

# A working Framework for the User-Centered Design Approach and a Survey of the available Methods

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**Abstract-** User-Centered Design (UCD) is a philosophy and a process that places the person at the centre and focuses on cognitive factors as they come into play during peoples' interactions with things. It concerns and can improve itself with both usefulness and usability. A key aspect of successful User-Centered Design is evaluating early and throughout the UCD process. User centered design is receiving increasing attention in recent years. Various methods and tools are used within organizations to improve the understanding of user and task requirements, support the iteration of design and evaluation. User-Centred Design Methods can be extremely valuable although using them in the right way, for the right reasons and at the right time is critical. It will differ from project to project to decide exactly which method to use, and when and how to use.

**Index Terms-** User-Centered Design, Multi-disciplinary Design, Participatory Design Methods, And Profiling Methods.

## I. INTRODUCTION

The User-Centered Design (UCD) can be defined in many ways, but all definitions are characterized by a focus on the user, and on incorporating the user's perspective in all stages of the design process. Donald Norman describes UCD as "a philosophy based on the needs and interests of the user, with an emphasis on making products usable and understandable" ([1] Norman 2002, p.188). By this definition, actual user involvement is not a part of UCD by necessity. However, involving the users in the User-Centered Design process is a common way of ensuring that their needs and interests are being met.

UCD is a project approach that puts the intended users of a site at the centre of its design and development. The salient features of the UCD approach are: firstly it involves the stakeholders directly during the whole of the development process and secondly the processes are carried out in an iterative fashion, with the cycle being repeated until the projects usability objectives have been attained. This makes it critical that the participants in these methods accurately reflect the profile of the actual users.

In this paper we present the User-Centered Design principles in section 2. In section 3 from the literature, we present a comparison of the most common user-centered design methods outlining their cost and showing when to use them. Then in

section 4 we propose taxonomy of the User-Centered Design methods and why this is essential for the User-Centered Design framework. Based on the taxonomy we tabulate the existing User-Centered Design methods as proposed by the researchers showing the number of stakeholders' participation and the field of application of the respective methods. In the next section we present an analysis and discussion where we discuss the advantages and limitation of each method

## II. USER-CENTERED DESIGN PRINCIPLE

ISO 13407 outlines four key human-centered design activities as: Requirements gathering, Requirements specification, Design, Evaluation. The User-Centered Design process has also been formalized in the [4] ISO-standard 13407 Human-centered design processes for interactive systems (ISO 1999). The standard describes UCD as an iterative process which is depicted in figure 1, and also states the following key principles:

- 1- The active involvement of users and clear understanding of user and task requirements.
- 2- An appropriate allocation of function between user and system.
- 3- Iteration of design solutions.
- 4- Multi-disciplinary design teams.

In order to make the users an active part of each step in this process there are a number of empirical methods, such as: Interviews, Surveys, Workshops, Focus groups, Field studies, Usability testing.

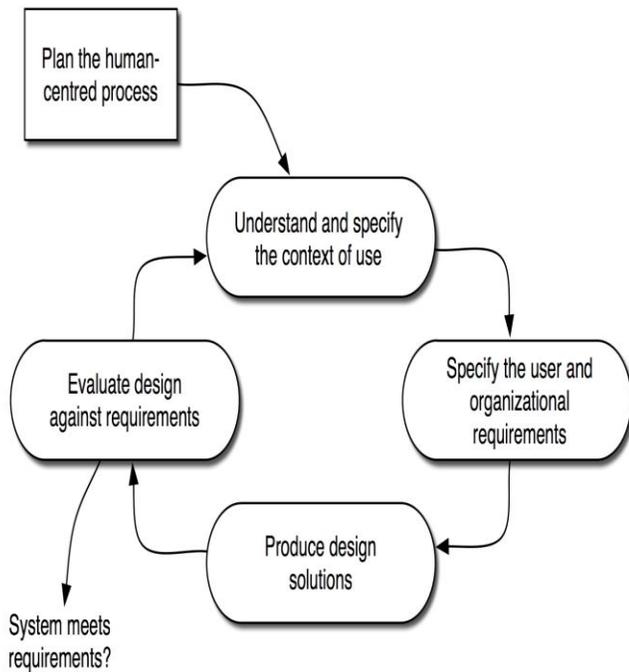


Figure 1. The human-centered design process, ISO-13407

User-Centered Design is a user interface design process that focuses on usability goals, user characteristics, Environment, tasks, and workflow in the design of an interface. UCD follows a series of well-defined methods and techniques for analysis, design, and evaluation of mainstream hardware, software, and web interfaces. The UCD process is an iterative process, where design and evaluation steps are built in from the first stage of projects, through implementation. [6]Rubin (1994) presents the UCD principles as: “to give early focus on requirements and tasks for Empirical Measurement and testing of product usage and also focuses on iterative Design.” The goal of UCD is to produce products that have a high degree of usability. [5] ISO 9241-11 (1998) defines usability as 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.” [6]Jeffrey Rubin (1994) describes usability objectives as: Usefulness, Effectiveness (ease of use), Learnability, Attitude (likeability).

### III. BROAD CLASSIFICATION OF AVAILABLE UCD METHODS

User-Centered Design is a design philosophy in which the emphasis is on the user and the aim is at the high level of usability. The UCD expert is focused on usefulness, ease of use and ease of learning for the user. This approach comprises a set of steps, methods and tools designed. It

Should be used at the early stage of the process that designers may find greatest use of the UCD methodology’s method ([16] Rauterberg.M, 2003). There are three phases of the UCD approach i.e. understanding the users, designing the product and evaluating the user’s interaction with the product. These three phases include specific deliverables and goals ([17]Kravetz.) In this paper we are considering twelve methods of User-Centered Design namely:

1. Card Sorting
2. Contextual Inquiry
3. Focus Groups
4. Interviews
5. Log File Analysis
6. Paper Prototyping
7. Surveys
8. Task Analysis
9. Usability Test and
10. Expert Review
11. Guided Walkthrough
12. Heuristic Evaluation

The following chart compares the most common User-Centered Design methods, outlines their cost and shows when to use them.

**Empirical Methods:** In these methods, data and the information are gathered directly from the users through observations and these methods are well known and widely used to evaluate the usability of a product. This is due to their effectiveness and cost-efficiency in discovering usability problems. These are the few methods within the User-Centered Design process that does not involve any direct contact with end users. Inspection methods are “expert” evaluations. These methods are useful when users are unavailable or when objective, high-level observations are needed.

#### Objective:

Inspection methods leverage domain expertise and best practices to provide quick and specific recommendations for product enhancements.

#### Methods:

1. Walkthrough
2. Heuristic Evaluation
3. Expert Review

The following chart compares the user-centered design methods; based on the taxonomy we tabulate the existing User-Centered Design methods as proposed by the researchers showing the number of stakeholders’ participation and the field of application of the respective methods.

Table 1: Comparison of UCD Methods

<b>Classification</b>	<b>Cost</b>	<b>Output</b>	<b>Early Design &amp; User requirements</b>	<b>Time resources required</b>	<b>When to use</b>
<b>Card Sorting</b>	High	Statistical	Yes	Low	Design
<b>Contextual Inquiry</b>	Medium	Stat. & Non-Stat	Yes	Medium	Requirements Gathering
<b>Focus Group</b>	High	Non-Statistical	Yes	Low	Requirements Gathering
<b>Interviews</b>	Low	Non-Statistical	Yes	Low	Requirements [1] Gathering & Evaluation
<b>Log File Analysis</b>	Low	Statistical	Yes	Low	Evaluation
<b>Paper Prototyping</b>	Medium	Stat. & Non-Stat	No	Medium	Design
<b>Surveys</b>	Low	Statistical	Yes	High	Requirements Gathering & Evaluation
<b>Task Analysis</b>	Medium	Stat. & Non-Stat	Yes	Medium	Requirements Gathering
<b>Usability Test</b>	Medium	Non-Statistical	No	Medium	Design & Evaluation
<b>Expert review</b>	Low	Statistical	No	Low	Design and evaluation
<b>Guided Walkthrough</b>	Medium	Stat. & Non-Stat	No	Medium	Design
<b>Heuristic Evaluation</b>	Low	Statistical	No	Low	Design

#### IV. TAXONOMY OF USER-CENTERED DESIGN METHODS

User-Centered Design is an iterative development environment [4]. The ISO 13407 standard explains how this can be structured. Iteration can take place in the small,

In these methods, data and the information are gathered directly from the users through observations and interviews. The following methods come under the Empirical Methods.

- 4.1.1. Inquiry Methods
- 4.1.2. Participatory Design Methods
- 4.1.3. Profiling Methods
- 4.1.4. Testing Methods

##### 4.1.1. Inquiry Methods

Inquiry methods are helpful for all projects because they lay the foundation for product projects design and development. It will be the foundation for creating feature sets and core requirement. Inquiry drives early design decisions and is most effective if the target user is clearly and narrowly defined.

Objective:

The objective of Inquiry methods is to become familiar with user needs and expectations, to inform business and user requirements.

Methods:

- 1. Focus Group
- 2. Contextual Inquiry
- 3. Surveys
- 4. Log File Analysis

##### 4.1.2. Participatory Design Methods

Participatory design methods are well suited for projects with complex labeling, taxonomy, or projects interface issues. It is based on users' active involvement in developing the product.

Objective:

Participatory design methods lead to rapid verification of design iterations, which greatly reduces time and costs for fixing design flaws.

Methods:

- 1. Card Sorting
- 2. Paper prototyping Test

##### 4.1.3. Profiling Methods

Profiling methods are particularly beneficial for when users are not accessible, budgets are tight, or development teams are spread out geographically.

Objective-

Profiling methods create empathy for your end users, which help facilitate product design and leads to clarity of the product vision.

Methods:

- 1. Task Analysis

##### 4.1.4. Testing Methods

These methods provide the most value for a project when product concepts have been verified with users.

Objective:

Testing methods reduce usability risks prior to product launch; create benchmarks to which future releases will be compared; and significantly reduce support-related costs.

Methods:

##### 4.2. Inspection Methods

These methods are well known and widely used to evaluate the usability of a product. This is due to their effectiveness and cost-efficiency in discovering usability problems. These are the few methods within the User-Centered Design process that does not involve any direct contact with end users.

Inspection methods are "expert" evaluations. These methods are useful when users are unavailable or when objective, high-level observations are needed.

Objective:

Inspection methods leverage domain expertise and best practices to provide quick and specific recommendations for product enhancements.

Methods:

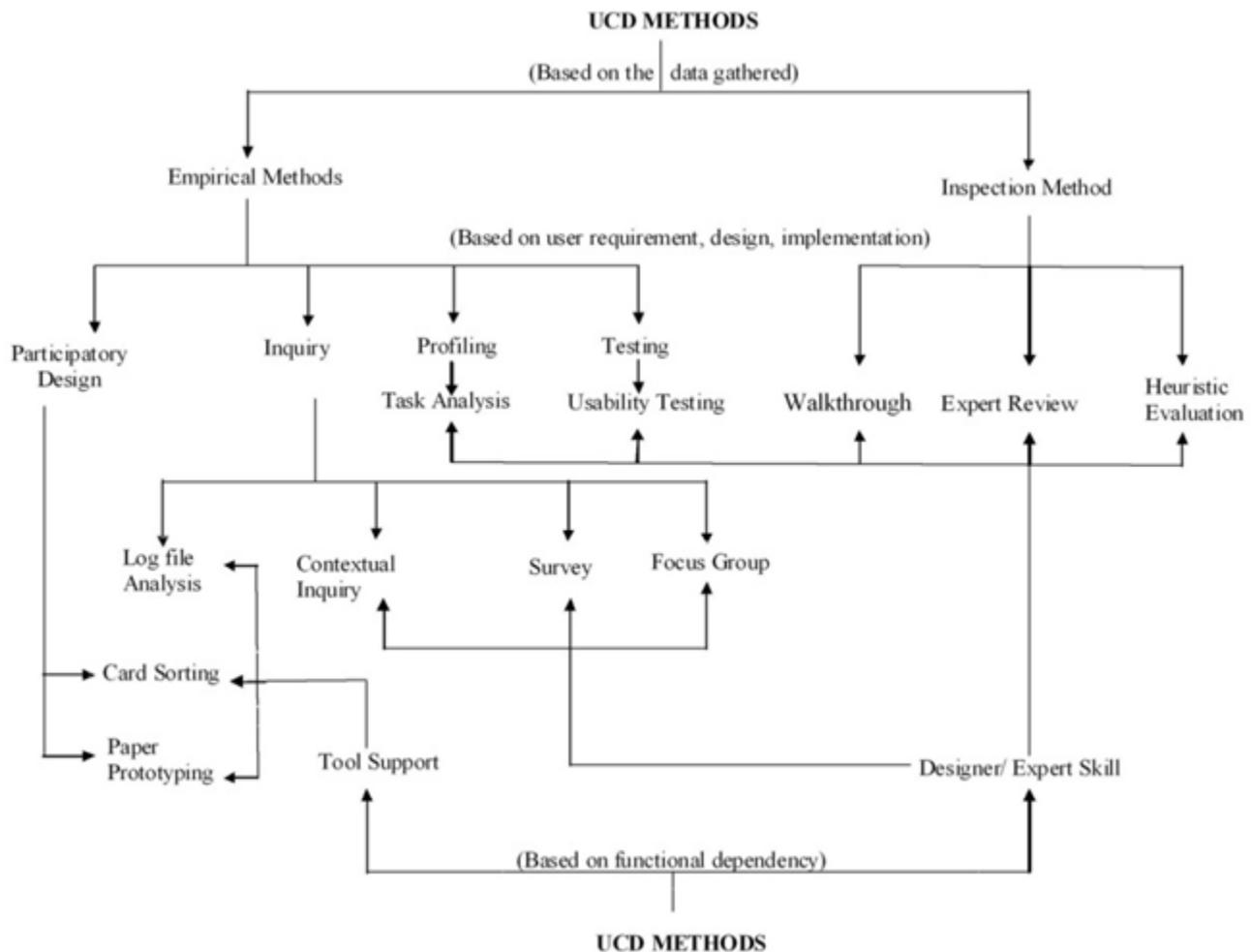
- 1. Walkthrough
- 2. Heuristic Evaluation
- 3. Expert Review

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**Table 2: UCD Methods description and its application area**

Classification	No. of Stakeholders involved	Functional Dependency	Application area
Card Sorting	10-20 users	Tool Support: The tool support is available based on the method. Stakeholder efforts are combined and analyzed statistically through IBM'S EZ which is used as a tool that helps analyze the stakeholder activity. This tool comprises two packages that is U sort and Ez Calc. U Sort is used by card sorting Participants to sort virtual cards or the designer can input after the physical card activity has been done.	designing a new site designing a new area of a site redesigning a site ([9]Maurer,and Warfel, (2004))
Contextual Enquiry	Varies(few-many)	Designer/Expert skill: No primary tool support is available based on the method. Context based enquiries are framed and qualitative analysis is of the collected data is done by the designer It is carried out mostly at the user's work place.	Qualitative data-gathering and data analysis (adapted in the fields of Psychology, Anthropology, and Sociology)
Focus Group	6-12 users/groups	Designer Skill: Targeted stakeholder is invited to a session of discussion. The designers/facilitators manage the discussion skillfully to stay in topic. ([7]Morgan ,1997)	Academic research Product marketing Evaluation research Quality improvement
Interview	Varies(few-many)	Designer/Expert skill: Interviewer asks semi-structured questions either face-to-face or by telephone. Those interviewed may include stakeholders, content experts, support staff, and users themselves. Both parties may choose to view a system online during part of the interview.	Obtaining in-depth data about a particular role or set of tasks Finding out what users want.
Log File Analysis	None	Tool Support: User's actions with a system are collected from server logs and examined later for usage patterns and potential problem areas.	To track site usage (it allows a web administrator to track file use and server traffic)
Paper Prototyping	5-7 users/groups	Tool Support: The tool support is available based on the method. More recently, <a href="#">digital paper prototyping</a> has been advocated by companies like <a href="#">Pidoco</a> due to advantages in terms of collaboration, flexibility and cost. It is <a href="#">throwaway prototyping</a> and involves creating rough, even-hand sketched, drawings of an interface to use as prototypes, or models, of a design.	Communication in the Team, Usability Testing, Design Testing, Information Architecture Rapid Prototyping, ([10]Bevan et. al. (2002))
Survey	Varies	Designer/Expert skill: Users are asked a	To obtain

		standard set of questions on paper, in person, by telephone, or by electronic mail.	quantitative data from users about existing tasks or the current system.
Task Analysis	At least 5 users/groups	Designer/Expert skill: It is to learn about an existing website to analyze the essential rationale. The analysis will involve the purpose of what people are doing, what they are trying to archive, why they are trying to archive it and how they are going about it' ([15] Preece et.al., 2002). The data abstracted helps to build the new requirements or to design new tasks.	It is suitable and recommended for most situations.
Usability Test	5-12 users	Designer/Expert skill: Testing is usually carried out on a one-to-one basis to allow the facilitator to closely observe the user's behavior. A second facilitator may be useful for recording purposes. The key to interpret the results of testing is to look for general trends and behavior patterns that indicate problems with the usability of the site.	Provides recommendations for how a design can be improved. Eye-tracking, teaching method, coaching method, self-reporting Logs
Expert review	3-5	Designer/Expert skill: After examining the system, Design experts give comment in detail on its adherence to principles of good design based on their expertise. Multiple experts are recommended to increase the probability that they will identify the main problems.	To identify usability problems in a product or service
Guided Walkthrough	1-4 users	Designer/Expert skill: Facilitator leads a user through a representation of the system asking questions either during or after the walkthrough to gauge the user's understanding of the system.	Checks structure and flow against user goals
Heuristic Evaluation	3-5 users	Designer/Expert skill: A group of evaluators (HCI experience) systematically apply a set of user-centered heuristics in order to evaluate the system. Multiple experts are recommended to increase the probability that they will identify the main problems.	Websites, e-learning system, groupware, notification system, and games. The method will provide recommendations for design improvements.



"Figure 2. UCD methods diagram"

## V. ANALYSIS AND DISCUSSION

In this paper we are considering twelve User-Centred Design Methods, and again classifying/grouping them into different methods namely: Empirical methods, Inspection Methods, Inquiry methods, Profiling Methods, Testing Methods, Participatory Design. These methods are grouped based on different aspects. Some methods based on the way of gathering data that is direct contact with the end users and some are on user requirements, design and implementation. Again UCD methods are classified based on functional dependency such as Tool Support and Designer/Expert Skill.

User-Centered Design methodology is a process for incorporating usability engineering into the systems and web site design process. It is an approach that supports the entire development process with user-centered activities, in order to create applications which are easy to use and are of added value to the intended users.

UCD methodology has been designed to be flexible, so that it can be adapted to the needs of system or web site. Some projects may benefit from completing all of the User-Centered Design tasks; others may only need to complete a few tasks. The larger the number of users, the more important it is to use the complete User-Centered Design methodology. UCD seeks to answer

questions about users and their tasks and goals, and then use the findings to drive development and design.

In UCD, user requirements are considered right from the beginning and included into the whole product cycle. User-centered Design involves simplifying the structure of tasks, making things visible, getting the mapping right, exploiting the powers of constraint, and designing for error.

Among the UCD methods is an excellent way to involve end users in the early stages of design. Task analysis is a profiling method that informs design by identifying and prioritizing the tasks that users will perform with a product, website, or service. This method begins with assumptions about user profiles, gleaned from initial market research. Throughout the design cycle, researchers validate the profiles and eventually create personas, or composite individuals, who ground the design effort in real users.

An Expert Review is an inspection method ([12] Nielsen, J. (1994)) designed to identify usability problems in a product or service. The review is carried out by a small group of usability experts, who analyze the product or service to identify any potential usability issues and the other inspection methods are Walkthrough and Heuristic Evaluation.

So now we can conclude that User-Centered Design provides a structured method for achieving usability in user interface design and the methodology as:

1. emphasizes an early focus on users and their tasks
2. promotes a top-down approach, dealing with high-level design issues first
3. is iterative
4. is scalable, based on the time and resources available to the project
5. Can be integrated with the software development lifecycle.

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