Part IV – Overview

Understanding The Problem
1. Introduction
2. Requirements Engineering
   1. Initiate Phase
   2. Elicit Phase
   3. Assess Phase
3. Managing Requirements & Change
4. Further Readings

Introduction

Web Engineering projects are likely to fail due to misunderstanding the problem – as a result of “wrong” requirements

Standish Group’s CHAOS Reports:
- 1994 and 1997 most significant contributors to project failure relate to requirements
- Computer Industry Daily / Sequent Computer Systems, Inc. study:
  - Most frequently named failure: “changing user requirements.”

Requirements and the Web

Common problems:
- Requirements change
- Requirements mean different things to different people
- Requirements are not always obvious
- Requirements are difficult to express
- Requirements are related to one another
- Requirements are driven by different parties
- Requirements have different levels of detail
- Requirements are not equally easy to meet
- Requirements are difficult to gather
- And there is even more…
Dealing with Requirements

- Web applications differ significantly compared to other software applications
  - Data-intensive, different Performance aspects
  - Highly distributed and heterogeneous environments
  - High demands for security and privacy
  - High demands for accessibility and usability etc.
  - Aesthetic aspects
  - Follow trends
  - High demands for Legal aspects
- Internet Web application: User / Audience unknown
- Requirements will change at least if a Web application evolves

Dealing with Requirements II

- Defining and managing requirements are a major success factor
  - Requirements mean different things to different people: Educate all project participants about this fact
  - Document every requirement
- This relates to CHAOS success factor No.1 to improve user involvement
  - Who are the stakeholders?

Stakeholders

- Stakeholder – an individual who serves as the primary source for some information that can affect the outcome of the project and/or who is affected by its outcome.
  - E.g. Customer, Employee, Marketing/Press, Administration, Customer Support, Content Creators, Domain Experts
  - Usually do not share a common understanding
- Known Stakeholder
  - Internet & Extranet applications → interview stakeholder
- "Unknown" Stakeholder
  - Internet access → search for statistics
  - Later: user feedback, tracking and profiling for refining requirements

The Requirements Approach

- Idea – Apply a systematic approach to define and manage requirements for a desired software product in the WWW

What is a Requirement?

- Requirement – is
  1) a condition or capability needed by a user to solve a problem or achieve an objective;
  2) a condition or capability that must be met or possessed by a Web-based software product or component to satisfy a contract, standard, specification, or other formally imposed documents;
  3) a documented representation of a condition or capability as in (1) or (2).

Types of Requirements

- **Functional requirements**
  - Fundamental subject matter of the system, i.e. something the product must be able to do
  - Measured by concrete means
  - E.g. Data values, class diagrams, algorithms

- **Non-functional requirements**
  - Behavioral properties that the specified functions must have, e.g. performance, usability, security etc.
  - Measured by specific means (the “nice-looking and easy to use problem”)
  - E.g. Performance: resource response time < 2 sec with less than 100 users

Note: A lot of different notations and terms exist, try to understand the core idea

Requirements Engineering

- **Requirements Engineering (RE)** – is a recurring process of the systematic, disciplined, and quantifiable application of approaches to define and manage the purpose and the external behavior of a proposed software product (here: in the WWW), and, which continues throughout the whole life cycle of the product

- RE includes elicitation, analysis, specification, verification, and management activities
  - Traceability is therefore a MUST
  - Cf. IEEE Std. 830 SRS and IEEE 828 Configuration Management Plans

- Requirements development process:
  - Initiate
  - Elicitation
  - Assessment
  - Specification
  - Validation

Performing RE

- **Requirements Analyst Role (RA)**
  - Responsible for “clear communication” – bridging the gap between vague stakeholder notions and clear specifications

- Some skills required
  - Interviewing skills,
  - Listening skills,
  - Facilitation skills,
  - Observational skills,
  - Writing skills

Goal of RE

- The goal of requirements engineering is the production of a good software requirements specification (SRS) and the disciplined management of its evolution

- Aspects of a good Requirement Statements and Specifications:
  - Modifiable, Consistent, Feasible, Necessary, Verifiable
  - Traceable, Complete, Precise, Prioritized
  - Versioning, Correct, Unambiguous

- Usable during operations and maintenance

Levels of Requirements

- **Business Requirements**
  - High-level objectives of the organization or customer

- **User Requirements**
  - Tasks that users must be able to perform using the new product

- **Operational Requirements**
  - Tasks that operations staff must be able to perform using the new product

- **Environmental Requirements**
  - Aspects of the technology available and to be applied as well as the project’s ecosystem

The Requirements Big Picture

- Increased Understanding of Requirements
  - Business Requirements
  - User Requirements
  - Environmental Requirements
  - Operational Requirements
  - Functional Requirements
  - Non-Functional Requirements
  - Software Requirements Specification (SRS)
Part IV ➤ Chapter//2 ➤ Requirements Engineering

**RE & Project Life-Cycle**

1. Prepare for RE activities
   - Team Mind-Set, Glossary etc.
2. Initiate Phase
   - Business Requirements under change control
3. Elicit Phase
   - Gathering information – Refine Requirements
4. Assess Phase
   - Transition from gathering to analyzing
5. Continuous evolution
   - Requirements & Change Management

**Prepare for RE Activities**

- Structure project team adequate
- Roles, e.g. requirements analyst (RA), quality assurance, standards-specialist, domain-expert, CCB
- Project team must be aware of RE
  - Common vocabulary
  - Procedures for proposing, reviewing, and resolving changes
  - Status reports
- Prepare to elicit
  - Observe your customer/users
  - Train for interviewing (Journalism School?)

**Prepare: Glossary**

- Defines important and common terms of a domain
- Used by analysts and developer to support same language
- System analyst or use case specifier responsible for use case glossary

**Objective**

- **Initiation Phase** – Initiation is the process of formally authorizing a new project
  - Links project to the performing organization
  - Formal document and output of this phase: **Project Charter** (issued by manager)
- Usually formal initiation after completion of further assessments
  - Functional Specification
  - Feasibility study
  - Etc.

**Developing Solution Concept**

- Identify business opportunity
  - The first customer meeting
  - Interview with key personnel, senior management (CEO, CTO, CIO)
- Gather business requirements
  - Use Cases and interview techniques
  - Focus on business improving processes, boundaries, external relationships, key business process stakeholder
### Use Cases

- **Use Case (UC)** – A (possibly ordered) set of actions, including variants, that a system performs that yields an observable result of value to a particular actor
  - UC complete from the outside actor’s view
  - Bulleted form, written structured:

  Natural Language, nothing else – just that

- **Use Case Realizations & Co.**
  - **Use Case Realizations**: Different ways to carry out a use case
  - **Use Case Scenario**: Single path through a use case
    - A story telling us how something (usually a business process) is done, i.e., a particular combination of conditions within that use case
  - **Use Case Diagram**: puts UCs and Actors into a graphical context
  - **Very effective with Senior Management**

### Drafting the Vision/Scope

- **Analyze and consider business impact**
  - Review (current and future) business processes and opportunities
  - Identify Stakeholder
  - Typical categories: common, specific, competitive, etc.
- **For Internet-Sites**
  - Create market requirements document (MRD)
  - MRD describes requirements of market segments, e.g., audience characteristics / profiles

### Drafting the Vision

- **Develop a first Vision statement**
  - Strategic plan – long-term view on solution
  - Focus on business requirements
  - Aligns all stakeholder in common direction
  - Cf. For-Who-The-Is-That-Unlike-Our Product example
- **Major Features**
  - Labels and Names for the major capabilities of the product
  - Assumptions, Dependencies, Legal Issues
  - Describe assumptions etc. mentioned by stakeholders

### Example: Vision eConcierge

- **FOR** guests of the hotel
- **WHO** need assistance in enhancing their stay by choosing restaurants or cultural events
- **THE** eConcierge Service (eCS)
- **IS** a portal
- **THAT** will provide an overview of events, activities and selected restaurants (partners)
- **UNLIKE** the current black-board approach
- **OUR PRODUCT** will provide ubiquitous assistance from the early beginning of the ordering process as well as during the stay by allowing to access the system with different devices

Base on: Software Requirements 2nd Edition by K.E. Wiegers

### Drafting the Scope

- **Define a first Scope statement**
  - Decomposition of Vision into “Business Feature Sets”
  - Sum of high-level deliverables and services to be provided
  - Manageable chunks
- **Scope of Initial Release (Version 1.0)**
  - Focus only on those features that will provide the most impact
- **Limitations and Exclusion List**
  - List what might get in and what is definitely out of scope (core rules for the CCB)
Product Scope

- **Statement of Requirements (SOR)**
  - SOR will be the document against which change control will be exercised
  - Sometimes called Functional Requirements Document (FRD) - set of statement of requirement
- Prepare for iterative approach (multi-versioning)
  - Baseline current version
  - Baselined → Put under change control

Project Scope

- Work that must be done to deliver a product with the specified features and functions
- **Aka Statement of Work (SOW)**
  - Narrative description of products or services to be supplied under contract
  - Sufficient detail required to allow team to determine if capable of providing the item

Vision and Scope

- **Prepare Project Initiation**
  - Prepare Project Initiation Documents
  - Prepare risk assessment document
  - Check for readiness: Personnel and training needs, possibly expert judgment
  - First assignments

Finalizing Initiate Phase

- Analyze and discuss benefits and first draft documents
  - Vision and Scope Verification by stakeholder
  - Note: ALL Requirements gathered are high-level requirements and will be further refined or even changed
- Initiated: Commitment to begin the next phase
  - Project Team – Customer: Memorandum of Agreement (Not a contract)
  - Project Team – Management: Project Charter

Initiate Phase – Summary
Introduction

- Goal:
  - Refining the business requirements
  - Better understanding the problem
  - Enhancing Vision/Scope Specification by refining the scope

- Refine Requirements for the solution
  - Business Requirements (why)
  - Functional Requirements (what)
  - Non-Functional Requirements (how)

### Performing Elicitation

- Identify further stakeholder & Find stakeholder representative (SR)
  - SR aka Product Champion
  - Elicit stakeholder requests
  - Categorize information as well as SRs

- Ongoing Process → change control

### Better Understanding

- Gather information in a holistic manner
  - Stakeholder (Personnel and Training Needs)
  - User profiles and audiences
  - Organizational structure (Both current and projected)
  - Market / Industry position
  - Organizational political climate
  - Business reach or scope
  - Current and future regulatory requirements
  - Product boundaries, constraints

- Requires finding stakeholder representatives
  - The question to solve: What would X need to do?
  - Be aware of implicit users

### Refining Scope

- Refining high-level business requirements
  - Rewriting Use Cases
  - Focusing on Use Case Scenario
  - Rules of thumb: Describe workflow not just purpose, all possible processes within a business use case, only those inside the business, only relevant ones

- Transforming – Graphical Notation
  - Use Case Diagram: puts UCs and Actors into context
Techniques For Gathering

- Standard approaches:
  - interviewing, shadowing, focus groups / group interview, brainstorming sessions, surveys, user instruction, prototyping, statistics
- Working with Subject Matter Expert (SME)
  - Class Responsibility Collaborator Modeling

### Categories of Information

- Based on existing Business Requirements
- Identify and classify Requirements with focus on
  - Business
    - Focus on Data and Processes (DATA)
  - User
    - Focus on User-Interface Experience (UIX)
  - Operations
    - Focus on the System Management and Operation (SMO)
  - System
    - Focus on the Process and Communication Aspects (DSA)
- And enhance the accuracy of Vision/Scope and SRS documents

### Business

- Prioritize projected business processes
  - Will determine order and construction of planning and development process
  - Identify internal/external dependencies
- Business data (Data/Content)
  - Describe entities/objects, refine glossary
- Data flow (Process and Interaction)
  - Specify the flow of data from a business perspective
  - E.g. DeMarco & Yourdon, Gane-Sarson model or UML analysis model
  - This will be important input for DSA

### UI Experience

- (User Interface) Design
  - Design is manifested in appearance of the Web solution
  - Visual ornamental characteristics embodied in, or applied to, chunks of information as well as their composition
- Relates to dimensions:
  - Presentation – Deals with appearance of the Web application, i.e. layout, color, fonts, links, etc.
  - Navigation – Application of the hypermedia paradigm to access information or perform tasks
  - Dialogue – Relates to interacting (including manipulating) the information space
- User-Centered Design puts these three dimensions into context with the overall tasks the user has to perform to fulfill his/her business goals
UIX: Experience

Focus on Overall Feel of the Site
- Who will use it? → audiences/user context
- Where is it used? → location context
- How is it used? → task/job context
- Which devices? → technical context (UA restrictions)

Cultural aspects of using the application
- I18N, L10N, G11N
- Identify localization requirements
- Globalization requirements

UIX: Accessibility

Accessibility Requirements
- http://www.w3.org/WAI
  Web Accessibility Initiative
- http://www.w3.org/TR/WCAG
  Web Content Accessibility Guidelines
- Web Accessibility Design

User-Agent/Device specific Requirements
- E.g. the use of specific handheld devices is required

UIX: Navigation

Relationship-Navigation Analysis
- Michael Bieber et al., NJIT, NJ, USA

Intensify hypermedia mindset of stakeholders and teams
- Promote a hypermedia mindset

Process RNA steps (simplified)
- Element of interest analysis
- Relationship analysis
- Navigation analysis

UIX: RNA’s Taxonomy

Generalization/Specialization
- Characteristic
- Descriptive
- Occurrence
- Configuration/Aggregation
- Membership/Grouping

Whole-part/Composition
- Ordering
- Activity
- Inference
- Intentional
- Hetero-organizational
- Temporal
- Spatial

Classification/Instantiation
- Equivalence
- Similar/Dissimilar

Association/Dependency
- Comparison

Internal/External

Generalization/Specialization

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Operations

Identify Requirements with focus on operation of the solution, e.g.
- Efficiency
- Availability
- Security
- Scalability
- Maintainability
- Reliability
- Interoperability
- Monitoring & Healing
- Robustness
- Reusability
- Policies
- Integrity

These often relate to non-functional requirements, rules or quality attributes
- Help in specification of SLA, OLA

Technology

Integration and Performance Requirements
- What software, data, existing systems (legacy) will be accessed
- How well or how rapidly a system must perform

Solution elements of the distributed system
- Hardware: Computer, firewall, router, switch, network etc.
- Operation: Operating system, network topology / VLAN etc.
- Hosting: Web server, messaging server, database server, etc.
- Core Services: Web services, mail, UDDI, IP/STS, location srv
- Application: Application composition, integration and federation

Analyze the impact of solution elements on the IT environment and vice versa
- E.g. Bandwidth, Cache, (required) response time, connections

Focus on the Distributed System Aspects (DSA)
Updating Vision/Scope

- Update Vision/Scope Specification
  - Update product scope
  - Draft project scope
  - Possibly: Gain customer agreement
  - Start Assess Phase

Assessing Requirements

- ...is about understanding and organizing requirements
  - In the general software engineering sense
  - With a dedicated focus on the product dimensions of distributed Web-based systems

- Review of functional requirements
  - Focus on product dimensions and features

- Dealing with non-functional requirements
  - Business rules
  - Quality attributes

Product Dimensions

- Review and (if possible) Classify Functional Requirements with focus on:
  - Data
  - User Interface Experience
    - Presentation: Layout & Design
    - User Interaction
    - Navigation
  - Distributed System Architecture
    - Process (check Business Processes)
    - Communication

Prototyping

- Proof-of-concept
  - Vertical Prototype
  - For some parts: From interface to process components, like the real-system will do

- Mock-ups, Sample-Screenshots
  - Horizontal Prototype
  - Initial navigation / presentation concept

- Vertical Prototype
  - Hotel Homepage
  - News
  - Services
  - eConcierge

- Horizontal Prototype
  - Mock-ups, Sample-Screenshots
  - Initial navigation / presentation concept

Prototyping for Risk Reduction

- Further approaches
  - Throwaway prototypes
  - Paperware
  - Storyboards
  - Illustrations
**Features**

- **Feature** – Functionality that the solution must deliver to be complete
  - Based on the functional and non-functional requirements of business and user requirements
  - Describe: benefit, increase customer or user satisfaction
  - Provides a name for a part of the scope
- **Feature Sets**
  - Set of features that belong together to support a certain need
  - May evolve and developed in several scopes

**Quality Attributes**

- Labeled Collection of quality related findings
  - Efficiency, Availability, Scalability, Integrity etc.
  - Focus on the most important ones
  - Usability, security, performance, reliability and reusability are major issues!
- Example:
  - PERF-1: Homepage rendered < 1 sec with following browsers on the following hardware
  - PERF-2: Page download < 2 sec over DSL
  - USAB-1: Concierge and trained staff shall be able to submit all eConcierge forms
  - USAB-2: Restaurant pages must be WAI-compliant

**Business Rules**

- Approach to non-functional requirements: **Business Rules Statements**
  - Define or constrain aspects
  - Assert business structure
  - Control or influence the behavior
  - Define parameter for System Management and Operation (SMO), e.g. for SLA
- **Business Rules Taxonomy**
  - Facts (Invariants) – e.g. all pages with terms of use
  - Constraints – MUST, SHOULD etc. rules
  - Action Enablers (Trigger) – if x then y
  - Computations – e.g. Orders > 100 EUR
  - Inferences - If Web Service does not respond within 2 sec. then the services is out of order

**Requirements Prioritization**

<table>
<thead>
<tr>
<th>Feature / Feature Sets</th>
<th>SR1</th>
<th>SR1</th>
<th>SR1</th>
<th>SR1</th>
<th>Total Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1. Order a room</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>F2. See list of selected restaurants</td>
<td>3</td>
<td>1</td>
<td>7</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>F3. Add restaurant costs to account</td>
<td>2</td>
<td>5</td>
<td>9</td>
<td>1</td>
<td>21</td>
</tr>
</tbody>
</table>

- Requirements Prioritization Matrix a living document
  - Different complex solutions exists
  - E.g. Quality Function Deployment (QFD) or Total Quality Management (TQM) approaches
  - Prioritize by VALUE, RISK, READINESS

**Documenting and SRS**

- Documenting Requirements
  - SRS - many people will rely on it
  - Maintainable and ready for change
- Dealing with change
  - Label Requirements: Sequence number, hierarchical numbering or textual tags
  - Prepare for the unknown (To Be Determined / TBD-Process)
- Dictionary helpful to use terms in SRS consistently (use existing Glossary)

**Prepare for Planning**

- Check feasibility of project direction / vision
- Define tasks, schedules, deadlines, WBS, reports etc.
- Prepare risk assessment document
- Check for readiness: Personnel and training needs, possibly expert judgment
- First assignments
Verteilte Web-basierte Systeme Vorlesung

Manage Scope

- Check scope every Major Milestone
- Activities:
  - Assign values to requirement attributes
  - Plan further progress with project and development management
  - Focus on highest risk requirements
  - Major refinement necessary?

Vision/Scope Specification

- Vision/Scope Specification Complete
- Inspect with stakeholder and gain customer agreement
- Vision/Scope document baselined
- Initial SRS developed and baselined
- Start Planning

- Study: Most successful projects spent 10-30% of total project resources until this milestone

- From problem description to plan
  - Transform customer into developer language

Beyond SRS

- From SRS to Plans, Designs, Codes etc.
- Shift:
  - Shift from problem definition to solution design
  - Shift from customer language to developer language
- SRS guides process:
  - Provides a framework
  - Source for plan, schedule and build solution
  - Serves as contract between team and customer

SRS and Planning

- SRS and Planning
- Development of Initial SRS
- Development of Product Plans
- Plans Approved

Requirements meet Change

- Requirements will change
  - Focus on Requirements Management
- Causes for Change:
  - Incident – Event deviates from expected behavior
  - Respond to new/changed business requirements
  - Introduce new and updated components and services
  - A Web-based system must be treated like a garden

- Key concepts to handle
  - Incident Management
  - Baselining, “Freeze late”, etc.
Managing Change

- Project’s Change Management
  - No requirement, feature, function, component etc. added or changed without approval
  - Responsible Change Control Board (CCB)
  - Cf. Standard IEEE 828
  - Essential to hinder creeping user requirement, gold plating
  - Should be applied from the early beginning of the project for all assets! (not exclusively related to RE)

- Change Request (CR) – A description of a potential improvement to the Web Application, often identified by the users

Change Management

- Remember:
  - Change Management is not a phase of Requirements Engineering
  - Change Management is the starting point for your project and continues from then on

Simple Change Control

CR due to issue etc.

Submitted

Impact & Readiness analysis

CCB

CCB accepts

Rejected

Verifying change

Change Made

Verified

Closed

Change ok, deployed

Change failed

No verification required, deployed

Verification failed

CCB

CCB rejects

Changing

Approved

Part IV ► Chapter://3 ► Managing Requirements & Change

Verteilte Web-basierte Systeme – SS 2006

Chapter://4

Further Readings

Literature

- Chapter 5: Thomas A. Powell, Web Site Engineering, Prentice Hall PTR
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- Chapter 8.2: David Lowe and Wendy Hall, Hypermedia and the Web – an Engineering Approach, John Wiley & Sons
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Further information available at Lecture Web Site

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