Integrating User Experience in Practices of Human-Centered Design Process in Product Design

Ahmed W Moustafa

Professor of product design and Ergonomics, Faculty of Applied Arts, Helwan University, ahmedwms@hotmail.com

Abstract:

The integration of User Experience (UX) with Human-Centered Design (HCD) is driven by the need for design techniques and methods that prioritize design for humans. This study aims to explore the possibility of integrating User Experience (UX) with Human-Centered Design (HCD) to improve the designer's ability to design a product. **Objectives:** 1- Investigate the organizational and technical aspects that enable or prevent the integration of UX principles and practices into the product design process, as well as the importance of organizational aspects of this integration, including influential considerations, success factors, challenges, and what may resist the integration of UX. 2- Explore the role of culture and the designer's work style or strategy in integrating UX, highlighting the dynamic nature of challenges and success factors over time. 3- Identify UX integration practices that designers should undertake to increase the likelihood of achieving UX integration in their designs. These practices include a variety of activities, with a particular focus on the organizational aspects of UX integration. **Methodology:** The study uses deductive reasoning, exploring user experience and human-centered design theoretically and providing clear evidence, to develop a coherent design approach that combines their advantages in product design. **Results:** The study emphasizes the importance of integrating user experience with human-centered design in product design. It highlights the dynamic nature of challenges and success factors, and the iterative nature of human-centered design, which involves idea generation, prototypes, user feedback, and responses. User experience is critical to the success of a product, encompassing the design and overall process of a product, device, or system. However, current human-centered design models do not fully utilize it due to its complexity. Design processes include human input, user feedback, and product testing and evaluation. Human-centered design concepts help facilitate the implementation of user engagement and the integration of emotional product experience with usability aspects for successful design.

Introduction

To provide an essential foundation for understanding the integration of user experience with human-centered design in product design we should set the stage for the subsequent discussions by highlighting the significance and relevance of this integration. This may occur by conveying the importance of considering user experience and human-centered design in product design. This aligns with the growing emphasis on User Experience (UX) as a fundamental concept in the field of Human-Computer Interaction (HCI) **(Lallemand et al., 2014).** Also we may need to address the challenges faced by practitioners and researchers in designing for user experience, emphasizing the need to bridge the gap between theoretical knowledge and practical application in creating rich experiences with product design.

Background and Rationale

The integration of user experience with human-centered design has been driven by the need to develop technology and organizations that are centered on human and life-critical design. As technology and emergent practices have transformed communication and interaction, providing a framework for human-systems integration. This evolution has prompted the development of methods and tools for the integration of people and organizations into the design and development of new technology, emphasizing the need to further develop human-systems integration foundations to support human-centered design **(Andre Boy, 2020).** Furthermore, the field of Human-Computer Interaction (HCI) has seen a growing emphasis on User Experience (UX) as a core concept, with a focus on translating theoretical knowledge into experiential objects called "Experience Triggers." These triggers, through their materiality, bring emotions and sensations to the design process, allowing designers to create more experiential final products. This emphasis on designing for User Experience has become a major concern for both researchers and design practitioners, highlighting the daily challenge of designing experiences and the need for collaboration between various disciplines in designing interactive products or systems **(Lallemand et al., 2014).**

Objectives:

The research aims to explore the integration of user experience (UX) with human-centered design (HCD) for enhancing product design. The specific objectives include:

- investigating the organizational and technical aspects that enable or prohibit the integration of UX principles and practices into the product

design process. This aligns with the findings of **(Kashfi, 2018),** which emphasize the importance of organizational aspects of integration, including influencing events, success factors, challenges, and resistance to UX integration.

- Exploring the role of culture, business model, and strategy in UX integration, highlighting the dynamic nature of challenges and success factors over time.

- Identify UX integration practices that designers should perform to increase the likelihood of achieving sustainable UX integration in their designs. These practices encompass a variety of activities, particularly focusing on the organizational aspects of UX integration.

Methodology:

The **study** uses a deductive reasoning approach, covering both user experience and human-centered design theoretically and providing observational evidence to back its conclusions. Ultimately, it develops a cohesive approach that combines the advantages of both approaches for application in product design.

Theoretical Framework:

1. Human-Centred Design Foundations

1.1 Human-Centered Design

Human-centered design is a multi-disciplinary approach that focuses on understanding user needs and aspirations, integrating them into the design process. It requires courage, empathy, intuition, creativity, and understanding of design, engineering, technology, and usability. This approach improves user experience, increasing system adoption and usage. However, as there is no single UX practice, exploring existing practices is crucial. Human-centered design, rooted in human factors and participatory design, is an iterative process focusing on usability in computer-mediated systems. It involves understanding users, eliciting their practices, and engaging them throughout the design process, reflecting the growing prevalence of computer-mediated systems. **(Wakkary, 2021).**

Human-centered design is widely used by design teams and commercial consultancies, but few designers consider themselves part of this field due to its experiential and non-contributory qualities. Modern design thinking rejects designs that don't consider technological, social, and cultural circumstances, hindering a more comprehensive understanding of design and hindering adoption by design organizations.

Human-Centred Design (HCD) is rooted in the understanding of people's needs, behaviors, and experiences. It emphasizes the importance of empathizing with users and integrating their perspectives into the design process. A key principle of HCD is the concept of "searching for the deep story," which involves employing an ethnographic approach to need finding to identify implicit needs that users may be unable to articulate

(Hartung & Rottenberg, 2019). This approach allows designers to immerse themselves fully in the user's world, gaining a comprehensive understanding of their routine, daily lives. Furthermore, HCD involves identifying and addressing psychosocial barriers that may hinder user experiences, ensuring that the design process accounts for the diverse needs and perspectives of the target audience **(Andre Boy, 2020).**

Incorporating the foundational aspects of HCD into the product design process is crucial for creating solutions that effectively meet the implicit needs of users, ultimately enhancing the overall user experience.

1.2. Definition and Principles of HCD

Human-centered design (HCD) is a fundamental approach that prioritizes understanding and addressing users' needs and preferences throughout the design process. Human-Centered design is an iterative, research-based design process that begins and ends with the user. This design philosophy emphasizes the importance of empathizing with users, defining their problems, ideating solutions, prototyping, and testing iteratively to ensure that the final product meets their requirements **(Hartung & Rottenberg, 2019).** Human-centered design (HCD) is a method that involves in-depth discovery and interviews to understand users' implicit needs. This ethnographic approach allows designers to understand their daily lives and experiences. The integration of HCD with user experience (UX) is crucial for creating products that provide meaningful experiences. By incorporating HCI research into experiential objects whith the so called 'Experience Triggers,' designers can bridge the gap between theoretical understanding and practical application, enhancing the overall user experience. This collaboration between design, ergonomics, and HCI is essential for creating interactive products that prioritize positive user experiences. **(Lallemand et al., 2014)**

In designing a product, service, or system, the designer must think about the audience and user of a product and attempt to understand their needs, goals, experience, knowledge, and attitudes. Basic questions to ask about the audience include: What do they want and need? What level of experience do they have with similar products? What is their level of knowledge with the content? With this information in mind, a design is created that is better suited to the audience. This design is then evaluated, and the designer goes back to better understand the audience, redesigning the product again based on the evaluation feedback. This process of evaluation and redesign continues until the product meets a usability goal **(Huynh et al.2021)**

Human-Centered design emphasizes the importance of understanding users' needs, goals, experiences, knowledge, and attitudes to align with the product's design. It comprises involving users throughout the design process, obtaining feedback early and often, and using techniques like paper prototyping and

usability evaluation. Addressing the whole user experience involves considering all aspects of the user's interaction with the product, including its user interface, branding, packaging, and installation. An iterative design process and multidisciplinary design team shape the approach, working in a rapid iterative cycle of design-evaluate-redesign until usability goals are met. This approach ensures that the product's design is effective and user-friendly **(Triberti and Brivio2020)**.

A common misconception about Human-Centered design is that it is synonymous with usability. Human-Centered design explicitly aims to understand the user and their needs when designing a product. This knowledge is then used to design the product. Usability evaluation, on the other hand, consists of methods to evaluate a design once it has been created. Although usability evaluation is one step within the Human-Centered design process, there are many additional steps needed before this can take place. **(Hasani et al.2020)**

The principles of Human-Centred Design. According to **Pheasant S, Haslegrave CM (2006)** Human-Centred Design:

1. **Empirical.** It is based on actual data. It aims to provide hard facts on human physical and mental traits, observable behavior, and reported experiences as the foundation for the design process decisions. It is suspicious of both broad ideas and gut feelings, with the possible exception that they might serve as the foundation for scientific research.
2. **Iterative.** It is cyclical. It's a cyclical process wherein an empirical study phase precedes a design phase wherein solutions are developed and subsequently subjected to empirical evaluation.
3. **Participative.** It Involves interaction. It aims to involve the product's final user as a proactive collaborator in the design phase.
4. **Non-procrustean** It is not procrustean. It tries to match the product to the user rather than the other way around, dealing with people as they are instead of as they may be.
5. **Takes due account of human diversity**: It considers human diversity appropriately. It seeks to find the greatest match for the largest number of individuals.
6. **Takes due account of the user's task.** It considers the user's task appropriately. It acknowledges that product and user matching is often task-specific.
7. **Systems-orientated**: It is focused on systems. It acknowledges that the relationship between a product and its consumer exists inside a larger socio-technical system, which functions within the framework of political and economic systems, natural ecosystems, and so forth.

8. **Pragmatic.** It is sensible as it acknowledges that there can be boundaries to what is practically feasible in a given situation and works to get the best result possible within the restrictions placed by these boundaries.

1.3. Design Principles in HCD

However, the focus of these principles is on characteristics that aid the usability and the learnability of user interfaces without much consideration for experiential qualities. The design of user experience (UX) and emotional aspects of interaction in a human user design can be complex, with some design goals being reliant on multidisciplinary methods. Other authors, such as **Hassenzahl (2004),** have returned to principles of successful and meaningful design, extending to the aforementioned traditional roots of HCD design principles. Hassenzahl thus introduced criteria that allow the design of a product or service to engage and/or meet the intrinsic values present in its users. These criteria include meaningfulness, Compliance with standards, Minimization of surprise, Ease of of operations, Small and simple intervention, Provide clear, consistent displays, Allow sufficient time to understand and respond or emotion-driven, experiential, and adding pleasure or joy in usage **(Berni & Borgianni, 2021)**. However the principles commonly used to guide design in HCD in light of UX utilization can be summarized and tailored to aid the efficient and effective development of a product as:

- People Centered People-centered product design involves considering all involved parties, including users, families, retailers, designers, technicians, nurses, marketing specialists, and involved staff. It requires careful observation, engagement with businesses, and policy makers.
- Solves the right problem: Ensuring that we solve the core, root issues, not just the problem as presented to us (which is often the symptom, not the cause)
- Everything is systematic: Taking a systems point of view, realizing that most complications result from the interdependencies of the multiple parts
- Provide feedback: Continually testing and refining our proposals, ensuring they truly meet the needs of the people for whom they are intended (Margetis et al.2021)

2. Foundations of User Experience Design

User experience (UX) design is a fundamental concept in the field of Human-Computer Interaction (HCI) and plays a crucial role in the design process. **(Lallemand et al., 2014)** emphasize the challenges faced by practitioners and researchers in designing for user experience, highlighting the gap between theoretical knowledge in HCI research and its practical application in design. They employed the concept of "Experience Triggers" as experiential objects that bring emotions and sensations to the design process, aiming to create more immersive and experiential final products. This underscores the importance of science-based UX design in addressing the

complexity of designing experiences and stimulating positive user experiences.

Moreover, human-centered design methods, as outlined by **(Hartung & Rottenberg, 2019)** , offer a powerful framework for understanding customer needs and addressing them effectively. The iterative nature of human-centered design, involving continuous research and analysis, underscores the significance of deeply understanding customers and stakeholders throughout the design process to create meaningful and successful products. Additionally, the emphasis on prototyping and user feedback in human-centered design aligns with the goal of enhancing the product design process through the integration of UX principles.

2.1. Definition and Principles of User Experience

User experience (UX) design is a fundamental concept within the field of Human-Computer Interaction (HCI) that has gained significant importance in recent years. **(Lallemand et al., 2014)** emphasize the challenge of bridging the gap between theoretical knowledge in HCI research and its practical application in creating rich experiences with interactive artifacts. Here "Experience Triggers" has been used as tools for science-based UX design, aiming to bring emotions and sensations into the design process, ultimately leading to more experiential final products. This shift towards an experiential perspective underscores the increasing significance of designing for user experience, a concern shared by both researchers and practitioners in the field.

Furthermore**, (Hellweger et al., 2015)** highlight the complexity of understanding UX, especially in the context of interactive systems designed by multidisciplinary teams. They underscore the multifaceted nature of user-product interaction, influenced by social and cultural factors, user aspects (values, emotions, expectations, and prior experience), and product factors (mobility and adaptivity). The authors stress the need for an interdisciplinary approach to UX, drawing on perspectives from IT, design, and psychology to achieve a deeper understanding of this complex phenomenon. These insights provide a comprehensive understanding of the principles of user experience design, emphasizing the need for a holistic and interdisciplinary approach to effectively integrate UX with human-centered design.

2.2. Key Concepts in User Experience

Usability: is a crucial aspect of user experience (UX) and is measured through a Human-Centered design (HCD) process. It involves the ability of a system, product, or service to be used effectively, efficiently, and satisfying by specific users in a specific context. Usability is essential for user experience and is based on three concepts: effectiveness, efficiency, and satisfaction. Formative tests, such as heuristic evaluations, user observations, and laboratory tests, are used to evaluate usability iteratively throughout the design process. Accessibility is also a key component of usability **(Sauer et al., 2020)**.

Accessibility: Accessibility is the ability of users to access and perform functions in design, regardless of their background, preferences, or physical or mental factors. Guidelines provide accessibility rules, while recent researchers have developed modeling and usability evaluation methods. Screen design accessibility is evaluated by converting it into alphabetic string format and comparing it to reasonable formats and word types. Accessibility is measured by the time ratio of solving tasks with and without screen readers.

Effectiveness: is concerned with the completeness and accuracy with which users achieve specified goals. Effectiveness also defines the measurement of usability, which could be expressed as a percentage (Ferreira et al.2020). Questions formulated for testing effectiveness might be: did the user reach the goal? Did the user experience any obstacle, and if so, what was it?

Efficiency: can be measured as the ratio of a task's resources used to its task's duration. It is easy to see that while finding A in a list of letters of one hundred would take an average of 2200 ms using a binary search. Questions covering efficiency might be: how many times a system was used to reach the task? What was the path that the user took in reaching the result?

Satisfaction: is generally defined as the user's comfort and acceptability of the work system and its use. The answer to satisfaction is much more difficult to extract. This information comes from subjective user judgment that is emotional. Not easily quantified, it can ask questions like: are you satisfied with the results? Would you use the system again?

2.3. Importance of User Experience in Design

User experience (UX) design is the process design teams use to create products that provide meaningful and relevant experiences to users. UX design involves the design of the entire process of acquiring and integrating the product, including aspects of branding, design, usability and function **(Interaction Design Foundation, 2016).** With the emphasis on user-centeredness, the user experience of products is gaining more and more importance. The experience that a user has in using a product has a serious impact on product evaluation and product success. Both of these go hand in hand concerning the success of a product in the marketplace. Companies should take care of the experience factor of products to make them more favorable for the target consumer base **(Sauer, J., et al., 2020)**. The appropriateness of an end product

depends on its functionality, aesthetics, reduced workload, cognitive burden, and other factors. Target users with favorable needs will consider a product better than alternatives. The needs and user experience are interconnected, with the presence of items in both lists favoring the product and the absence of items making it inappropriate. To make the product more favorable, the second list should be included in the design process. Usability concerns appropriateness to intended use, evaluated using six international standards: ease of learning, efficiency, use, usefulness, ease of retention, and satisfaction. A satisfied user's experience in cognition and motor action indicates a more favorable product evaluation, and the reduction of workload and cognitive burden stabilizes product design decisions. **(Sauer et al., 2020)**.

Aside from the two above-mentioned factors towards product appropriateness, aesthetics also play a major role in product evaluation. Design factors like proportion, visual complexity, symmetry, and ornamentation of the product derive the aesthetic judgment of the product, which ultimately influences the decision-making of the user to consider an end product. Even when the functionality of the aesthetic design is kept constant, good aesthetic design induces better first impressions, preferences, and decisions than less aesthetic design (Shi et al., 2021). In short, UX helps product designers create products that are both practical and usable. UX in designing addresses the following six major areas:

1. **Usefulness.** The product must fill a practical need for the user.
2. **Desirability.** The product must use attractive and consistent aesthetics, such as visual design.
3. **Usability.** The product must be simple to use and provide a familiar suite of features and functions.
4. **Accessibility.** The product must be usable by everyone, including users with disabilities.
5. **Supportability.** The product must be well-supported so that users can resolve problems quickly and easily.
6. **Credibility.** The product must be trustworthy -- such as from a reputable company or implementing careful security Stephen J. Bigelow, (2007) User experience definition [Source]

3- Analytical Study
3.1. The Relationship between UX and HCD
Understanding the relationship between user experience (UX) and human-centered design (HCD) is crucial for enhancing the product design process. **(Ivonne Chamorro-Koc & Popovic, 2009)** identified mnay causal relationships that explain the influence of human experience and context-of-use on product usability. Their pilot study with designers illustrated that awareness of these causal relationships can assist in generating novel ways to enhance product usability, emphasizing the

importance of considering user experience in the design process. Furthermore**, (Lallemand et al., 2014)** highlighted the challenge of translating HCI research into practical design, highlighting the importance of interdisciplinary cooperation in creating interactive products that enhance user experiences.

3.2. Overlap and Distinctions
The integration of user experience (UX) and human-centered design (HCD) aims to create interactive products that stimulate positive user experiences. Both fields emphasize understanding customer needs and seeking feedback. UX focuses on creating rich experiences with interactive artifacts, often using "Experience Triggers" for science-based UX design. This approach aims to bring emotions and sensations to the design process, emphasizing the materiality of artifacts to enhance user experiences **(Lallemand et al., 2014)**. On the other hand, HCD emphasizes a deep understanding of customers and stakeholders, offering a powerful framework for understanding customer needs through iterative research and prototyping **(Hartung & Rottenberg, 2019)**.

3.3. Conjunctions and variation between
Understanding the convergence and distinction between user experience (UX) and human-centered design (HCD) is crucial in product design. Both aim to create interactive products that stimulate positive user experiences. UX uses "Experience Triggers" to create rich experiences, while HCD emphasizes understanding customers and stakeholders through iterative research and prototyping. These distinctions offer valuable insights for designers to improve the product design process.

3.4. The Intersection of (UX) and (HCD)
The intersection of User Experience (UX) and Human-Centred Design (HCD) is a critical aspect of the product design process. Both UX and HCD emphasize the importance of understanding user needs and preferences, with UX focusing on the overall experience of the user and HCD prioritizing the active involvement of users throughout the design process (Hussein et al., 2013). This intersection highlights the interconnected nature of these two aspects, emphasizing the need for a holistic approach to product design that integrates both UX and HCD principles. By integrating User Experience with Human-Centred Design, designers can create products that not only meet user needs but also provide a positive and meaningful user experience **(Lallemand et al., 2014)**.

3.5. Benefits of Integrating UX with HCD
The integration of user experience (UX) with human-centered design (HCD) enhances product design by creating emotionally engaging and satisfying products. Understanding the challenges and success factors in UX integration can provide valuable insights for organizations transitioning from developing user interfaces to prioritizing usability and UX. The present study explores the challenges and opportunities of integrating user

experience (UX) principles and practices into design organizations.:

- **Improved User Satisfaction:** The study by **Lallemand et al., (2014)** highlights the benefits of integrating user experience (UX) with human-centered design (HCD) to enhance user satisfaction. They propose the use of "Experience Triggers" as a tool for science-based UX design, aiming to create more experiential products, thereby enhancing the understanding of experience theories. Furthermore, the study by **Kashfi, P., (2018)** reveals that the synergy between UX and HCD contributes to creating products that prioritize user needs and deliver exceptional experiences. His work emphasized a shift towards possibility-driven design, focusing on positive user experience. It uses product emotion theory, user feedback, and user scores to guide design practices, aiming to enhance user satisfaction with designed products and explore future development potential.

- **more inclusive design process:** HCD and UX combined guarantee an inclusive design process that considers various perspectives from the greatest number of users groups, contingent on relevance. This makes the solutions more democratic and less dangerous by ensuring that the needs and safety of the context's more vulnerable groups have been taken into account.

- **Higher levels of embracing and sustainability:** Greater levels of sustainability and acceptance is a result of the user's sense of ownership over the solution: US places a strong focus on experience sharing and participation in the design process. Long-term acceptance and maintenance of solutions are more likely when community members actively contribute to their creation. Higher adoption rates and longer-term solution sustainability result from this.

- **Easier to achieve impact:** The UX and HCD approaches aim to involve the community in the design and implementation of solutions. The UX approach ensures active community involvement, while HCD's iterative nature allows for refinement. Combining these approaches simplifies incorporating solutions and scaling processes within the community and in similar contexts, making it easier to implement and execute solutions.

- **More culturally sensitive:** UX ensures solutions are tailored to human experiences and align with user practices, emphasizing user viewpoints and integration. HCD-created design solutions are useful and relevant to the user's experience, making them suitable for the person and their surroundings.

- **Boost user/customer loyalty:** Apple's success can be attributed to its iPhone, which has consistently met consumer demands since its 2007 release. Despite competitors offering lower prices, Apple's devotion to its product attracts loyal customers who advocate for the product, choose its design over competitors, and commit to future benefits. This loyalty leads to improved Return on Investment (ROI), enabling business growth, increased sales, higher prices, and longer-term revenue.

- **Deeper insight and increased empathy:** HCD places a strong emphasis on developing a thorough grasp of each user's needs, goals, experiences, preferences, and obstacles. By taking into account the sociocultural, historical, and environmental background of the society, UX adds even another dimension. This offers two viewpoints, allowing for a deeper and more complex comprehension of the problem **(Kashfi, 2018).**

3.6. Challenges in Integration

When integrating user experience (UX) with human-centered design (HCD) in the product design process, several challenges and considerations need to be addressed. One of the key challenges is the gap between theoretical knowledge developed in HCI research and the practical knowledge used by designers. This gap can hinder the effective integration of UX and HCD, as designers may struggle to translate theoretical work into practical design elements that enhance user experience **(Lallemand et al., 2014).** Additionally, the complexity of designing experiences presents a daily challenge for experience designers, as only a few artifacts designed within the HCI field are explicitly rooted in the body of knowledge related to human interaction and experience.

Furthermore, the integration of UX principles into product design organizations faces challenges such as communication and collaboration between UX and non-UX practitioners, as well as the timeline of events that enable or prohibit UX integration in companies **(Kashfi, 2018).** Understanding and addressing these challenges is essential for achieving sustainable UX integration in the product design process. **(Newton, 2019)** emphasizes the importance of understanding the role of organizational culture in embedding HCD practices and highlights the need for further research into areas such as aligning organizational values with HCD theories and practices, identifying barriers to need-finding, and leveraging social science practices in applying design thinking cohesively. This underscores the complexities that may arise within organizational structures and processes, emphasizing the need for a deeper understanding of how to navigate and address organizational resistance when implementing user experience and HCD principles in the product design process.

3.7. Strategies for Integration

To integrate user experience (UX) with human-centered design, practitioners can use strategies and best practices. One approach is to translate HCI research into "Experience Triggers," **(Lallemand et al., 2014)** which bring emotions and sensations to the design process. This allows designers to understand experience theories and create more experiential final products. Organizations can also address challenges by implementing models of requirements that facilitate communication and collaboration between UX and non-UX practitioners. Product design is a critical process that involves conceptualization, design, development, evaluation, and marketing to satisfy consumer needs. However, it faces complexities like diverse stakeholders, conflicting goals, new technologies, and market opportunities. This can lead to a loss of balance between users and engineers and neglect of a shift in focus from products to users and product usage. Traditional design methods remain product-oriented and technology-oriented, necessitating a practical approach to guide designers in focusing on users and product usage in the early stages of the design process. **(Moran & Carroll, 2020).**

Product design is a complex process that involves conceptualization, design, development, evaluation, and marketing to meet consumer needs. Designers must navigate complexities like diverse stakeholders, conflicting goals, new technologies, scientific achievements, and market opportunities. This can lead to a loss of balance between users and engineers. An approach is needed to guide designers in focusing on users and product usage in the early stages. **(Li et al., 2021).** There are five potential methods and techniques for integrating user experience in the product design process:

1. **User perspective methods and techniques:** These involve making users and their needs explicit in the design process. Experts can assist in including the user perspective.
2. **User-based design methods and techniques:** These focus on integrating the user perspective at the generation and evaluation of concept designs. The proficiency and effectiveness of these methods depend on the knowledge, experience, and attitude of the design team.
3. **Guidelines and design rules:** These provide specific rules and considerations regarding product design. Documentation methods and techniques address how design information is documented, which greatly influences the presence and consideration of the user perspective in the design process.
4. **Communication and collaboration methods and techniques:** These techniques enhance communication and collaboration regarding the user perspective between various parties involved in the product design process.

3.7.1. User Research

User research is the practice of conducting studies to uncover user behaviors, needs, and motivations.

In the early stages of the Human-Centered design process, user research is a way to understand the broadest context for a design question. User research methods can be grouped into quantitative versus qualitative, and direct versus indirect methods. Each method varies in terms of timeframe, cost, and degree of control over the environment of user interaction **(Muratovski, 2021)**.

Surveys and interviews are direct, qualitative methods used to capture self-reported user behavior. Surveys are standardized, while interviews may use follow-up questions. They are commonly used in the context of technology acceptance and usability. The study used both surveys and individual interviews as data collection methods **(Lareau, A. 2021).**

The survey may be created using an online tool and hosted on a purpose-created site, offering cost-efficiency, time efficiency, and anonymity. Open-ended questions provided unexpected insights and improved understanding of the cause-and-effect relationship. Semi-structured individual interviews were used as a complementary method, allowing for deeper discussion and exploration of issues in unexpected ways. Both methods were beneficial for the study's findings. The semi-structured individual interviews were conducted one-on-one and lasted between 45 minutes and 2 hours, aiming to disentangle insights and issues concerning less intuitive or flare-of-the-moment themes revealed by the survey **(Lareau, 2021)**.

Despite their differences, it is possible to consider surveys and interviews together as potential user research methods that require, above all, carefully designed questions. Hence, just as emphasis is placed on question design for surveys, attention must also be given to question design in interviews. In this section, general design criteria, strategies, and examples for both interviews and surveys will be presented, grouped into three components: question policy, which deals with how many and what kinds of questions to ask; question wording and format, which deals with what wording and question format is most appropriate; and question sequencing, which deals with the order in which questions are posed **(Jain, 2021)**.

In any user research method, the questions that are posed must be valid, whether independently or interdependently. A survey question is valid if it measures the concepts it is supposed to measure. In general, three threats to validity exist: question ambiguity, jargon, and over-comprehension. Ambiguity is a significant threat to validity. To ensure clarity, a good guideline is to limit a question to one interpretation. Jargon is another threat to validity. High education levels may limit the range of user comprehension for some technical terms. Over-comprehension is when a survey question asks too much. This can cause users to be confused or frustrated due to the difficulty of answering. Hence, it is necessary to sequence questions beginning with easy questions before

difficult ones **(Mourrieras, O., & Hormness, M. (2018).**

3.7.2. Persona Development

- **Creating Personas:** A persona is a fictional character representing one or multiple customer segments and their related goals, needs, and pain points. Creating personas begins with gathering user data using techniques such as interviewing, surveying, and contextual inquiry. Sorting this data will help the design team discover behavior patterns and then personify them into various user types. A persona can include demographics such as age and occupation, but it is more important to consider the persona's goals, needs, pain points, and behavior patterns affecting the design. Including a vivid picture or fictitious name is useful to enhance identification. Personas are goal-directed and not user instances. Each persona must have at least one scenario where its goals are related to the product or service being designed **(Salminen et al.2020).**

It is suggested that methods for persona development and application should be integrated throughout the work of a team and revisited regularly. Personas loosely follow scenarios in describing user goals and contexts of use. However, personas differ from scenarios in that they are characterizations of classes of users, rather than classes of real-world tasks. Although personas and scenarios should be used together, it is considered crucial to create personas prior to the development of scenarios. A well-crafted persona should elicit an understanding of the relationships between the user types and the proposed system. If possible, personas and scenarios should be informed by empirical data. The agency of the personas, that is, how the personas of the users interact with the designer's models of the system, is a key consideration in the design process **(Salminen et al.2020)**. Designing with personas consists of keeping them alive throughout the development process by referring to them every time a design decision must be made. It requires ensuring that the personas are accurate and relevant for the design to check if a requirement is compatible with a persona and, if not, how it will affect the persona's goals and motivations. Conducting regular reviews to assess if a design still accommodates the personas after major design changes is also good practice. It is also good practice to run usefulness tests with the personas to validate that the design concept meets their needs and goals. Finally, it should be assessed each year if the personas are still valid representations of the segments **(Huynh et al.2021)**.

- **Using Personas:** The use of personas, representations of user types and contexts, can be an effective way to facilitate understanding of the user's world within a design team. During the user interface design, the personas can be used to put yourself in the users' shoes to evaluate if the design meets their goals and needs. It can also be helpful to think of the personas' tools, environments, emotions, and experiences when designing. Finally, it is useful to check with the persona's goals if the design concept creates new ways to achieve their goals, if it adds new pain points and undesired behavior, or if it meets their goals better than existing alternatives. Overall, it is important to remember that every design decision directly affects the user experience of the personas, and this must be taken seriously **(Nielsen et al.2021).**

The Human-Centered design approach was used in the development of an information system, involving users in all phases from problem definition to evaluation. Traditional methods used in this approach include research of the user's world and iterative participatory design methods, such as focus groups, participatory low-fidelity prototyping, and iterative high-fidelity prototyping. Contextual inquiry and usability tests were used for data gathering and evaluation. However, conveying the user's world to the design team was a challenge throughout the project. A shared understanding of the user, or 'user experience,' was a constant focus, often achieved through personas or cultural probes. Efforts to integrate persona methods into the Human-Centered design process were described, including how their effectiveness was influenced and proposed hypotheses for improving their effectiveness. The team found that methods for persona development and use need to be integrated into the team's work flow and revisited regularly. **(Greenbaum & Kyng, 2020).**

3.7.3. Prototyping

Prototyping is crucial in the design and development process, providing a visual and very often physical guide for users. Prototypes bring conceptual design to life by adding interactivity and links between them, including element functioning. There are two types of prototypes: low-fidelity and high-fidelity, which differ in their resemblance to the final product. Prototyping is essential for testing usability and enhancing user experience before the product is set up. Advantages of prototyping include visual presentation, early testing, error identification, and necessary changes before manufacturing **(Dave et al.2021)**.

3.7.4. Visual Design Principles

In the field of design, color is often studied with a tighter connection to the profession itself. Color in design explores colors as phenomena that can be studied with visual perception experiments. This view on color became quite popular among graphic

designers and led to the rise of color studies within this community.

The Human-Centered visual design principles refer to a set of community practices and guidelines that can be used by a visual designer to create successful and high-quality designs. The Human-Centered visual design principles include color theory and typography. These principles have been used to create low-fidelity designs of the proposed application interface. Color theory describes the characteristics of colors and how they can be combined into groups. Colors can be combined into groups according to their similarities in hue, saturation, and brightness. Color theory defines several color schemes of different complexity, such as monochromatic palettes, three-color palettes, and six-color palettes. A visual designer typically uses color theory to analyze color groupings in existing compositions and plan color arrangements in prospective compositions **(Salinas et al.2020)**.

3.7.5. Color Theory and Typography
Visual design principles are essential rules that guide design decisions and create visually appealing designs. Human-Centered design principles focus on how users perceive, comprehend, and interact with a design. Key visual design principles include color theory, which explains how colors work, interact, and create specific effects on the viewer. Designers should understand basic concepts like the color wheel, color harmony, color temperature, and color symbolism. The color wheel organizes colors based on wavelengths, while color harmony is the pleasing combination of colors that creates a desired effect. Color temperature affects the mood and atmosphere of a design, while color symbolism refers to the cultural and emotional meanings associated with colors. When choosing colors, designers should consider the target audience and context. **(Kimmons2020)**.

Typography is a crucial visual design principle especially for packaging and branding of certain visual design products that involves arranging type to make written language legible, readable, and visually appealing. It involves understanding basic concepts like typefaces, font sizes, line heights, letter spacing, and text alignment. Typefaces are designed to improve readability for different levels of headings, and body text. Line heights are used to improve readability, and letter spacing is adjusted to enhance the text's appearance.

3.7.6. Interaction Design
Interaction design is a crucial aspect of creating user-friendly interfaces, aiming to ensure smooth and efficient interactions between users and products, services, or systems. It involves defining and designing the product's surface using a Human-Centered approach, balancing the desire for a desirable interface with usability **(McGraw & Harbison, 2020)**. This process involves four phases: problem analysis, design of possible solutions, prototype building, and user evaluation. Visual modeling techniques like wireframes,

navigation flows, and design patterns are used to foster collaboration among multi-disciplinary teams. Wireframes represent the interface's basic features, navigation flows show users' navigation through different pages or screens, and design patterns analyze and represent solutions to common problems, sharing knowledge and experience through narrative descriptions, representations, and contexts **(Salinas et al.2020)**.

3.7.7. Creating Intuitive Interfaces
Designing intuitive interfaces can be seen as an art, a science, or a combination of both. Whether you take a methodical approach or a more chaotic one, it is similar to cooking or baking: carefully combine the right ingredients in the right order, and you will usually end up with something good. Nevertheless, every person taking on this design task brings personal experience, skills, knowledge, and habits to the project, which may not always be beneficial to the audience **(Meyer and Norman2020)**.

Consider the question "How do you go about designing interface screens?" In the past decade, several checklists and models have been proposed containing guidelines that one can follow to produce usable designs. These guidelines represent a large portion of the user interface design experience gained during the past few decades and are not brand-new ideas in any way. However, while they are good guidelines and great to use as reminders, they may not be enough to produce usable designs by themselves and should be regarded as a starting point for the interface design process. The success of a Human-Centered design process also relies heavily on the designer's skills and knowledge regarding how users interact with products **(Tellioğlu, 2021)**.

There are three main interaction styles for users to interact with a computer: command phrase style, menu style, and direct manipulation style. Each style has specific characteristics that make it better or worse for specific applications and users. Designers should consider the terminology used, consistency of command words, and the number of similar menus, commands, or objects. There is no absolute best interaction style, but each style offers different implementations and can help designers add additional product characteristics **(Hasani et al.2020)**.

Along with choosing the strategy through which users can interact with a product, it is also necessary to define similar design strategies on a finer level. Because a design involves not only the product's high-level characteristics but also the design of individual interaction objects, there are general principles with which all presented kinds of other interface objects should comply. A good design will always make compromises, seeking a balance between the different principles characterizing various aspects of the interface.

3.7.8. Iterative Design Process
Human-Centered Design (HCD) is an iterative design process that focuses on collecting user feedback during the process. The principle of HCD

is to respond to genuine needs, dislikes, and difficulties identified by end users, rather than merely reflecting the designer's perceptions. This section discusses how HCD principles are integrated in practice and how user feedback is collected and incorporated into ongoing design iterations. It also explores concrete methods for collecting user feedback **(Kriglstein, S., & Wallner, G. (2013)**.

The design process is iterative and user feedback is integrated into it. User observations lead to design iterations that align with HCD principles. Techniques for collecting user feedback are discussed, including methods for conducting user observations in digital information system design. Five levels of iterative design are identified, ranging from non-responsive to genuine user needs to more radical designs. The study concludes that there is a more or less radical form of Human-Centered design integrated in practice when designing new digital information systems **(Auernhammer and Roth2021)**.

3.7.9. Challenges and Solutions in Integration

The integration of user experience (UX) in Human-Centered design (HCD) practices is crucial due to the increasing complexity of it is essential to consider the impact of technology on various qualitative dimensions. However, users' complexity, agency, and emergent behaviors make it difficult to recognize them. Theories on the emergence and revision of practices can help clarify the relationship between technology and its practices. Framing theories in terms of design space and delineation questions may reveal gaps in scientific knowledge, inspiring future research. **(Hasani et al.2020)**.

To ensure success in Human-Centered design, key stakeholders and program champions should communicate the vision of change and plan initiatives enthusiastically. Mentoring others and identifying program champions can create positive buzz. Relevant projects should be selected and designed to create early positive outcomes, such as smaller pilot projects. Process resources, tools, and templates should be provided upfront, along with an inclusive training program. During implementation, identifying early resistance and addressing key concerns is crucial. In-depth interviews with stakeholders should address issues beyond technical usability, and observing UX training sessions can help understand organizational concerns. Realistic integration should occur over several years, developing industry-specific methods and tools. Recognizing the power, culture, and history of central design or engineering departments is essential. **(Acar Y., et al.2016)**.

4. Measuring User Experience

Understanding user experience is crucial for integrating approaches, tools, and practices in an organization. Organizational goals and ambition levels should be considered in relation to user experience. User experience maturity models or pyramids provide valuable frameworks for

discussion and development **(Sauer et al., 2020)**. However, user experience is often overlooked, hindering societal and competitive benefits. To improve user experience, interaction design practices should be understood in terms of frames of interpretation, translating concepts into practical design tools, actions, and approved values **(Klink et al., 2021)**. . User experience measurement is essential for understanding its practical and theoretical implications, offering quantitative data, flexibility, detailed information, benchmarking, design knowledge, increased supervision capacity, and documentation of design decisions. The outcomes of measurement should be clear, precise, and openly documented, evaluating interaction design in relation to user experience goals **(Salinas et al.2020)**.

4.1. Metrics and KPIs

Internal metrics are crucial for monitoring and improving features, while individual feedback can lead to poorly aligned design iterations. Current measures can detect emerging problems before users perceive them. Regular tracking of basic metrics complements external feedback, but caution is needed. Quantitative metrics alone may not provide a clear picture of user experience, as they capture only certain aspects. Additionally, metrics involving subjective filters are openly debated, and a single numerical indicator of user experience is also a concern **(Borkin M. A, 2013)**.

4.2. measuring impact

Design decisions impact implementation and user experience. Different design features affect satisfaction levels differently than others like usability, hedonic quality, memorability, or complexity **(Sauer et al., 2020)**..Experience-based usability focuses on how a design makes users feel and complies with Human-Centered design criteria. It includes factors like hedonic quality, complexity, novelty, memorability, and similarity to prior experience. To create effective designs, intrinsic variables related to expected usage should be considered. Prioritizing efficiency over experience may lead to prioritized designs.

4.3. Usability Testing

Usability testing is a method that observes user interactions with a product or service to improve usability. It helps identify potential issues, establish reasons for problems, evaluate severity, and assess issues after resolution. Different forms of testing exist, based on user interaction, location, moderator, and data collected **(Barnum, 2020)**. Remote testing eliminates geographical limitations and increases the likelihood of observing motivations driving task completion. Individual testing focuses on one user's activity, revealing warmth, enthusiasm, and creativity. Lab experiments aim to establish universal laws in mathematical equations or models, while field studies describe empirical phenomena. Both methods provide valuable insights into the product or service's effectiveness. Each form of testing offers advantages, such as observing motivations

driving task completion, focusing on one user at a time, and observing motivations driving task completion.

Lewis and Sauro (2021) developed 40 heuristics to analyze Human-Centered design processes, focusing on usability testing and user experience. They tested these heuristics on two web applications: a web design training tool and a video game production application. The study found that designers go through usability testing more often than design teams, and designers provide more consideration to user experience during evaluation and planning stages. The differences in filling in usage in the design process are based on the number of design team members, suggesting that design teams are less likely to assess usability and user experience during the design process. The article emphasizes the growing interest in user experience and the need to understand how user experience is integrated into existing usability testing practices from a design perspective. Two issues are highlighted: how web applications are usable based on existing heuristics and how user experience is integrated into these practices **(Liao et al.2020)** .

5. Case Studies and Examples

The study examines the integration of user experience (UX) in the Human-Computer Design (HCD) process in four case studies within a multinational company producing data analytics technology. The first case involves data-centric IoT designers struggling to understand users and different contexts. The second case focuses on achieving user-centeredness in context-aware technology through personas and design themes. The third case uses scenario-based design to promote user understanding within technology contexts. The fourth case examines designing for human-in-the-loop AI from a user accessibility perspective. **(Nugraha and Fatwanto2021)**. Case studies show successful integration of user experience with human-centered design in various industries, such as aerospace. This shift towards life-centered technology and organizations emphasizes the need for coordinated requirements and competent socio-technical managers. Human-centered designers and systems architects play a crucial role in this holistic approach, akin to an "orchestra model," emphasizing the importance of a competent socio-technical manager **(Andre Boy, 2020).**

By translating theoretical work into experiential objects, designers can immerse themselves in the theories of experience, ultimately leading to the creation of more experiential final products. This approach highlights the ongoing challenge of designing experiences and the importance of leveraging theoretical and empirical findings to stimulate positive user experiences, emphasizing the collaboration between disciplines such as design, ergonomics, and HCI **(Lallemand et al., 2014).**

5.1. Successful Integration in Industry

The successful integration of user experience (UX) with human-centered design (HCD) in industry is exemplified by the evolution of Human System Integration (HSI) in aerospace over the last 40 years **(Andre Boy, 2020).** The HSI experience, concepts, and methods developed in aerospace have been extended to other industrial and public sectors, such as mobility and medicine. This extension reflects a shift from the traditional hierarchical model to the orchestra model, emphasizing coordinated requirements, socio-technical management, and engagement of stakeholders. The orchestra model, as a framework for human-systems integration, highlights the need for a common frame of reference and the roles of human-centered designers and systems architects in the design and development of new technology.

5.2. Enhancing process by emotions and sensations

Furthermore, embedding Human-Computer Interaction (HCI) research into experience triggers has been shown to enhance the design process by bringing emotions and sensations into the design process **(Lallemand et al., 2014).** These experience triggers serve as a tool for science-based UX design, aiming to create more experiential final products. This integration underscores the importance of collaboration between disciplines in designing interactive products or systems that stimulate positive user experiences. As such, the successful integration of UX with HCD in industry is demonstrated through the application of HSI principles and the incorporation of HCI research into the design process.

6. Future Trends in the Field

To talk about how user experience and human-centered design will be integrated in the future, with a particular emphasis on the paradigm shift towards User Experience 3.0, which makes use of machine learning for UX design and human-AI interaction. It emphasizes how crucial it is for businesses to monitor market shifts, rivals, and emerging technology in order to remain competitive. The necessity of expanding human-centered perspectives to include natural phenomena and environmental concerns is emphasized by the emergence of intelligent assistants and machine learning methodologies for UX research. Another technique to make use of Emerging Technologies is to improve visual computing skills. **Andre Boy, (2020),**.

Emerging technologies are transforming user experience and human-centered design, with machine learning being used in UX research and Human-Centered Design (HCD) being a design approach that prioritizes usability, accessibility, and ergonomics. HCD considers the entire user experience during problem-solving, considering user needs, environment, ergonomics, and aesthetics. Technological trends in computing user inputs, visual computing capabilities, and hardware and software advancements contribute to the

development of interactive systems. New technologies bring new ways of doing things, such as participatory design, explorative design, and value-based design **(Polaine, A., et al. 2013)**.

Small and medium-sized enterprises are increasingly focusing on user experience (UX) in a competitive technology environment. The demand for intuitive and enjoyable interactions between users and devices, including intelligent artifacts and robots, is expected to rise. The complexity and multi-disciplinary nature of UX have opened new challenges for design research, product development, and education. To address this, designers should shift attention from the product to the user, focusing on commonalities and utilizing a finite number of user variables to structure user characteristics **(Yoon et al., 2020)**

Artificial intelligence (AI) is transforming the design of practical Human Computer Interface (HCI) applications. AI enables computers to perform tasks like visual perception, speech recognition, decision-making, and language translation. It uses algorithms, datasets, and deep learning to solve problems. Personalization in digital products and services allows them to present content and functionalities based on users' information, such as demographics, preferences, and context. Recommender systems are a popular paradigm for personalization, used by online vendors to suggest items to customers. HCD is increasingly adopting AI and personalization in online product and service design:

1. AI is being used to collect user data in different disciplines and domains.
2. AI-powered user insight generation has emerged within the scope of big data from both qualitative and quantitative perspectives. This trend aims to automatically derive user insights, such as user needs, motivations, and interactions when engaged in an existing product or service.

The exploration of AI-powered personalization mechanisms in large-scale Human-Centered products and services, such as the web, social media, and TV, has broadened the horizon of potential applications of HCD **(Lallemand et al., 2014)**.

AI can also offer a huge volume of data on users' preferences from different perspectives, such as user behavior, reputation, and trust. However, this trend challenges traditional HCD methods and does not consider user goals and experiences **(Interaction Design Foundation, 2016).** esigning for AI products and services requires addressing unique design challenges and searching for new design processes. Personalized products and services challenge the applicability of traditional user modeling and task analysis.

7. Findings

In conclusion, the integration of user experience (UX) with human-centered design (HCD) offers valuable insights and principles for enhancing the product design process. It has been established that the importance of organizational aspects in integrating UX principles and practices into product design and development, highlighting influencing events, success factors, challenges, resistance to UX integration, and UX integration as an organizational change. The study underscores the dynamic nature of challenges and success factors over time. Additionally, research stresses the iterative nature of human-centered design, emphasizing the generation of ideas to address stakeholder needs, ongoing prototyping, and user feedback throughout the design process to ensure the product's success in the marketplace. The emphasis on a deep understanding of customers and stakeholders through human-centered design offers a powerful framework for creating better products that meet market needs.
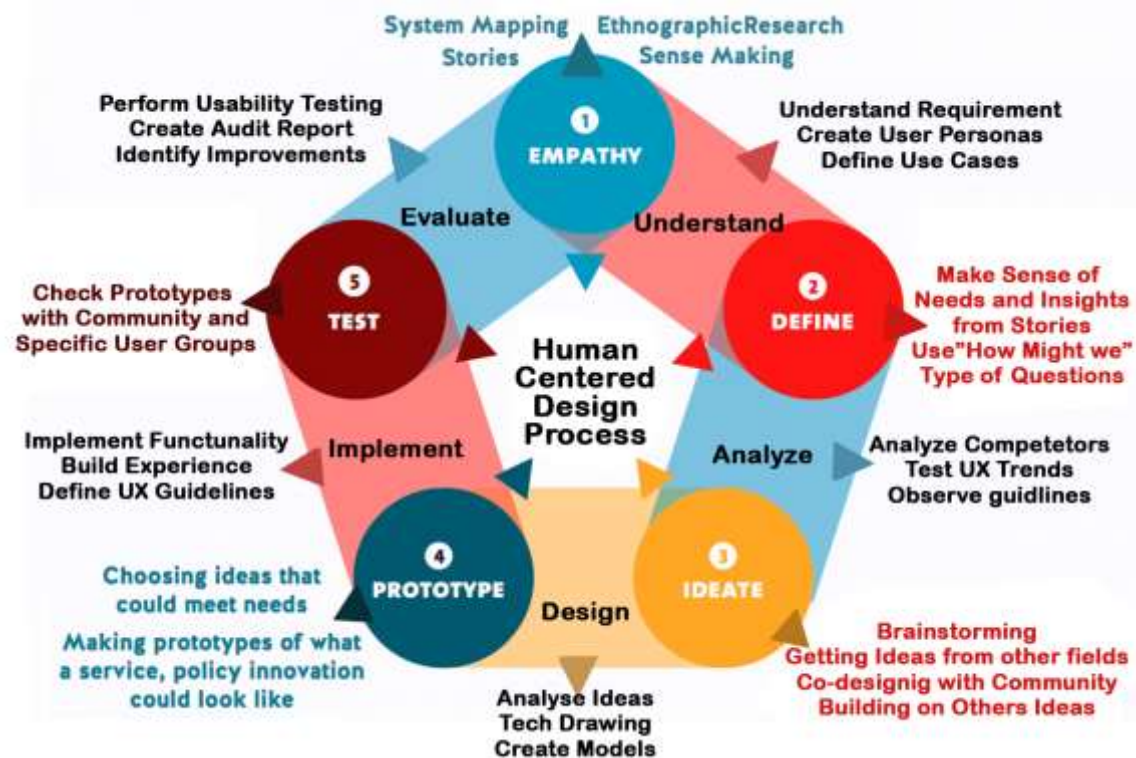
User Experience Design

User Experience is the value that you provide to your user when he is using your product. "User Experience Design (UXD) is the practice of increasing user satisfaction with a product by making it more usable, accessible, and enjoyable to interact with is known as user experience design." Developing a user experience to the level of customer satisfaction is not a single designer or person it is a team's responsibility frmed by a company's vision. Great user experience design not only highlights and promotes your product design, it has become a key part of building and growing customer confidence. As Steve Jobs, once said "Design is not just what it looks like and feels like. Design is how it works." A great product or compelling content without an appealing user experience may affect the ability of an organization to achieve its business goals.

The process of designing or developing a product must always include good user experience design. In order to create a special blend of structure, content, and user experience that will efficiently achieve the necessary goals, designers engage with users. The integrated UX/HCD design serves as evidence for the theory that keeping the user at the center of the design process is crucial to its success. With this method, you can produce designs that are clear, straightforward, adaptable, engaging, and intuitive that will give your users a WOW experience and set you apart from the competition.

The Integrated UXD and HCD

User experience design process is an iterative method that helps you continuously improve and polish your designs. In this design process, designers go through different stages repeatedly while evaluating your designs on each stage. The stages usually are, Research, Understand, Design, Implement, Evaluate . They fit precisely among the five stages of HCD. Each of the UX stages complements and integrates well with one of the stages of the HCD, empathy, define, ideate, prototype, test. Each stage complemented by the following UX stage adds relevant stakeholders in your organization that take part in the process to

make product design highly efficient and usable.

7.1. Impact on Product Success

As user experience (UX) is a term used to define users' experience with anything they use or come in contact with, whether it be products, systems, or services, therefore, in a competitive design environment, companies are competing to create the best user experience and to provide their users with must-have products or services. In other words, user experience encompasses the design and totality of a product, device, or system, including the evaluation of how successful it is in use. Research on consumer products reveals that successful products from a UX perspective have better usability and intuitive experiences, leading to commercial product success. Understanding how to create a good UX is a core skill for designers to succeed. UX is a complex design concept with diverse applications, but it is not yet a design tool or methodology. Companies struggle to consistently create a UX concept, communicate it beyond a small core group, or transfer it to implementation. Current Human-Centered Design models do not fully capture the complexity of designing for UX. There is a constant desire in industries to know more about UX's effectiveness beyond simple examples. Research on UX is wide in scope and often lacking in depth due to the diversity of products designed for UX and the complexity of their design. Industry practitioners vary dramatically in their approach to UX, and good success from a product perspective does not necessarily equate to a good UX design or development process.

7.2. Impact on Product Evaluation

Human-Centered design processes involve user input to define product requirements and build solutions that meet expectations. It involves concept generation, prototyping, product development, and evaluation. Product evaluation is crucial in integrating user experience, considering usability aspects, efficiency, and user input reduction. It is conducted at each design phase after concept, prototypes, and product interpretations to evaluate information ergonomics, technical usability, and overall user assessment. Implicit product evaluation refers to spontaneous and direct evaluation without the involvement of a reflective and analytical system. Product evaluation is a crucial process in product design, focusing on the properties and attributes of a product that influence immediate hedonic and emotional evaluation. This evaluation can be spontaneous, direct, or conscious, involving the verbalization of product attributes. It is essential to identify design shortcomings and errors, which may require modification. Product testing involves collecting user and usability information for real-world use of the design product. Human-centered design concepts help ease user input implementation. New aspects related to emotional product experience have emerged in product evaluation, but these should be integrated with usability aspects to ensure a successful product design. Overall, product evaluation is essential for enhancing the overall user experience and product design.

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