MCS

Requirements Engineering for Web Applications

CS-477 Web Engineering

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Outline

Requirements engineering

- Requirements play an important role in system development
- RE deals with the principles, methods, and tools to identify, describe, validate and manage requirements in system development (Grunbacher, 2006).
- RE for standard applications need to be adapted for Web applications
- This can not be done unless various aspects, attributes and characteristics of Web applications are not understood.

Categories of characteristics

- Web applications differ from traditional applications in various ways
- Web applications have non-linear navigation and require frequent updates
- Four main categories of characteristics/features of a Web application:
  - Product related characteristics
  - Usage related characteristics
  - Development related characteristics
  - Evolution characteristics

Product characteristics

- Characteristics related to product (Web application, traditional software applications)
- Product related characteristics cover the main building blocks of Web applications
- Web application consists of three building blocks 1) content, 2) hypertext and 3) presentation
- Generation, presentation and update of content is the main output of Web applications
- Hypertext defines the navigational structure of the Web application
- Presentation deals with the user interface of the Web application

Content features - Product Characteristics I

- Besides the development of software component, developers are often required to create content for the Web applications
- *Document-centric character and multimedia* refers to the fact that content is targeted to the needs of a particular user group.
- Content is provided in the form of tables, text, graphics, audio & video
- Multimedia content is also delivered through Web
- *Quality demands* differ from various content types and the user groups.
- General quality attributes may include frequency of updates, provision of relevant information and reliability of content.

Content features - Product Characteristics II

- For example, news sites need to be continuously updated.
- Content has to be organised in the form of various topics.
- Personalization of the content by a particular user helps him to focus on news of his interests
- e-Commerce Web sites(online shopping) require updated information related to price and stock availability

What content attributes are important for a stock exchange Web site which allows online trading (buying and selling of shares)?

Hypertext features - Product Characteristics I

- Hypertextual documents as the main form of information presentation.
- Basic elements of hypertextual model are nodes, links and anchors.
- Hypertextual nature of Web applications has two important features:
  - Non linearity
    - Standard hypertext assumes a systematics reading behaviour of a user
    - Hypertextual structure of Web applications is non-linear i.e., freedom of navigation in any order
    - Hypertexts are pre-defined (static) or are generated dynamically
    - Non-linear nature or freedom of movement introduce new problems of disorientation
  - Disorientation and cognitive overload

Hypertext features - Product Characteristics II

- Disorientation is to loose one's bearings in a non-linear document
- Cognitive overload is caused by the additional attention required to keep in mind several paths or tasks simultaneously
- Disorientation can be avoided by using site maps, keywords, searches, navigational history etc.
- Useful link names and meaningful linking reduces cognitive overload

Presentation features - Product Characteristics I

- Presentation deals with the user interface of a Web application
- Two main features can be related to the presentation
  - Aesthetics
    - Look and feel of Web application an important factor
    - It is highly fashionable and trendy and often is one of the main factors in Web applications especially e-Commerce and entertainment portals
  - Self explanation
    - Use Web application without documentation or a manual
    - Consistent navigational structure helps users to use the application easily

Usage-related characteristics I

- Usage of a Web application is extremely diversified
- Diversity lies in the users' background, platform/device being used and the frequency of usage
- Prediction and control of this contextual behaviour is difficult
- Web applications need to adapt to the changes in usage situations or *contexts*
- Three groups of usage-specific characteristics are identified 1) social context 2) technical context and 3)natural context

Social context - Usage characteristics I

- social context of the users i.e., multicultural and usage frequency introduces great level of heterogeneity
- Spontaneity
  - Frequency of a user's visit to a Web site is unpredictable
  - Same is the case with loyalty, user may move to competitor's Web site
  - Example, compare your favourite search engines (Google vs Yahoo) or email services
  - Spontaneity introduces the issue of scalability i.e., no of users can not be predicted
- Multiculturality
  - Different user groups belong to different cultural backgrounds
  - Customisation content is therefore, required to meet the needs of each group i.e., consider users' with certain disabilities

Social context - Usage characteristics II

- A Web application targeting an International audience has to consider the time zone differences as well
- Customise the contents according to cultural norms
- Personalisation of content and presentation style is also required

Technical context - Usage characteristics I

- Defines the technical aspects i.e., network issues, hardware/software of the devices etc.
- Quality of Service
  - network connection's bandwidth and reliability varies considerably
  - In case of multimedia content, content delivery should be based on client's/user's available connection speed
  - Mobile Web applications require more adaptation to the network characteristics at application level for example different handset capabilities, signal strength, connection mode (GPRS, 3G)
- Multi-platform delivery
  - Users have full control of their devices, and client applications (browsers)
  - Browsers are customised by the users (caching, cookies, presentation layouts, security levels etc.)

Technical context - Usage characteristics II

- This customisation effects the performance, user interaction and transaction functionality

Natural context - Usage characteristics I

- Related with the location and time of access
- Globalisation
  - The geographical location of the user
  - Consider regional and cultural differences
  - Requires increased security measures to impose restrictions on the access of certain features/information
- Availability
  - Web application is available for use immediately, so is the content
  - Web application should be made online/live once quality attributes have been satisfied
  - Requirement on stability of the Web application increases due to 24/7 operation and availability

Development Related Characteristics

- Deal with different development resources required
  - Development Team
  - Technical Infrastructure
  - Process
  - Integration

Development Related Characteristics .. I

Development Team

- Multidisciplinarity
  - Web applications are a combination of different features coming from various domains
  - knowledge of publishing, software development, marketing, and arts is required
- Young average age
  - Young developers with less experience
  - Not following old conventions and standards
- Community Development
  - Open source development
  - group of developers contributing to the various projects

Development Related Characteristics .. I

Technical Infrastructure

- Inhomogeneity
  - Two core components of Web application development
    - Server and browser
  - Servers can be configured by the developers
  - Control over users' browser and their preferences is not possible
- Immaturity
  - Immature components used due to increasing time to market pressure
  - Knowledge of the existing development environment is often lost or doesn't evolves due to rapidly changing versions

Development Related Characteristics .. I

Process

- Flexibility
  - Rapidly changing requirements require a flexible development process
- Parallelism
  - Short development times require that tasks/components are often split and developed in parallel
  - Various teams working on the components in parallel
  - design, implementation and quality assurance are carried out simultaneously for different versions

Integration

- Internal Integration

Development Related Characteristics .. II

- Integration with existing legacy systems i.e., product catalogs, existing payrolls etc.

- External Integration
  - the integration of content and services of external Web applications is a special characteristic of Web applications
  - A large number of external sources with high frequency of changes and high degree of autonomy
  - Heterogeneity at different levels

Further Study & Reference

1. Evolution characteristics
2. Chapter 1 of the given book.

Reference: Chapter 1 *"Web Engineering: The discipline of Systematics Development of Web Applications"*

RE Fundamentals I

Definition

"Requirements engineering is the branch of software engineering concerned with the real-world goals for, functions of, and constraints on software systems. It is also concerned with the relationship of these factors to precise specifications of software behavior, and to their evolution over time and across software families."- (Zave, 1997).

Sources of requirements

- The objectives and expectations of stakeholders provide initial requirements
- Stakeholders have direct/indirect influence on the requirements of the proposed system

RE Fundamentals II

- Important stakeholders are customers, users, and developers.
- Diversity in stakeholders' objectives is the cause of diversity and conflict in the software requirements
- A Requirement describes a property to be met or a service to be provided by a system
- A requirement document defines all requirements and constraints agreed between the contractor and the customer
- RE an iterative process i.e., getting complete requirements at the beginning of the development not realistic

RE Activities I

RE consists of different activities:

- Requirement elicitation and negotiation
- Requirement documentation
- requirement verification and validation
- requirements management

Requirement elicitation and negotiation

- Requirements are gathered by frequent interaction with various stakeholders
- Negotiation is an important activity for creating consensus among the stakeholders on requirements
- Communications and knowledge exchange is important for RE

RE Activities II

- Different tools can be used i.e., scenario-based methods, multicriteria decision processes, interviews or document analysis

Requirement documentation

- A requirements document contains refined and detailed description of agreed requirements
- The degree of detail and formality of the document depends on the nature of the project
- Relevant techniques: Informal descriptions (user stories) and semi-formal descriptions (use cases)

Requirements verification and validation

- Validate requirements
  - Did we specify the right thing?

RE Activities III

- Verify requirements
  - Did we specify things correctly?
- Traditional methods of v&v i.e., reviews, inspections, and prototyping
- For Web applications we can use online feedback

Requirement management

- Change an important part of requirements
- RE management tools support both addition of new requirements and changes to existing requirements
- Tools can help to manage the impact of changes by the analysis of inter dependencies of requirements

RE methods adaptation

- Existing RE methods need to be adapted to fit the specifics needs of Web application development
- Specifically, following three aspects of RE need to be considered:
  - Requirement types
  - Methods to present, describe and document requirements (notations)
  - RE tools

Requirement types I

- Two major types of requirements are functional and non-functional requirements
- Functional requirements define system capabilities and services
- Non-functional requirements defined the properties of capabilities and desired level of services.
- Relevant requirement types of Web applications are:
  - Functional requirements
  - Content requirements
  - Quality requirements
  - System environment requirements
  - User interface requirements
  - Evolution requirements

Functional requirements

Requirement types II

- Functional requirements specify the capabilities and services a system is supposed to offer (e.g., a user can select different payment options at the time of checkout)
- Functional requirements can be defined by using use case scenarios and formatted specifications

Content requirements

- Content requirements specify the contents a Web application should present
- Contents can be presented in the form of a glossary

Quality requirements

- Quality requirements define the level of quality of services and capabilities
- Also define important system properties

Requirement types III

- Software quality can be described by six quality characteristics:
  - Functionality
  - Reliability
  - Usability
  - Efficiency
  - Maintainability
  - Portability

System environment requirements

- How a Web application is integrated into target environment
- interaction of Web application with the external components, i.e., legacy systems, COTS components and special hardware

User Interface requirements

Requirement types IV

- these requirements define how a Web application interacts with different classes of users
- Define the navigational and content aspects
- Create scenarios with the involvement of users to present how users will perform various tasks

Notations I

Different notations are available to describe, define and present requirements

Relevant notations are discussed below:

Stories

Stories are informal descriptions of desired properties

These are useful in developing a common understanding between the customer and developers

Itemized requirements

These are simple specifications in natural language

each requirement has a unique identifier

Formatted specifications

Notations II

Formatted specification use a well defined syntax

Natal-language descriptions can be used within this frame

Examples:

UML use case descriptions

Formal specifications

Formal specifications are written in a language that uses formally defined syntax and semantics

Examples include "Z".

Requirement Elicitation tools

Requirement Elicitation tools

- Easy winwin

Requirements validation tools

- Online feedback systems

Requirements management tools

- Can store requirements in a database

Further Reading & References

1. Section 2.3: RE Specifics in Web Engineering
2. Section 2.4: Principles for RE of Web Applications
3. Chapter 2 of the given book.