

Facets of Human-centered Design: The Evolution of Designing by, with, and for People

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“[...] We have developed speed, but we have shut ourselves in, machinery that gives us abundance, has left us in want. Our knowledge has made us cynical, our cleverness hard and unkind. We think too much and feel too little. More than machinery, we need humanity. More than cleverness, we need kindness and gentleness. Without these qualities, life will be violent, and all will be lost. [...] You, the people, have the power - the power to create machines. The power to create happiness! You, the people, have the power to make this life free and beautiful, to make this life a wonderful adventure.” - Charlie Chaplin 1940 in The Great Dictator.

Abstract

The book chapter outlines different facets of Human-centered Design, which evolved over half a century. These facets have different foundational influences that lead to Design by, with, and for people. Designing for people, including Ergonomics and Human Factors and Interactions Design, originated from early developments in experimental psychology. Similarly, designing for people with specific needs emerged from developments in medicine and rehabilitation, which resulted in design approaches, such as Universal Design and Inclusive Design. Designing with people, including Participatory Design, developed from communal architecture. Designing by people is grounded in psychology on creativity, resulting in design approaches, such as Creative Engineering and Design Thinking. Early developments in social psychology developed over time into Social Design and Design by Society. These approaches emerged as designers responded to socio-material and socio-economic challenges with new Human-centered Design approaches. This book chapter aims to raise awareness of the contextual evolution of different Human-centered Design approaches and the need to continuously respond creatively to these challenges with new design solutions and adequate design approaches.

Keywords: Human-centered Design, Design approach, History, Evolution

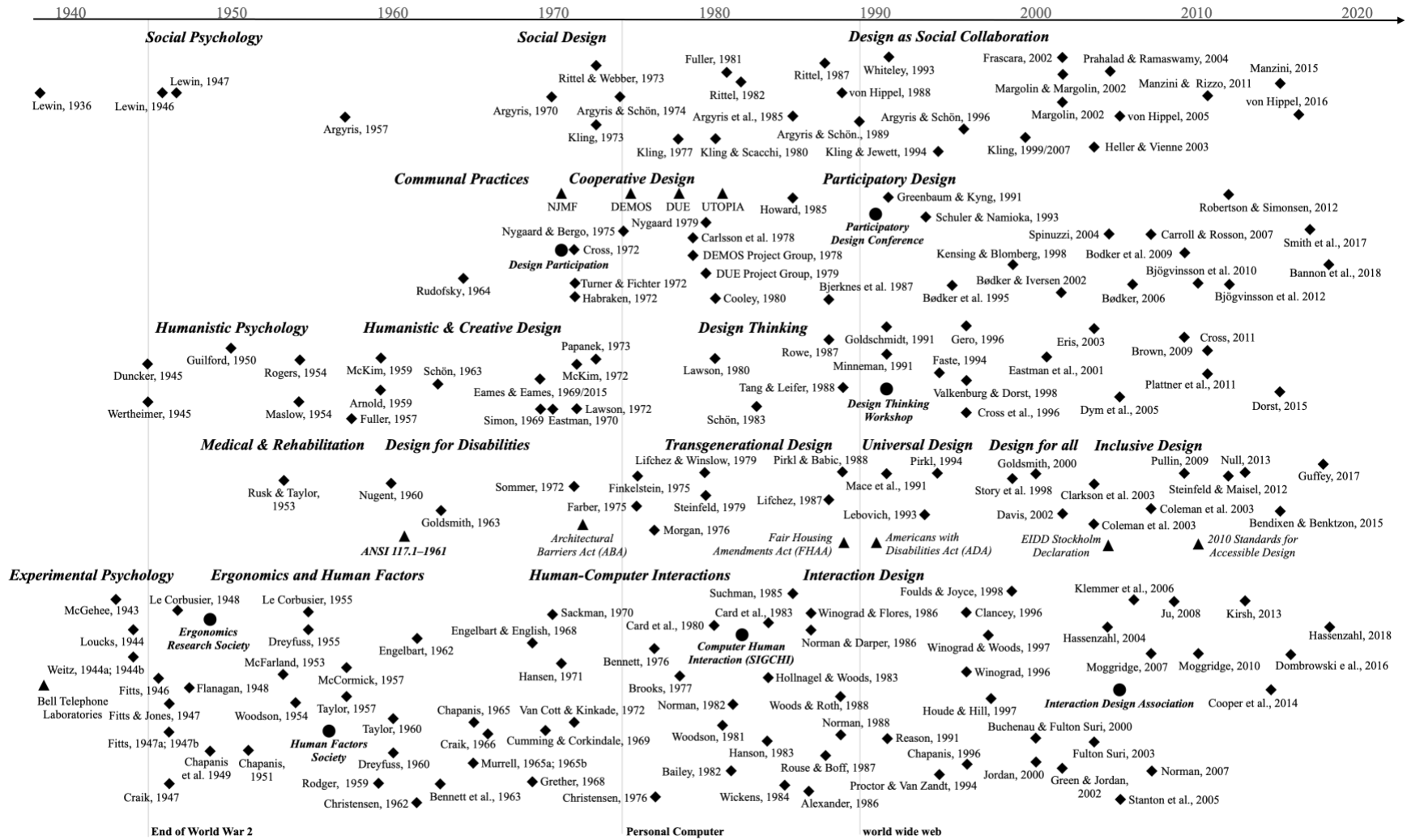
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1 Introduction

Over the last century, Design evolved from form-giving to the design and development of technology, interactions, experiences, and organizations (Archer, 1965; Buchanan, 2015; Fulton Suri, 2003; Moggridge, 2007). These developments emerged as new challenges required new design approaches. For example, Archer (1965, p. 57) expressed: “[...] there has been a world-wide shift in emphasis from the sculptural to the technological. Ways have had to be found to incorporate knowledge of ergonomics, cybernetics, marketing, and management science into design thinking. As with most technology, there has been a trend towards the adoption of a systems approach as distinct from an artifact approach.” A similar shift is the development of *Human-centered Design* that emphasizes people and the living world rather than artifacts and systems. Over the last half-century, various contextual challenges and developments resulted in approaches, such as Ergonomics and Human Factors, Participatory Design, Inclusive Design, Creative Engineering, and Social Design (e.g., Arnold, 1959; Carlsson, Ehn, Erlander, Perby, & Sandberg, 1978; Chapanis, Garner, & Morgan, 1949; Clarkson, Coleman, Keates, & Lebbon, 2013; Rittel, 1987).

Early *Experimental Psychologists* developed approaches to assessing the psychological fitness for operating airplanes (Benary, Kronfeld, Stern, & Selz, 1919; Koonce, 1984). These psychological developments changed from assessing people’s qualifications to designing technology for people, resulting in Ergonomics and Human Factors (Christensen, 1962; Edholm & Murrell, 1973). A similar development for designing for specific needs of people resulted from developments in *Medicine and Rehabilitation* (Rusk & Taylor, 1953). Including non-designers in the design project in *Communal Architecture* resulted from the opportunities provided by insights from various stakeholders, such as urban dwellers and craftspeople (Rudofsky, 1964). *Humanistic Psychology* developments of creativity and human values influenced humanistic and creative design practices (Auernhammer & Roth, 2021; Christensen, 1976; Maslow, 1954, 1956). Similarly, developments in *Social Psychology* resulted in dialectic design approaches to resolve social tensions (Lewin, 1936, 1946, 1947; Rittel, 1987). Figure 1 outlines the evolution of these diverse Human-centered Design approaches.

Figure 1. Several diverse evolutions of Human-centered Design



2 Experimental Psychology in Design

One of the first professional practices that considered people's behavioral capabilities and limitations was aviation psychology (Koonce, 1984). In the 1910s, psychologists examined people's abilities to identify their suitability for operating airplanes (Benary et al., 1919). These developments shifted from assuring people's fitness to use technology to designing technology suitable for people.

2.1 Ergonomics and Human Factors

As early as the 1920s, laboratories focused on studying people's behavior when using designed solutions, and one of the first Human Factor laboratories in the United States was the Bell Telephone Laboratories in 1938 (Christensen, 1976). Researchers and designers utilized experimental psychology to design for people's physiological and psychological abilities in defense-related systems (e.g., Fitts, 1946; Fitts, 1947a, 1947b; Fitts & Jones, 1947; Flanagan, 1947; Loucks, 1944; McFarland, 1946; McGehee, 1943; Weitz, 1944a, 1944b). These experimental psychology approaches were utilized to design artifacts in everyday life (Chapanis, 1951; Chapanis et al., 1949). In 1949, these developments resulted in establishing the *Ergonomics* research society in the United Kingdom and, in 1957, the *Human Factors* society in the United States (Christensen, 1976; Edholm & Murrell, 1973). These societies brought together interdisciplinary researchers, who started developing new methodologies to investigate psychological and physiological aspects of people in the interaction with machines and within work environments (Chapanis, 1965; Craik, 1947, 1966; McCormick, 1957; Murrell, 1965a, 1965b; Rodger, 1959; Taylor, 1957; Taylor & Garvey, 1959; Woodson, 1954). The fundamental doctrine of Ergonomics and Human Factors was to design solutions that allowed people to accomplish a specified task in the way it meets the characteristics of those who use it. Le Corbusier (1948, 1955) and Henry Dreyfuss (1960) developed anthropometry of people to design for people's physiology. Over the decades, Ergonomics and Human Factors advanced as a systematic and interdisciplinary approach to designing for people and society (Bennett, Degan, & Spiegel, 1963; Christensen, 1962; Cumming & Corkindale, 1969; Grether, 1968; Hanson, 1983; Van Cott & Kinkade, 1972). Many interdisciplinary scholars developed practices, tools, methods, models, and theories to design for people's psychological and physiological attributes

(e.g., Alexander, 1986; Bailey, 1982; Chapanis, 1996; Proctor & Van Zandt, 1994; Reason, 1990; Rouse & Boff, 1987; Stanton, Salmon, Walker, & Baber, 2005; Wickens, 1984; Woodson, 1981). These Human-centered Design approaches developed further through new technological advancements, such as computer systems.

2.2 *Human-computer Interactions*

In the 1970s, the design approach and community in *Human-Computing Interaction* emerged under various names, such as human or user engineering and cognitive systems engineering (Bennett, 1976; Brooks, 1977; Card, Moran, & Newell, 1980, 1983; Hansen, 1972; Hollnagel & Woods, 1983; Norman, 1982, 1986). For example, Engelbart (1962), interested in developing means to support people in complex problem solving, developed a design approach to ‘augmenting human intellect,’ resulting in developments of personal computing. He and his team presented means, such as the computer mouse, command input, video conferencing, and word processing, for enabling people’s abilities at the “Mother of all Demos” (Engelbart & English, 1968). The focus changed from analog to interactive digital systems (Hansen, 1972). New psychological approaches were required to design for people’s interactions with digital systems with a focus on storing or retrieving information (Sackman, 1970). In the 1970s, designers at Stanford Research Institute and Xerox PARC introduced psychological research to examine and design human interaction with computers, resulting in the field of Human-Computer Interactions (Card et al., 1983; Cooper, Reimann, Cronin, & Noessel, 2014). In the late 1970s, the ACM community became more concerned about human interaction with computer systems towards people-orientated systems (Borman, 1996). They established in 1982 the Computer-Human Interaction group (ACM SIGCHI), focusing on cognitive and psychological aspects of people when interacting with digital systems (Card et al., 1983; Clancey, 1997; Foulds & Joyce, 1998; Hollnagel & Woods, 1983; Norman, 1982, 1986; Suchman, 1983, 1985; Winograd & Flores, 1986; Woods & Roth, 1988).

2.3 *Interaction Design*

The approaches developed for digital system design found their way back to the industrial design-side integrating objects, media, and software under the term *Interaction Design* (Houde & Hill, 1997; Moggridge, 2007, 2010; Norman, 1988; Winograd, 1996). Bill Moggridge and Bill

Verplank, who worked on the first laptop computer, coined the term Interaction Design in the 1980s. Several decades later, in 2005, the Interaction Design Association was incorporated (Cooper, Reimann, & Cronin, 2007). Designers and scholars focused on non-utilitarian aspects of design, such as people's pleasure, emotions, and experiences (e.g., Buchenau & Fulton Suri, 2000; Fulton Suri, 2003; Green & Jordan, 2002; Hassenzahl, 2004, 2018; Houde & Hill, 1997; Jordan, 2000; Norman, 2007). The focus expanded to designing for embodied cognitive approaches and implicit interactions (Ju, 2008; Kirsh, 2013; Klemmer, Hartmann, & Takayama, 2006).

3 Medicine and Rehabilitation in Design

Another Human-centered Design approach emerged from developments in *Medicine and Rehabilitation* and the concern of people with diverse needs (Rusk & Taylor, 1953).

3.1 Design for People with Disabilities

In the 1950s, institutions, such as the Institute of Physical Medicine and Rehabilitation in New York, started developing a coordinated approach for the dissemination of information concerning self-help devices that might aid disabled persons in the performance of the daily activities of life and work (Rusk & Taylor, 1953). This approach advanced and popularized out of the argument that despite the scientific and medical technological advancements, problems increased for people with disabilities (Nugent, 1961). This movement resulted in the first building standard that addressed disability, the ANSI 117.1–1961, and the first federal law requiring accessibility in government buildings, the Architectural Barriers Act (American National Standards Institute, 1980; Farber, 1975). Designers started evaluating existing design solutions concerning people's specific needs and abilities and utilized these insights to redesign solutions for people with disabilities and towards a barrier-free environment (Goldsmith, 1963; Morgan, 1976; Sommer, 1972; Steinfeld, 1979). The human values and concern for people with different needs resulted in *Designing for People with Disabilities*. In 1978, Larry Leifer created an interdisciplinary design program and practice at Stanford's Rehabilitation Engineering Research and Development Center at the Palo Alto VA.

In 1972, scholars at the University of California, Berkeley, established the Center for Independent Living (Zukas, 1975). This center was a grassroots organization to design environments for people's independence, empowering them to perform their daily routines. The emphasis shifted from disability to independent living, without discrimination of ethnicity, gender, age, and immigrant status (Lifchez, 1987; Lifchez & Winslow, 1979). Scholars argued that such collaborative design between designers and people with disabilities leads to designers' essential attitudes for designing for people (Finkelstein, 1975).

3.2 Transgenerational Design

The increased attention from institutions and the growth of public interest resulted in focusing on diverse groups. Design approaches matching the needs of people with physical and sensory disabilities resulted in *Transgenerational Design* (Pirkl & Babic, 1988). Designers consider the broadest spectrum of individuals, such as young, old, able, and disabled people, without disadvantaging a specific group (Pirkl, 1994).

3.3 Universal Design

Shortly after, the 1990 American with Disabilities Act was established with the emphasis on considering all people in the design process ("Americans with Disabilities Act (ADA) of 1990," ; Lebovich, 1993). This act resulted in the emergence of *Universal Design* (Mace, Hardie, & Place, 1991). The Disabilities Act and Universal Design profoundly contributed to reducing discrimination against people with disabilities in all areas of public life. Designers are obligated to consider the entire life span of people, including temporary disability and future use, when designing spaces and products (Mace et al., 1991; Story, Mueller, & Mace, 1998). Universal Design became the precursor of a new wave of approaches in which products must be universally accommodating and cater conveniently for all people (Goldsmith, 2000). The spectrum of specific needs became the new prism through which postmodernity examines and defines itself (Davis, 2002).

3.4 Design for all

In Ireland, the European Institute for Design and Disability was founded to foster the practice of designing for people of all abilities, which resulted in the *Design for All* (Coleman, Bendixen,

& Tahkokallio, 2003). In 2004, the institute passed “The Stockholm Declaration,” which emphasized the design for human diversity, social inclusion, and equality (Bendixen & Benktzon, 2015).

3.5 *Inclusive Design*

In a similar disposition, the core value proposition of *Inclusive Design* is optimizing the design and development of solutions for individuals with specific needs (Clarkson, Coleman, Keates, & Lebbon, 2003; Coleman, Clarkson, Cassim, & Dong, 2007). Design for all People emphasizes the importance of accommodating and empowering all people. Commercial design and design for disability can inspire each other through a more playful, creative approach (Pullin, 2009). Many designers and design scholars developed practices and methods to create inclusive solutions, systems, and environments (Guffey, 2017; Null, 2013; Steinfeld & Maisel, 2012).

4 Humanistic Psychology in Design

The evolution with the emphasis on the designers’ values, attitudes, abilities, and activities to design for people emerged in the 1950s. Christensen (1976) suggested that the emphasis on human values reflects the perceived movement up Maslow’s (1954) scale towards self-fulfillment. Humanistic psychology on creativity informed designers in their approach (Auernhammer & Roth, 2021).

4.1 *Humanistic and creative Design*

Designers, including John Arnold (1959) and Bob McKim (1959), developed a humanistic and creative design approach. Both collaborated with psychologists, such as Abraham Maslow and J.P. Guilford. Insights from gestalt and creativity psychology, including Wertheimer (1945), Duncker (1945), Maslow (1954, 1962), Guilford (1950, 1959), and Rogers (1954), informed the creative design practices. This approach focuses on creatively satisfying people’s physical, intellectual, and emotional needs (Adams, 1974; Arnold, 1959; Fuller, 1957; McKim, 1959, 1980). These creative practices aimed to creatively design for impact in the real world (Papanek, 1973). Such design works with conviction and enthusiasm in the intersection of designers’ and clients’ interests and profound considerations for society (Eames & Eames, 2015).

4.2 *Design Thinking*

These design practices developed into *Design Thinking* (Buchanan, 1992; Cross, 2011; Lawson, 1972, 1980; Rowe, 1987). From a structuralist perspective, psychological theories of productive thinking resulted in developments in design science and design cognition (Eastman, 1970; Selz, 1922; Simon, 1969, 1981). Similarly, many design scholars build on Wertheimer's (1945) productive thinking to develop insights and approaches in design thinking (Goldschmidt, 1991; Lawson, 1972, 1980; McKim, 1980; Schön, 1963). In 1991, the research workshop in Design Thinking focused on design cognition and computational modeling of the design process, establishing the Design Thinking Research Symposium series (Cross, 2018). Many design scholars studied and developed design thinking practices and approaches (Dorst, 2015; Dym, Agogino, Eris, Frey, & Leifer, 2005; Eastman, Newstetter, & McCracken, 2001; Eris, 2003; Faste, 1994; Gero, 1996; Goldschmidt, 1991; Jung, 2011; Minneman, 1991; Plattner, Meinel, & Leifer, 2011; Schön, 1983; Tang & Leifer, 1988; Valkenburg & Dorst, 1998).

5 Communal Practices in Design

In the 1960s, another movement emerged that focused on designing with people as a source of inspiration and democratization in design (Rudofsky, 1964).

5.1 *Design Participation*

Early ideas of involving people in design resulted from the argument that architects and designers got out of touch with people's needs, and there is an untapped source of inspiration from the practical knowledge of the untutored builders and urban dwellers (Rudofsky, 1964; Turner & Fichter, 1972). Design is emergent from different people in society, and participation in design allows tapping into this source of emerging perspectives and ideas. A similar idea was developed in the 1960s in the Netherlands based on Habraken's (1972) "support and infill" concept, incorporating different stakeholders (Carp, 1986). In 1971, these ideas were brought together in The Design Research Society conference with the primary theme *Design Participation* (Cross, 1972).

5.2 *Cooperative Design*

In Scandinavia, projects such as NJMF, DEMOS, DUE, and UTOPIA emphasized the participation of people in the design activities (Carlsson et al., 1978; Ehn & Kyng, 1987; Group, 1979; Howard, 1989; Nygaard, 1979; Nygaard & Terje Berge, 1975; "The DEMOS Project: A Short Presentation," 1978). These projects, in collaboration with workers unions, emerged as computer mainframe systems impacted the work environment. These projects led to *Cooperative Design*, in which designers collaborated with non-designers to develop computerized tools and systems in the workplace (Sundblad, 2011). These developments gave rise to the term *Human-centered Design* (Cooley, 1980, pp. 76-77). Cooley (1980, p. 77) emphasized that people have to decide to fight for the right to be the architects of the future or allow a tiny minority to reduce them to bee-like responses. This design approach considers the broader socioeconomic and socio-technical context and its impact on people through participation.

5.3 *Participatory Design*

The collaborative design approaches popularized under the term *Participatory Design*. In 1990, the international Participatory Design research community gathered at the first Participatory Design Conference (Bødker, Grønbæk, & Kyng, 1995; Robertson & Simonsen, 2012). Participatory Design democratizes the design practices and embraces the politics involved in a design project (Björgvinsson, Ehn, & Hillgren, 2010; Kensing & Blomberg, 1998). However, there are several challenges in providing the conditions for designing with people, such as considering who is participating, the time frame of continuous participation, power-structures involved in decision-making, compensations for participation, and social dynamic where no social community exists and no consensus seems to be possible (Björgvinsson, Ehn, & Hillgren, 2012; Bødker 1996; Robertson & Simonsen, 2012). Several designers and scholars developed techniques and practices to design with people (e.g., Bjercknes, Ehn, & Kyng, 1987; Greenbaum & Kyng, 1991; Schuler & Namioka, 1993). Participation in information system design became common practice (Bannon, Bardzell, & Bødker, 2018; Bodker, Kensing, & Simonsen, 2009; Carroll & Rosson, 2007; Smith, Bossen, & Kanstrup, 2017).

6 Social Psychology in Design

Research in *Social Psychology* established action research practices to resolve societal tensions (Lewin, 1936, 1946, 1947). This development provided a social practice to resolve social tensions emergent in the interactions of people with the artificial, cultural, and natural environment.

6.1 Social Design

The practices developed in social psychology evolved into action science and organizational learning, emphasizing the conflict between the individual and the designed organizational system (Argyris, 1957, 1970; Argyris, Putnam, & Smith, 1985; Argyris & Schön, 1989, 1992, 1996). (1957). Resolving social tensions requires dialogue and action. In architecture and urban planning, similar ideas emerged, requiring dialectic reasoning to tame wicked problems inherent in a pluralistic society (Rittel, 1987; Rittel & Webber, 1973). In a similar disposition, social informatics focuses on designing information systems and technology to enable social systems, such as organizations (Kling, 1973, 1977; Kling & Scacchi, 1980, 1982; Kling & Star, 1998). Socio-political dynamics influence the design practices and projects, and the design outcome impacts society (Frascara, 2002; Margolin, 2002; Margolin & Margolin, 2002). Designing is a socially constructed and political effort, requiring considering many diverse groups who do not have the economic or political means to generate a formal design demand (Manzini, 2015; Margolin, 2002; Rittel & Webber, 1973; Whiteley, 1997).

6.2 Design as Social Collaboration

From a birds-eye view, design solutions are created collaboratively by, with, and for many people. A design culture in which many people contribute results in open, free, distributed, and shared innovation (von Hippel, 1988, 2005, 2016). In management, the term *Co-design* emerged with the emphasis on co-creating value between customers and organizations. The meaning and creation of value shifted from a product and a firm-centric approach to personalized consumer experiences (Prahalad, 2004; Prahalad & Ramaswamy, 2004). Co-design is a network of informed, empowered, and active people who co-design valuable solutions with organizations, resulting in entire distributed communities of people co-designing solutions. It is also a force for social and political change (Heller & Vienne, 2003). Such *Social Collaboration* of designing is

an ongoing social activity that requires people with attitudes, values, attributes, and abilities within a supportive environment, allowing design for various needs and tensions collaboratively (Auernhammer & Roth, 2021).

7 Conclusion

Different cultural, socio-economical, and other contextual developments in specific periods led to the evolution of diverse Human-centered Design approaches. Experimental psychology informed designers in the practices to design for the physiological and psychological needs of people. This approach developed further into Human-Computer Interactions and Interaction Design. New developments in experimental psychology and new technological advancements, such as the personal computer, resulting in new Human-centered Design approaches. Today, global pandemics and climate changes require designers to respond with new design approaches. For example, collaboration in design is impacted by remote settings and the use of technology, influencing the abilities of design teams to respond to these challenges. Designers need to develop new design approaches to tackle the many challenges, such as inequality in society and ecological sustainability, creatively. This book chapter illustrated the interrelations between emergent situations and developments of design approaches and highlights the importance of developing new design approaches to tackle the many societal, economic, and ecological challenges of today and tomorrow.

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