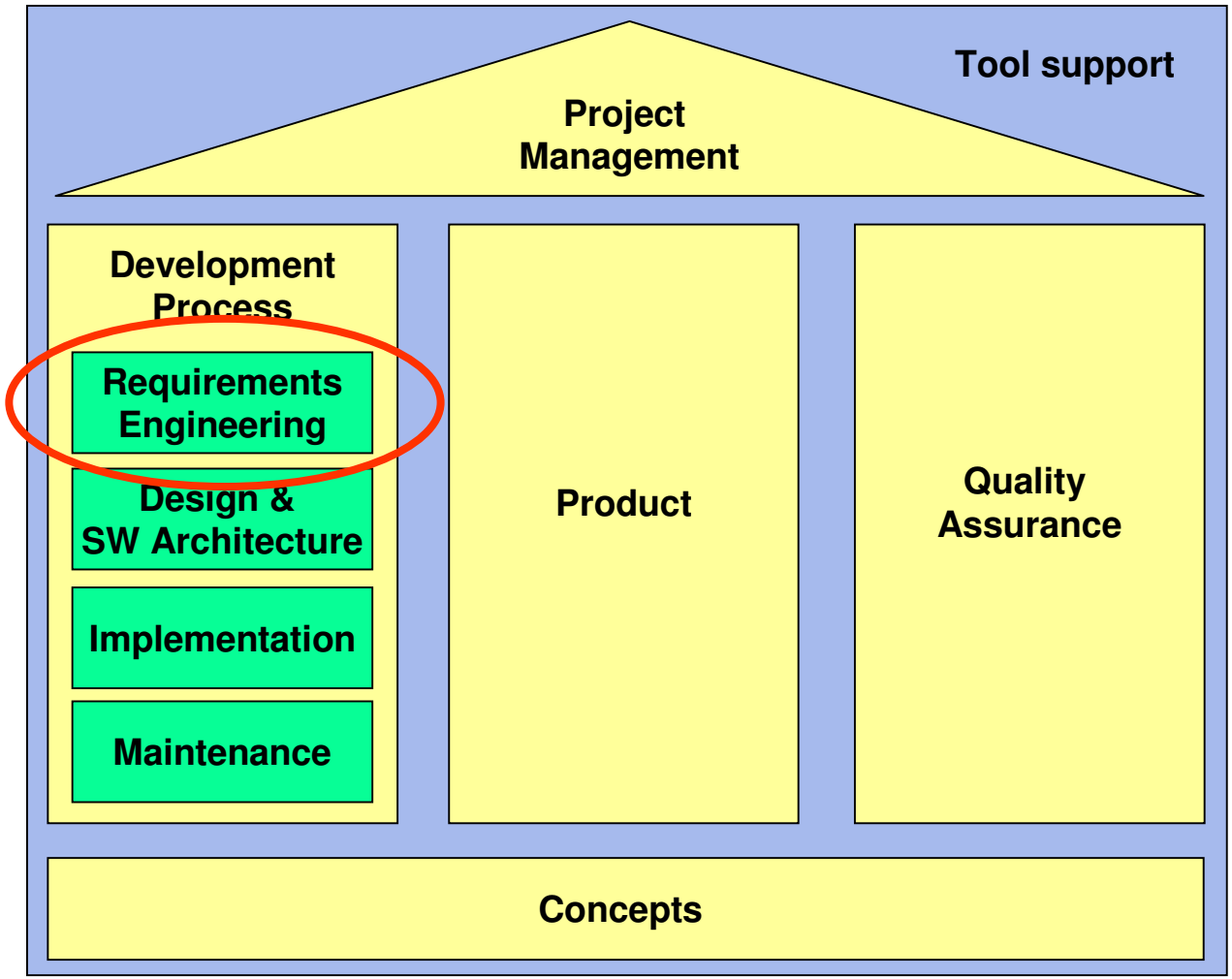
Software/Web Engineering Areas



(Web) software development implies also much effort in other activities rather than implementation

Requirements Engineering: Definition

- Requirements engineering (RE) is concerned with identifying the purpose of a software system, and the contexts in which it will be used.
- RE is a systematic approach
- RE acts as a bridge between
  - the real world needs of users and customers, and
  - the stakeholders involved in the development of the software system, and
  - capabilities and opportunities offered by software technologies

Contents Lecture 2

- Problem world and solution world
- Specifics of RE for Web systems
- RE process
- Techniques for RE
- Methods: NDT and UWE

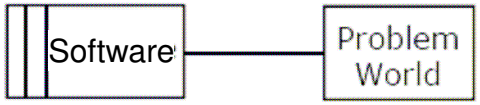
Risk Factor: Requirements Analysis

- Risk that requirements are
  - unclearly specified
  - incorrect
  - incomplete
  - instable
  - containing bugs
- Consequences of poor requirements analysis
  - erroneous planning of budget and time
  - inadequate resources
  - low acceptance by users
- Industry has many problems due to
  - balance technologies and business application aspects
- Requirements role in the development of Web software is underestimated
  - customer satisfaction
  - quality of the Web application

»Requirement definitions are the prime sources of project failures «
(Glass' law)

(Web) Software Development

- Provides solution to a problem of the real world, e.g.
  - to obtain tourist information
  - to perform bank transactions
  - to be assisted when travelling (booking flights, hotel reservation, maps & navigation)
- Requires existence of set of technologies enabling solutions, e.g.
  - HTML-forms allows for search mechanisms
  - Secure transfer makes online banking possible
  - AJAX technology allows for Google maps

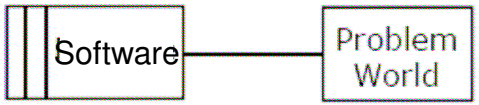


- Characteristics
  - distinction between problem world and solution world
  - Web domain driven by technologies

- Separation of business application and technologies used to implement it
  - new business ideas require innovative technological support
  - new technologies allow for new type of business applications

Problem World vs. Solution World

- Problems have
  - a real world
    - account, bank card (#), account owner, transactions
  - behaviour
    - money transfer, pin & tan check,
  - restrictions
    - transfer amount less or equal current money status of account + credit amount

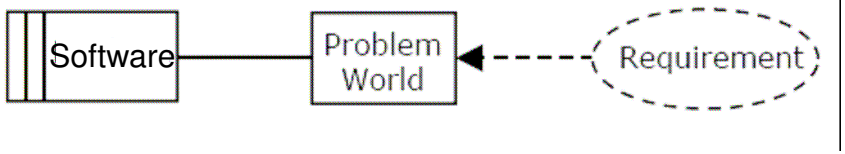


- Identification of customer's requirements

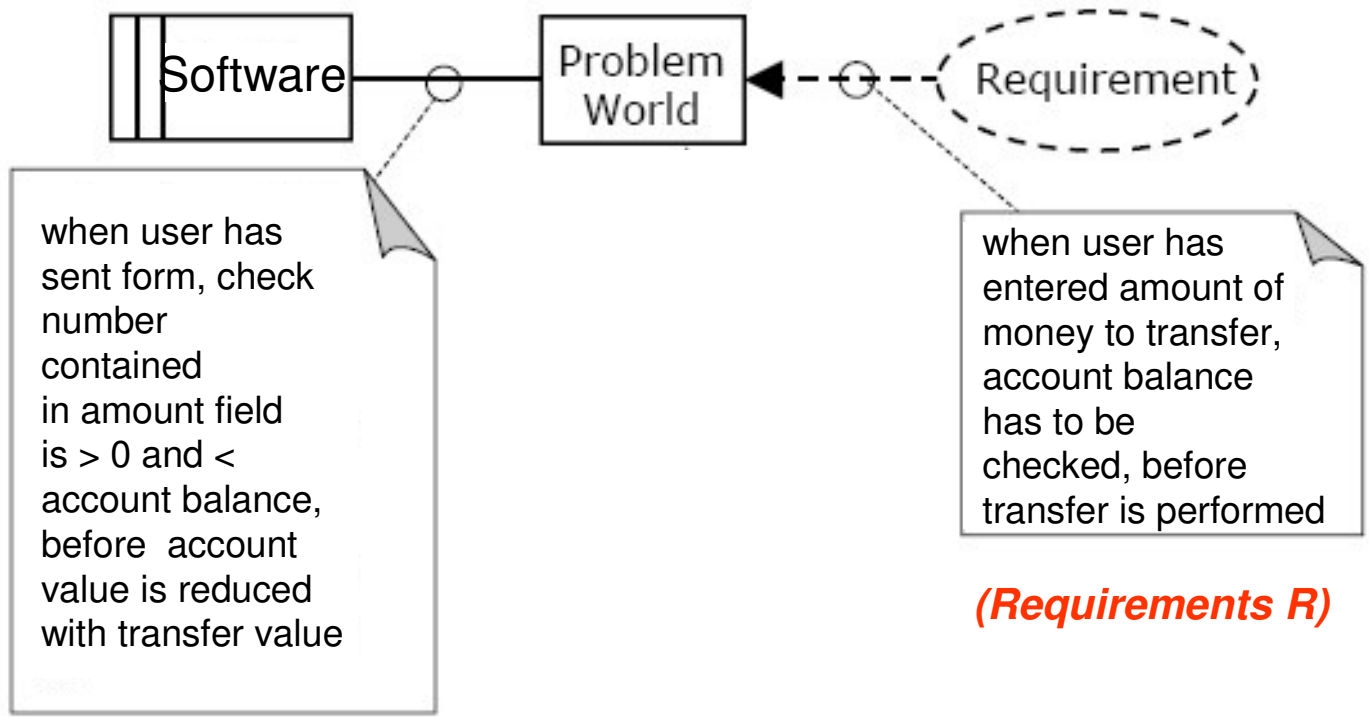
  mainly conditions on the problem world not on the solution world!!

  - pin & tan has to be checked
  - account status has to be checked

- Developing a software for the problem means
  - identification of sub-problems
  - finding solutions for sub-problems
  - composition of these solutions



Requirements Specification vs. Software Specification



(Software Specification S)

(Requirements R)

Differences for RE for the Web

- User Domain
  - user divorced from development
  - no traditional entry or exit point
  - technology more visible to the user
  - high reliance on user interface
  - non-functional requirements primacy
  - volatility in user requirements
- Developer Domain
  - multidisciplinary teams
  - aesthetic and cognitive differences
  - developer inexperience
  - uncertainty
  - rapidly changing technology
  - lack of useful methods
- Environment
  - tight linkage between business architecture and the technical design
  - impact of legacy systems
  - aggressive release demands
  - immaturity of Web development techniques
  - development changes the business model
  - highly competitive, market environment
  - fine grained evolution and maintenance

S. Jeary & K. Phalp 2004

Types of Requirements

- Functional
  - content
  - hypertext structure
  - user interface
  - adaptivity/ubiquity
  - mobility
- Non-functional
  - availability
  - performance
  - security of transactions
  - reliability
  - usability
    - understandability
    - learnability
  - changeability
  - portability
  - ethic issues

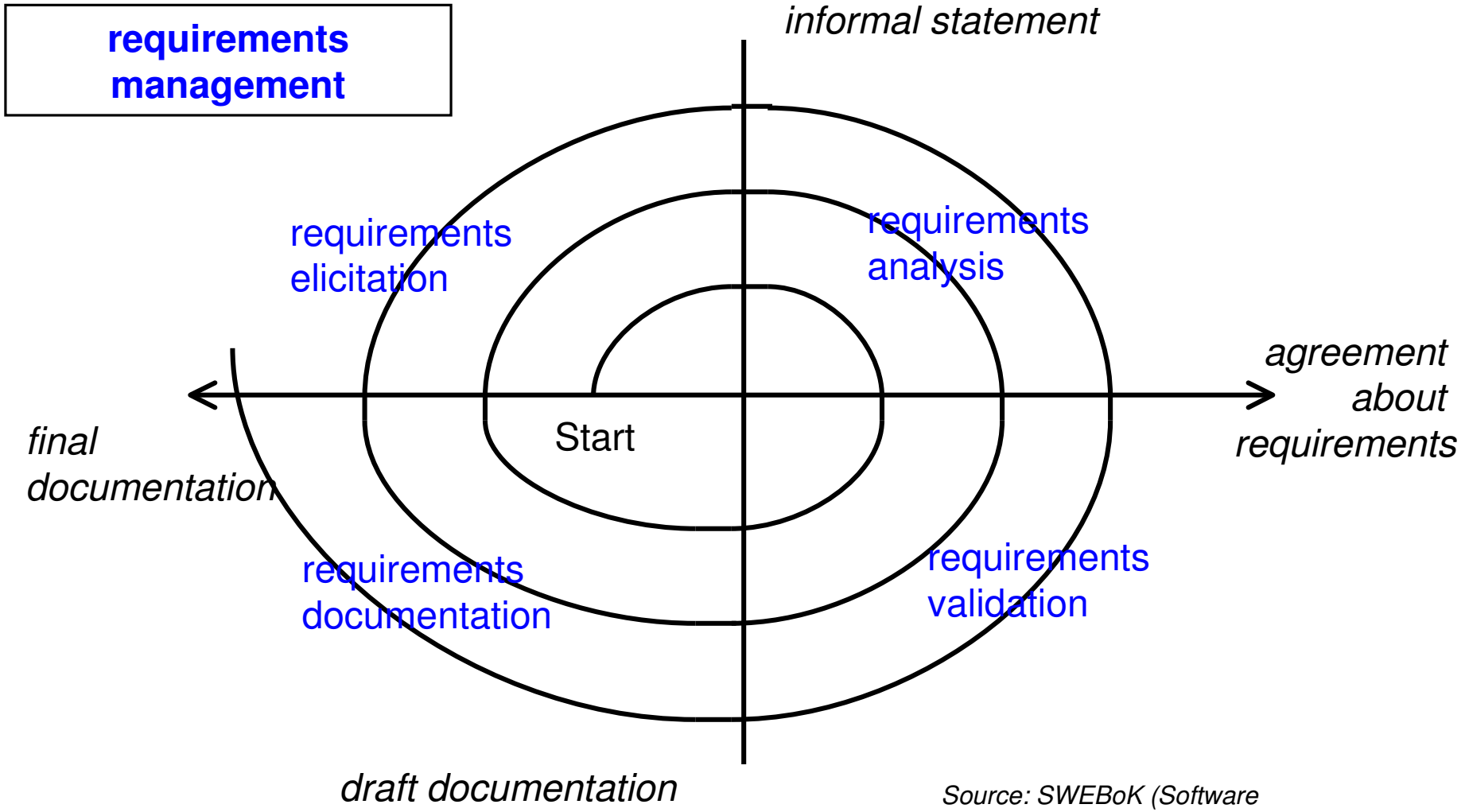
Functional Requirements

- Content
  - money transfer for different type of accounts
  - transfer history
- Hypertext structure
  - take categories of services into account
  - check of account status should be possible from everywhere
  - less than 5 steps to find a service or product
- Business processes
  - confirm selection of product (step 1), payment (step 2), invoice (step 3)
  - select software, select mirror, download
- Layout / Presentation
  - use corporate identity (CI) of the company for colours, fonts and shapes
  - appropriate for visually impaired (“barrier free internet”)

Non-functional Requirements

- Quality
  - Web application has to support 5000 simultaneous enquiries (performance)
  - secure transfer for all customer data
- Usability
  - arbitrary user shall be able to find a service in less than two minutes
  - shopping cart must be available (selectable) all the time
- Project management
  - Web application (solution) must be online on September 15th, 2007
- Technical environment
  - open source software
  - Web services should be implemented using JBoss technologies

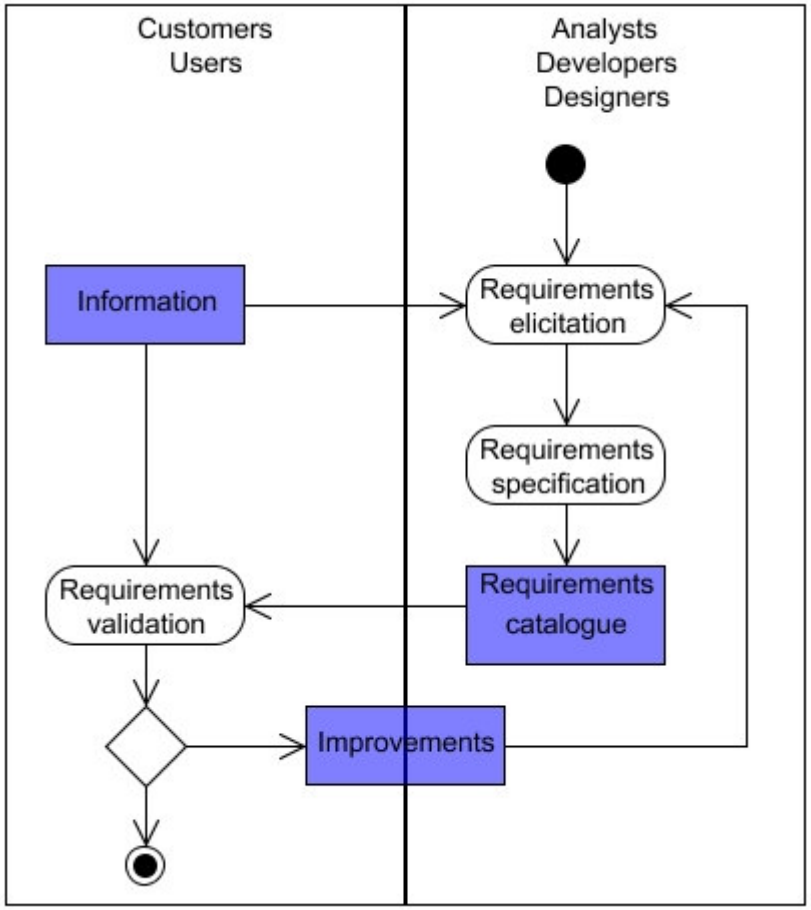
Requirements Engineering Process (1)



Source: SWEBoK (Software Engineering Body of Knowledge), IEEE project

Requirements Engineering Process (2)

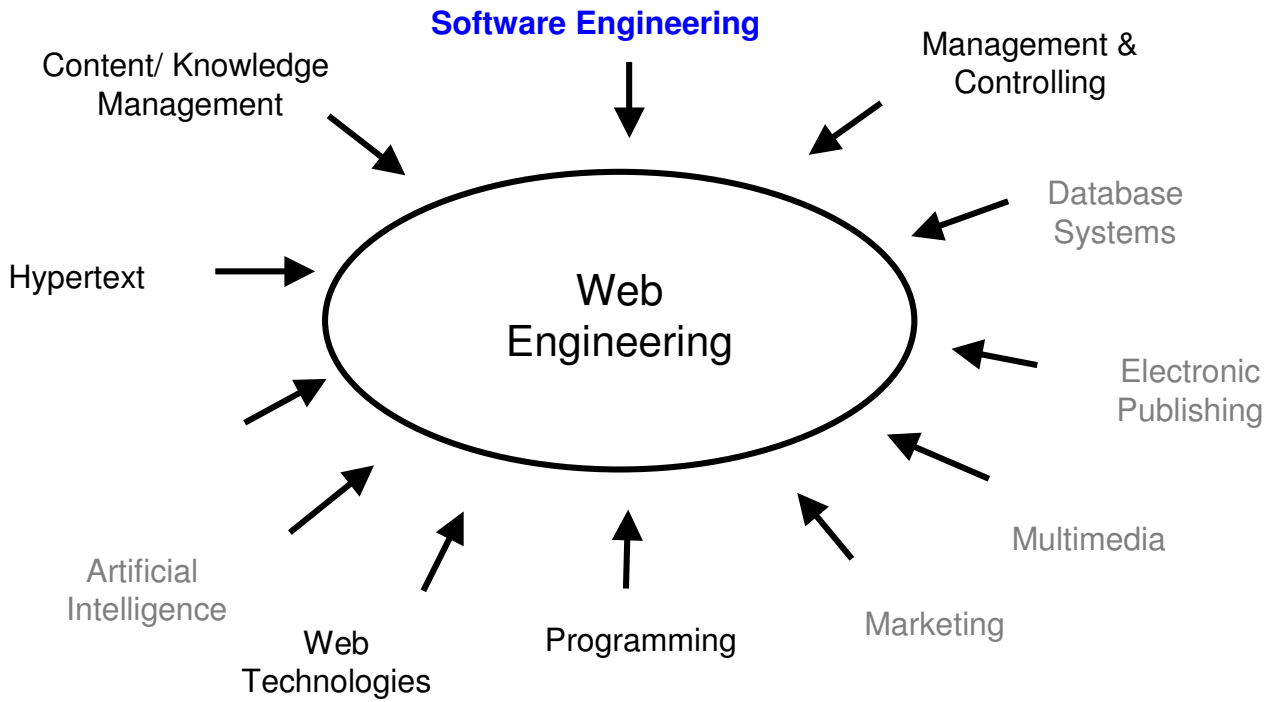
- Elicitation – capture
  - identification of functionalities the system has to fulfil
  - identification of non-functional characteristics
- Specification – documentation
  - textual and graphical description of captured requirements
- Validation
  - prove that the specification conforms the users/customers needs



Stakeholders

- Most important
  - customer
  - user
  - developer

- More relevant by Web applications
  - content manager
  - marketing experts
  - usability experts
  - graphical designers
  - ....



Elicitation of Requirements

- Capture or elicitation
  - identification of functionalities the system has to fulfil
    - Web user groups
    - required content
    - navigation needs
    - business processes
    - presentation aspects, styles, corporate identity
  - identification of non-functional characteristics
    - performance, usability
- Techniques
  - interviews
    - questionnaires
    - checklists
  - concept mapping
  - brainstorming
  - sketching
  - storyboarding

Specification of Requirements

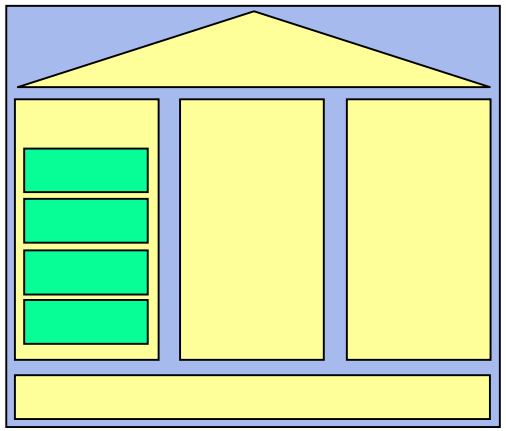
- Analysis, specification or documentation
  - description of captured requirements
  - graphical representation of requirements
- Techniques
  - informal description/representation
    - natural language
    - glossaries
    - ontologies
    - scenarios
    - user stories in XP
  - semi-formal
    - templates
    - visual models, e.g. UML use cases
  - formal
    - formal languages, e.g. specification in Z
  - prototypes

Validation of Requirements

- Validation
  - process with the goal to prove that the specification of the requirements defines the complete system that the user needs
- Techniques
  - reviews
    - walk-throughs or inspections
    - audits
  - traceability matrices
  - prototypes

Requirements Engineering Methods
(same as in Software Engineering)

- Each method comprises
  - tool support
  - development process establishing
    - steps
    - expected results
  - techniques for
    - construction
    - analysis
    - transformations
  - notation
    - syntax of documentation
    - types of diagrams
    - semantics
- Methods are based on
  - basic concepts
- Examples
  - NDT, UWE, OOHDM, W2000, …



NDT: Navigation Development Techniques

- Method characteristics
  - focus mainly on requirements analysis (not on design)
  - template-based specification
  - lack of graphical representation
  - requires specific tool support: NDT-Tool
- Method specification
  - MOF Metamodel for each requirements type
- Pros
  - appropriated technique for customer-developer communication
- Cons
  - maintenance problems
- Extension
  - transformation to and from UML graphical notation (use cases and activity diagrams)

FR-01	**Login**	
Description		
Actors		
Normal sequence	**Step**	**Action**
	1	
	2	
	3	
	4	
	5	
Exceptions	**Step**	**Action**
	4a	
	5a	

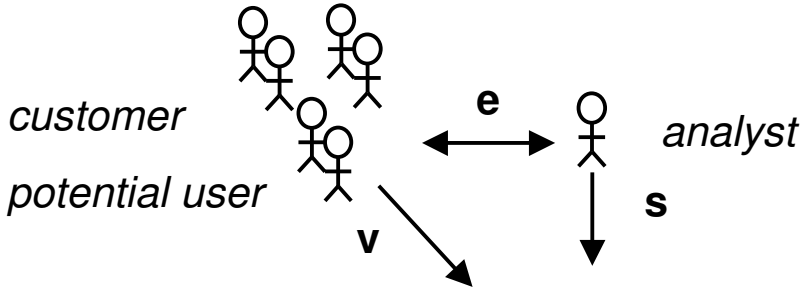
**NDT: M. J. Escalona*
University of Sevilla, Spain, 2004

Simple Music Portal Example

- inspired by `www.mp3.com`
- offers albums for downloading
- contains information about singer, composer, and publisher
- this information is available for free
- registered users can search albums and download them
- for downloading they need to have enough credit on their prepaid account
- accounts are rechargeable

NDT: Process, Techniques and Results

- Elicitation
  - mainly interviews
  - other techniques possible
- Specification
  - templates
  - cross references
  - use cases derived from templates
- Validation
  - review
  - traceability matrices



IR-02	Song request
Description	Application provides information to a song and download possibility
Actors	AC-01: User AC-02: Registered User
Entry parameters	The user indicates name or part of song name
Associated functionality	FR-01: Search by song name or song author
Information shown	SR-01 Album SR-02 Song SR-03 Author
Exit	IR-04
Entry	IR-01

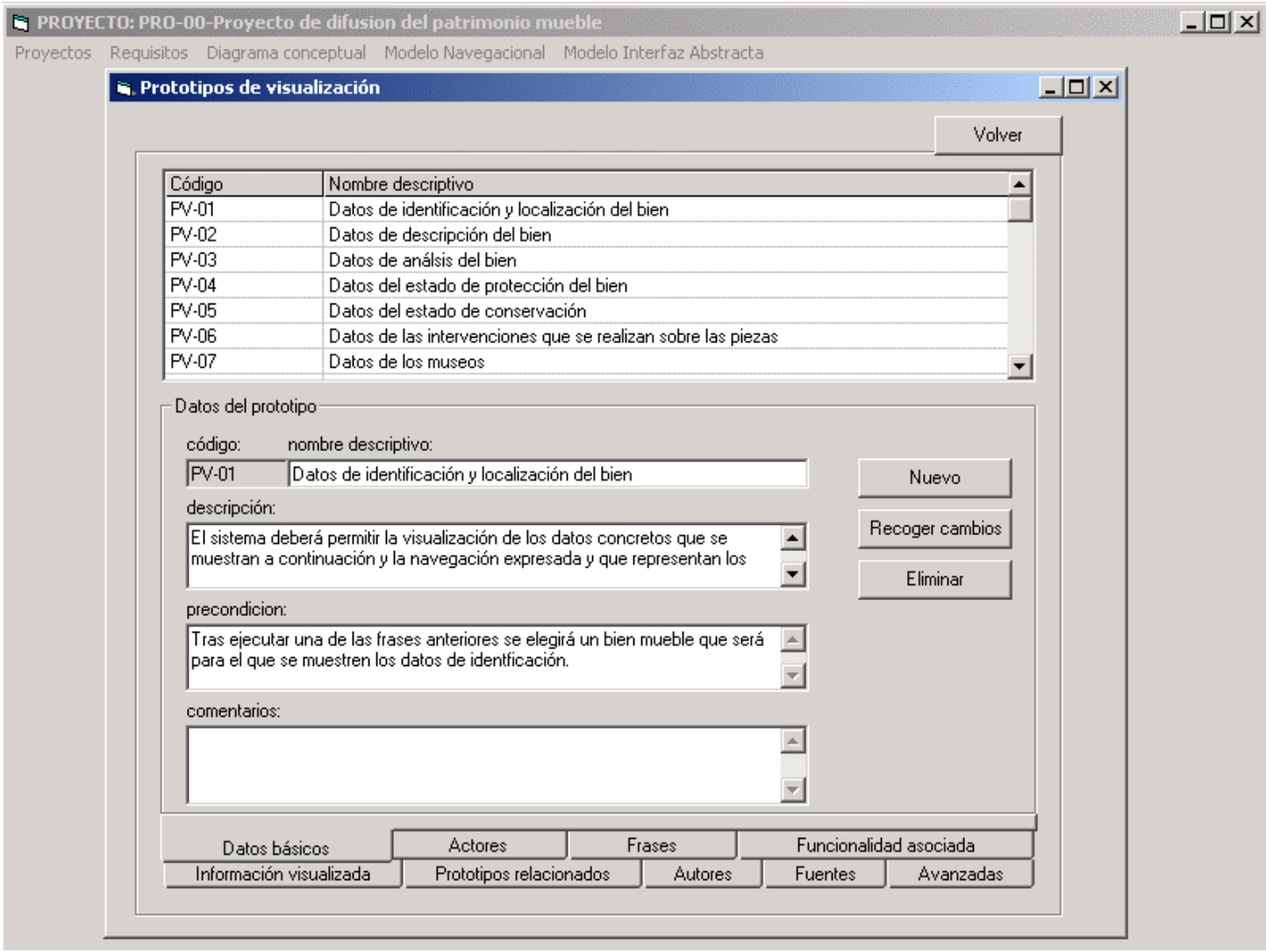
NDT: Template-Based Specification

- Different types of templates for
  - actor requirements (user groups)
  - storage information requirements (content)
  - functional requirements
  - interaction requirements
  - visualization prototype (page layout)
  - non-functional requirements
  - traceability matrix

- Example
  - functional requirement (FR-01)
  - describes login process

FR-01	**Login**	
Description	Authentication to allow access to the checkout process	
Actors	Use case actor AC-01 Web User	
Normal sequence	**Step**	**Action**
	1	System asks for userID and password
	2	Input of UseID and password
	3	Check of both
	4	Storage of UserID and password
	5	Access to checkout allowed
Exceptions	**Step**	**Action**
	4a	The user is not registered; the user executes FR-02
	4b	UserID or password not valid, continue with step 2

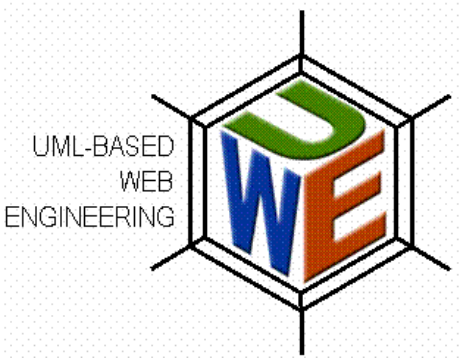
NDT-Tool


PROYECTO: PRO-00-Proyecto de difusion del patrimonio mueble
Proyectos
Requisitos
Diagrama conceptual
Modelo Navegacional
Modelo Interfaz Abstracta
Prototipos de visualización
Volver
Código
Nombre descriptivo
PV-01
Datos de identificación y localización del bien
PV-02
Datos de descripción del bien
PV-03
Datos de análsis del bien
PV-04
Datos del estado de protección del bien
PV-05
Datos del estado de conservación
PV-06
Datos de las intervenciones que se realizan sobre las piezas
PV-07
Datos de los museos
Datos del prototipo
código:
nombre descriptivo:
PV-01
Datos de identificación y localización del bien
descripción:
El sistema deberá permitir la visualización de los datos concretos que se muestran a continuación y la navegación expresada y que representan los
precondicion:
Tras ejecutar una de las frases anteriores se elegirá un bien mueble que será para el que se muestren los datos de identficación.
comentarios:
Nuevo
Recoger cambios
Eliminar
Datos básicos
Actores
Frases
Funcionalidad asociada
Información visualizada
Prototipos relacionados
Autores
Fuentes
Avanzadas

UWE: UML-based Web Engineering

- Method characteristics
  - semi-formal graphical specification
  - uses extension mechanisms provided by the UML stereotypes
    - e.g. «navigation» use case
    - OCL constraints
  - open source case tool support (ArgoUWE)
- Method specification

  MOF Metamodel
- Advantage
  - use of OMG standards (UML, MOF, OCL, ...)
- Basis for Design
  - transformations to design models



UWE: Koch, Knapp, Zhang, Baumeister, 2007

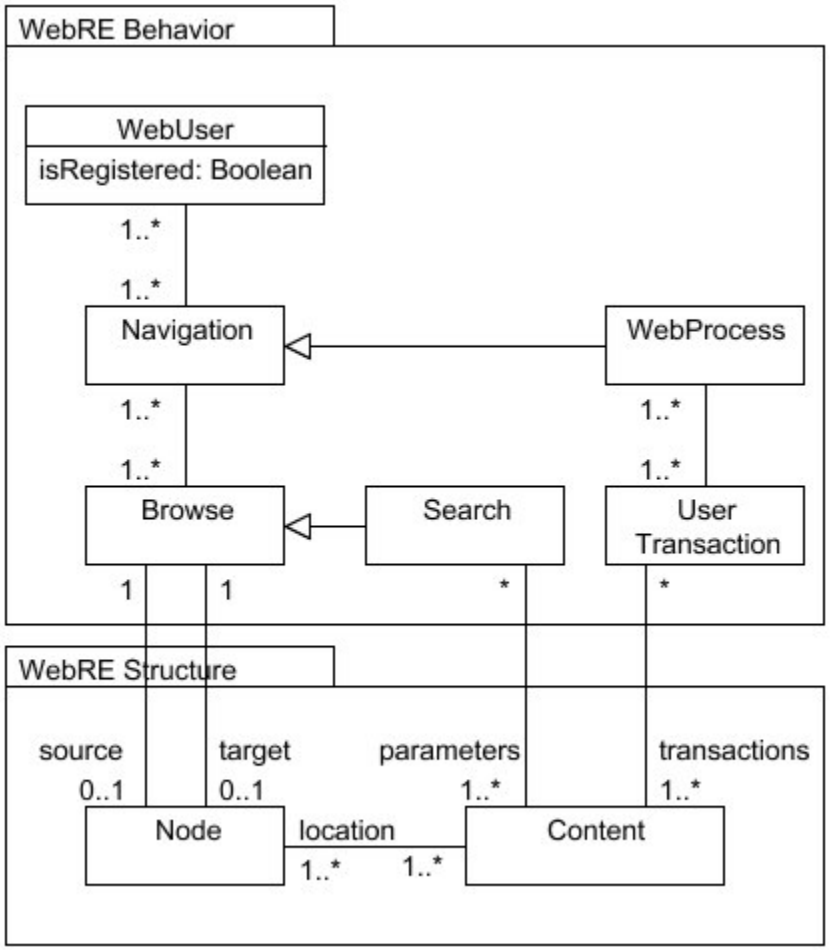
UWE: Basic Concepts

- Structural elements
  - Web users: actors
  - content: information provided by the Web system
  - node: requirements on application structure
  - Web user interface: presentation relevant aspects
- Behavioral elements
  - navigation functionality and business processes on the Web
  - browse and search activities
  - user transactions, e.g. credit card payment

Metamodel for Web Requirements Engineering

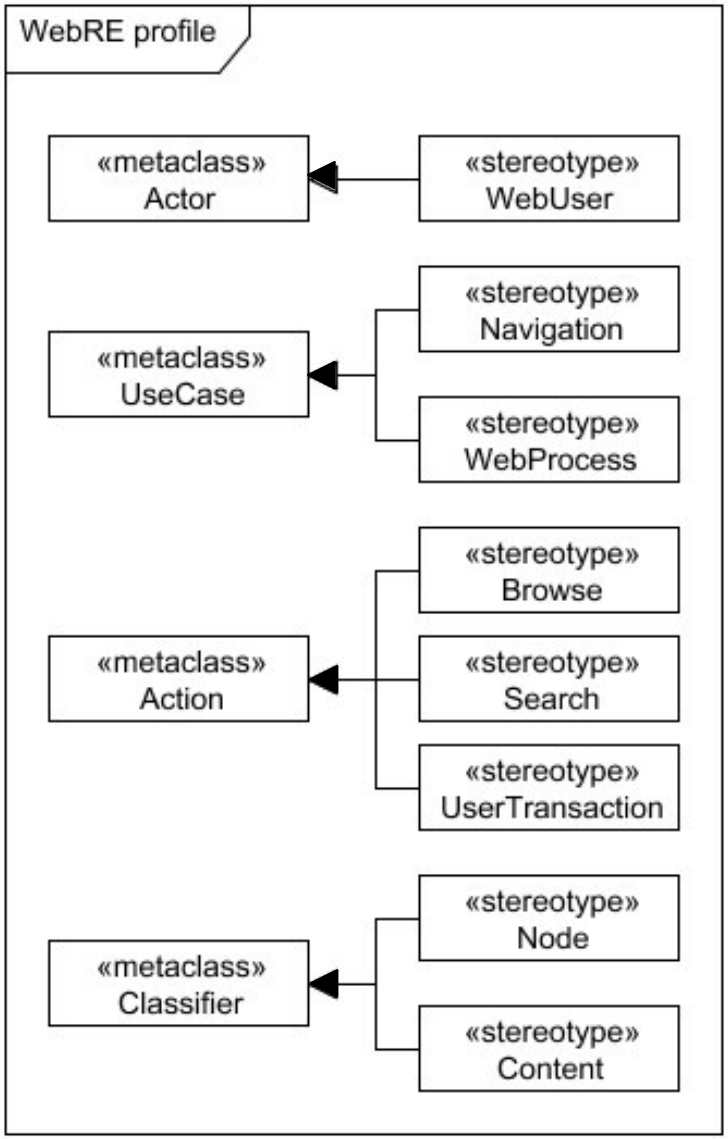
- Grouping elements in packages
- Define relationships among elements
  - inheritance (e.g. search defined as an extended browse)
  - associations (e.g. a browse requires a source and a target node)
- Define invariants (OCL constraints)

```
context Search
inv: self.parameters -> forAll
     (p | p.location ->
          includes
          (self.source))
```



UWE: Definition of an UML Profile

- UML stereotype for each Web requirements concept
- Extends relationship
- UML metaclass
- Advantages
  - no need to specify complete semantic of new modeling elements
  - use of all UML CASE-Tools

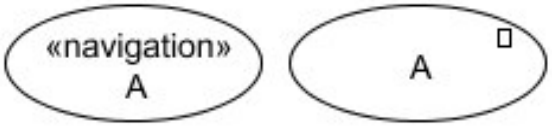


UWE: Process, Techniques and Results

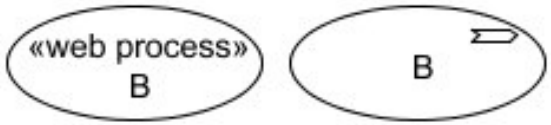
- Elicitation
  - interviews
  - brainstorming
  - …
- Specification
  - UML use case diagrams
  - UML activity diagrams
  - invariants in OCL (Object Constraints Language)
- Validation
  - review
  - …

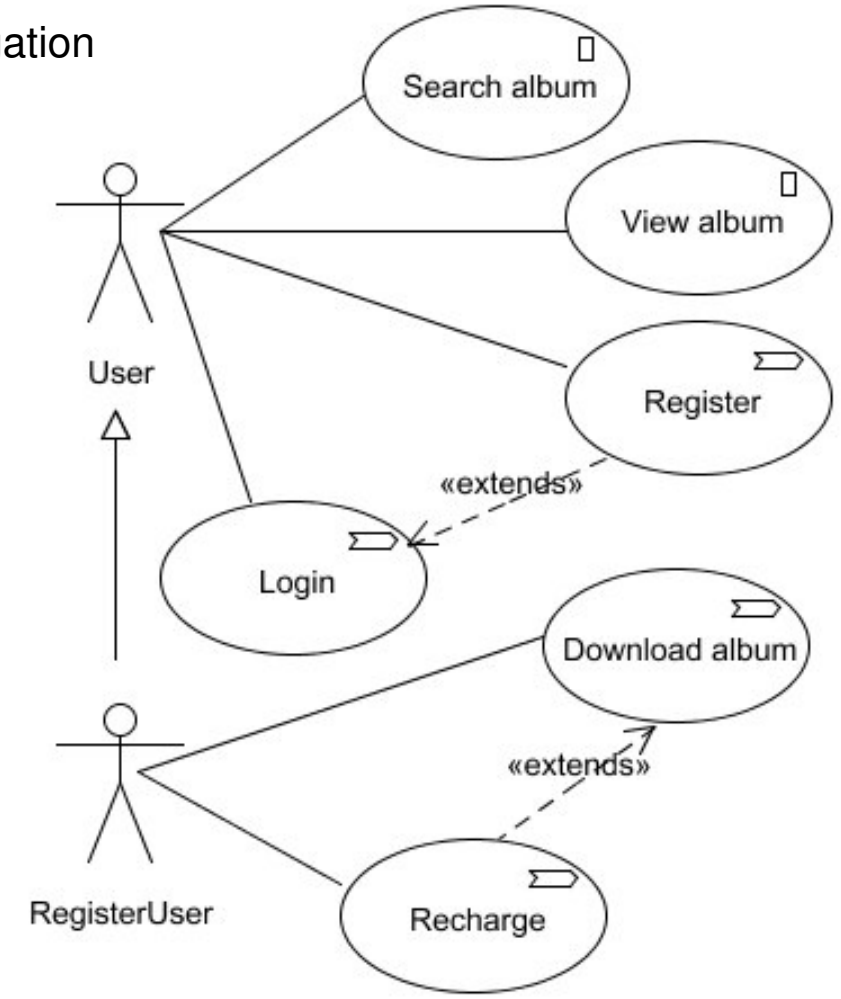
UWE: Notation for Use Case Model Elements

- UML use case diagram
  - distinguished between process and navigation use cases
- Visual representation of Web modeling constructs
  - navigation



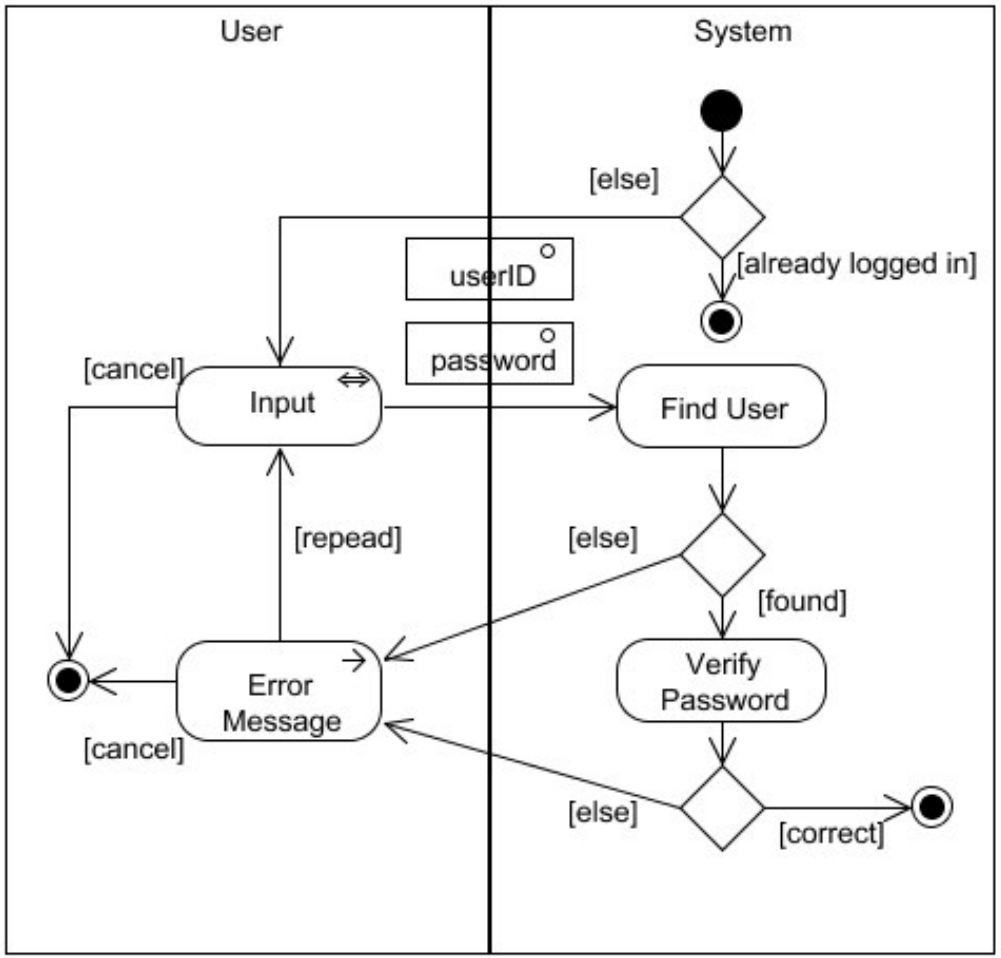
  - «process»



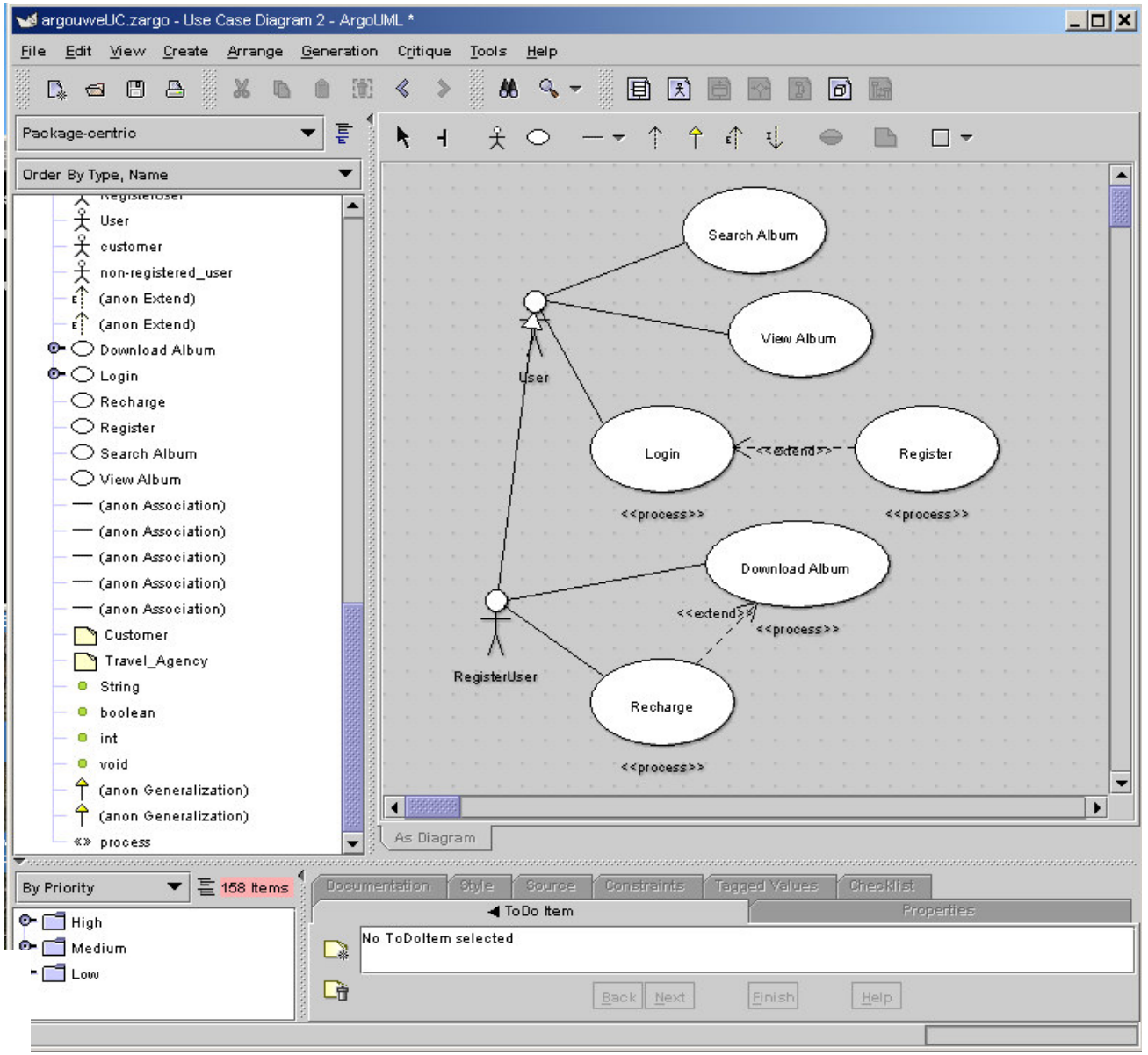


UWE: Notation for Activity Diagram Elements

RE Element	UML Metaclass	Icon
Browse	Activity	⇨
Search	Activity	?
User Transaction	Activity	⇔
Content	Class	○
Node	Class	□
Web User Interface	Class	▣

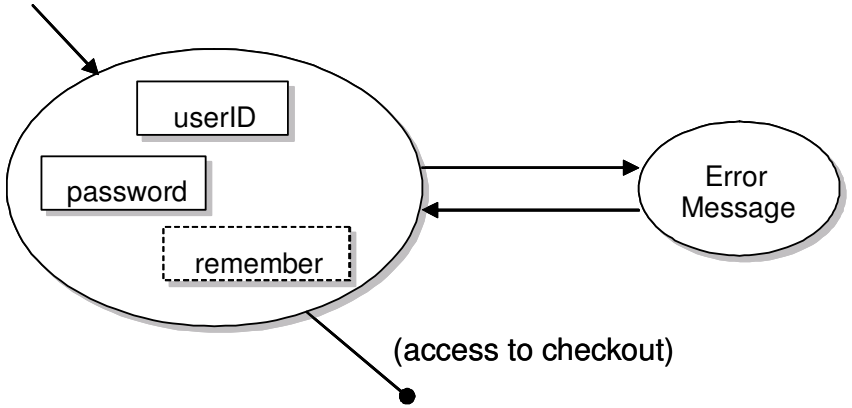


Tool Support: ArgoUWE

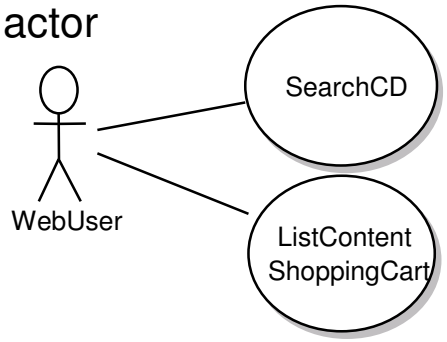


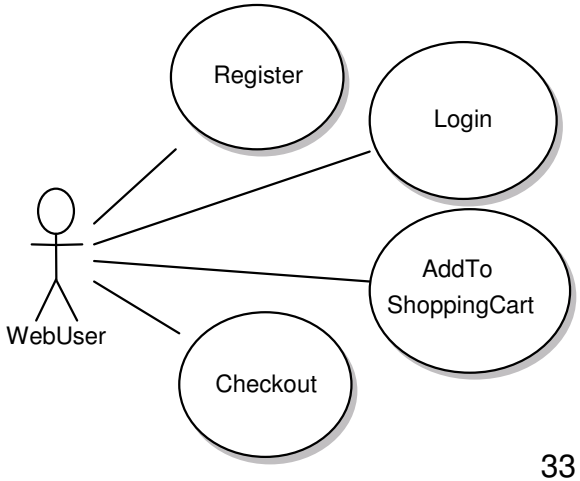
Other Modeling Approaches

- Object-Oriented Hypermedia Design Method (OOHDM)
  - use cases model (standard UML)
  - user interaction diagram (UID)
    - entry and exit points to UIDs
    - user input data
    - communication to other UIDs
  - proprietary notation for UIDs visual representation



- W2000
  - use case diagrams
    - browsing activities
    - functional requirements
  - separate models for each actor





Requirements Engineering: Summary

- Problem world and solution world
  - identification from the user (customer) point of view
- Specifics of RE for Web systems
  - relevance of user interface, rapidly changing technology, …
- RE process
  - elicitation, specification, validation
- Techniques for RE
  - template-based specification
  - visual representation of models
- Methods
  - NDT: Navigation Development Technique
  - UWE: UML-based Web Engineering

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