HUMAN-COMPUTER INTERACTION THIRD EDITION

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User Centered Design (UCD)

User Centered Design (UCD)

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Introduction

- The primary aim of the process of design and implementation of an interactive system should be to *maximize the usability* of the system.
- It is therefore important for us to understand:
  - The characteristics, methods and tools of a process of design and implementation that can maximize usability
  - The characteristics of usability
  - How to measure and/or evaluate the usability of an interactive system (*another class on evaluation*)

Defining UCD

- UCD is also referred to as the *user-centered methodology* or *human-centered design* or *human-centered methodology*.
- UCD is an approach to design that grounds the process in information about the people who will use the product.
- UCD follows a series of methods and techniques for analysis, design, and evaluation of software products.
- The UCD process is iterative and focuses on users through all the life-cycle phases in order to realize usable products.
- "*UCD is an iterative process whose goal is the development of usable systems, achieved through involvement of potential users of a system in system design.*" (Karat, 1996)

Defining UCD

- There is an international standard that forms the basis for UCD (ISO 13407: Human centred design process for interactive systems)
- "*Human-centred design is an approach to interactive system development that focuses specifically on making systems usable. It is a multi-disciplinary activity which incorporates human factors and ergonomics knowledge and techniques. The application of human factors and ergonomics to interactive systems design enhances effectiveness and efficiency, improves human working conditions, and counteracts possible adverse effects of use on human health, safety and performance. Applying ergonomics to the design of systems involves taking account of human capabilities, skills, limitations and needs.*"

Defining UCD

- Note that the ISO 13407 standard defines a general process for including human-centered activities throughout a development life-cycle, but does not dictate the specific methods.
- UCD intends to ensure that the user is at the center during the design process in order to realize products that meet usability requirements.

Usability

- Definitions of usability:
  - The property that reflects the ease of use of a computer system (Miller, 1971).
  - A system's "*capability in human functional terms to be used easily and effectively by the specified range of users, given specified training and support, to fulfill a specified range of tasks, within the specified range of environmental scenarios*" (Shackel, 1981); Shackel later (1986) suggests that usability has the criteria of effectiveness, learnability, flexibility, and user attitude.
  - "*a measure of the ease with which a system can be learned or used, its safety, effectiveness and efficiency, and the attitude of its users towards it.*" (Preece, 1994)
  - According to Jakob Nielsen, usability is defined by 5 quality components:
    - Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?
    - Efficiency: Once users have learned the design, how quickly can they perform tasks?
    - Memorability: When users return to the design after a period of not using it, how easily can they reestablish proficiency?
    - Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?
    - Satisfaction: How pleasant is it to use the design?
  - A commonly used definition of usability is that given by International Standards Organization (ISO/DIS 9241): Usability refers to "*the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.*"

Usability

- Other terms:
  - Quality of software: the intrinsic and extrinsic ability of the software system to support the achievement of the purpose of the user and their organization.
  - Context of use: a set of associated or corresponding real-world conditions and constraints in which the user interacts with the software system [toward achieving purpose of the user and their organization].
  - Some scholars consider “usability” to be “quality in use”.

Usability

- Advantages of usability
  - Allows you to focus on user needs and organization
    - More focused during system development and therefore reduced development time
    - Decrease of training required
  - Increases productivity
    - Reduction of user errors
  - Improve the quality of products
    - Increased profile of competitive products
    - Decrease time and cost of maintenance
  - Improve quality of life
    - Reduced stress and increased satisfaction of the user
    - Improved working environment
  - Allows compliance e.g. with ISO standards, European directives on displays

Usability

- We observed that a common definition of usability is: "*the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.*"

- Effectiveness:
  - the accuracy and completeness with which users of the system reach the purposes for which the system has been designed.
  - the extent to which the user is able to reach goal while using the system.
- Efficiency:
  - the relationship between the effectiveness of the interaction and the allocated or expended resources to achieve the goals.
- Satisfaction:
  - the users' comfort with and positive attitudes towards the use of the system.

Usability

- Measures of effectiveness:
  - They are related to the purposes and activities planned for the system and measure the accuracy with which the system supports the user to achieve those purposes.
  - For instance: measure of the outcome of user's interaction, error rates, etc.
  - Example: if the aim is to "type a letter" then possible measures are: the number of misspellings, document formatting features, etc.
  - Example: if the aim is to "search articles on a certain topic" then possible measures are: the number of relevant articles in the result, etc.

- Measures of efficiency:
  - They are linked to the consumption of resources required to attain the purposes.
  - For instance: task completion time, learning time, physical resources expended, etc.
  - Example: if the aim is "to print a report" then possible measures are: number of copies printed in a unit of time, ratio between the total number of copies printed and the number copies printed correctly, etc.

- Measures of satisfaction:
  - They are linked to the users' comfort with and positive attitudes towards the system, or pleasantness of interacting with the system.
  - Users' satisfaction can be measured subjectively (e.g. by rating/preference scales, etc) and/or objectively (e.g. , physiological monitoring, etc). [Note the subjective rating scales could be based on effectiveness and efficiency]

Characteristics of UCD

1. Know your users
   - characteristics, tasks, context/organization/environment in which they use the system.

2. Actively involve users early and continuously

3. Rapid and frequent iteration of designs with usability assessments

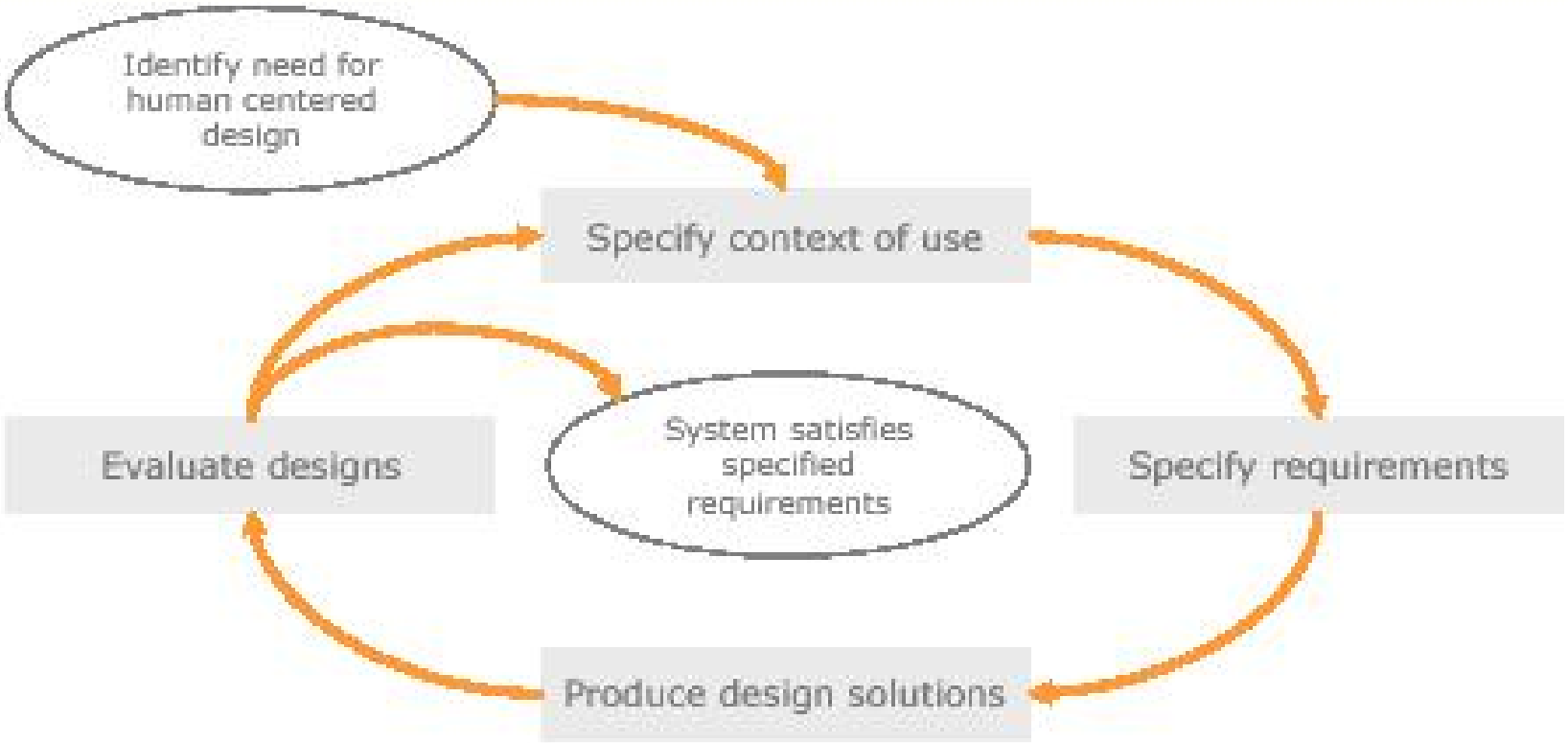
4. Multidisciplinary team
   - in line with the ISO 13407 standard (Human-centred design processes for interactive systems).
   - development team is made up from representatives of all the groups who have a 'stake' in the proposed software (stakeholders) e.g. domain experts, usability specialists, software engineers, etc.

UCD activities

- According to the ISO 13407 standard, there are four essential user-centered design activities which should be undertaken to incorporate usability requirements into the software development process

1. understand and specify the *context of use*
2. specify the user and organizational *requirements*
3. produce *designs and prototypes*
4. carry out *assessments/evaluations*

UCD activities



(based on ISO 13407: Human centred design process for interactive systems)

UCD activities

- 1. Understand and specify the context of use
  - The quality of use of a system depends very much upon the context in which a system will be used
  - In some cases contextual information may already be known; although, where a new product or system is to be introduced, then it will be necessary to collect the relevant contextual information
  - At the end the following aspects are understood:
    - the characteristics of the intended users
    - the tasks the users will perform , and allocation of activities between users and system
    - constraints and characteristics of the socio-organizational and technological environment in which the users will use the system
  - The results of this initial activity are embodied in a document which describes the context of use for the proposed software
  - The document:
    - should be validated by users
    - should be revised cyclically
    - influences the design

UCD activities

- 2. Specify the user and organizational requirements
  - Building on the context of use description obtained previously, an explicit statement of the user-centered requirements for the new software should be formulated
  - There are various methods which can help define these requirements, but according to ISO 13407 some elements to be covered in the specification include:
    - identification of the range of relevant users and other personnel in the design
    - provision of a clear statement of design goals
    - an indication of appropriate priorities for the different requirements
    - evidence of acceptance of the requirements by the stakeholders or their representatives
    - acknowledgement of any statutory or legislative requirements, for example for health and safety

UCD activities

- 3. Produce designs and prototypes
  - The key goal is to simulate the design solution(s) using paper or computer-based mock-ups
  - Explore design solutions by through mock-ups, and prototypes in general, of the proposed system and then later presenting them to a representative sample of users
  - Involve users early in order to explore and refine design choices in light of feedback
  - Iterate design solutions until the design/usability goals or requirements are met

UCD activities

- 4. Carry out evaluations
  - The usability evaluation of design decisions is crucial!
  - Develop an evaluation plan for the current stage
  - Do an assessment each of system lifecycle stages (with or without users)
    - identify anomalies and defects most relevant at this stage
    - select the best solution for the system in light of the requirements at this stage
    - report the results and recommendation for refining the design at this stage; the refine design becomes the design in the next stage
  - This evaluation process is iterated at each stage until design/usability goals or requirements are met

UCD activities

- There are many methods which can be used to achieve the goals of user-centered design (and will be covered later in the course)
  - Requirements gathering techniques: characteristics of users, etc
  - Task analysis: analysis of user tasks/activities
  - Evaluation techniques: expert-based, user-based, etc
  - etc