



DIGITAL FUTURES IN HUMAN-COMPUTER INTERACTION

Design Thinking for Digital Transformation

Edited by **Zhiyong Fu, Anna Barbara
and Peter Scupelli**



CRC Press
Taylor & Francis Group

Digital Futures in Human-Computer Interaction

The application of futures thinking in Human-Computer Interaction (HCI) has become increasingly important in recent years. Integrating speculative thinking with future design approaches has allowed HCI researchers to explore the potential impacts of technology on digital society. However, the implementation and application of futures thinking in HCI research is an emerging area. *Digital Futures in Human-Computer Interaction: Design Thinking for Digital Transformation* fills this gap by systematically analyzing HCI's innovation trends in the digital era.

This book explores the dialogue between digital transformation and futures thinking for alternative visions of HCI research. The book highlights significant trends and advancements in futures thinking related to HCI. Case studies illustrate the role of futures thinking, offering readers a broad overview of the subject while detailing the competencies and practices that can lead to successful futures design.

This engaging and informative reference will appeal to students, academics, and researchers interested in various design aspects related to HCI. These aspects include service design, sustainable design, product design, space design, visual communication, design education, futures studies, and social innovation.



Taylor & Francis

Taylor & Francis Group

<http://taylorandfrancis.com>

Digital Futures in Human-Computer Interaction

Design Thinking for Digital Transformation

Edited by
Zhiyong Fu, Anna Barbara, and
Peter Scupelli



CRC Press

Taylor & Francis Group

Boca Raton London New York

CRC Press is an imprint of the
Taylor & Francis Group, an **informa** business

Designed cover image: image credited to PST Vector [ShutterShock ID: 2315568623]

First edition published 2025

by CRC Press

2385 NW Executive Center Drive, Suite 320, Boca Raton FL 33431

and by CRC Press

4 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

CRC Press is an imprint of Taylor & Francis Group, LLC

© 2025 selection and editorial matter, Zhiyong Fu, Anna Barbara and Peter Scupelli; individual chapters, the contributors

Reasonable efforts have been made to publish reliable data and information, but the author and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The authors and publishers have attempted to trace the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission to publish in this form has not been obtained. If any copyright material has not been acknowledged please write and let us know so we may rectify in any future reprint.

The Open Access version of this book, available at www.taylorfrancis.com, has been made available under a Creative Commons [Attribution-Non Commercial-No Derivatives (CC-BY-NC-ND)] 4.0 license.

Any third party material in this book is not included in the OA Creative Commons license, unless indicated otherwise in a credit line to the material. Please direct any permissions enquiries to the original rightsholder

Trademark notice: Product or corporate names may be trademarks or registered trademarks and are used only for identification and explanation without intent to infringe.

Library of Congress Cataloging-in-Publication Data

[Insert LoC Data here when available]

ISBN: 978-1-032-60760-3 (hbk)

ISBN: 978-1-032-69358-3 (pbk)

ISBN: 978-1-032-69360-6 (ebk)

DOI: 10.1201/9781032693606

Typeset in Times

by KnowledgeWorks Global Ltd.

Contents

Foreword	vii
Authors.....	ix
Contributors	xi

SECTION I Future Trends in HCI

Chapter 1	Digital Transformation and Future HCI.....	3
	<i>Zhiyong Fu and Jiawei Li</i>	
Chapter 2	Vision of Digital Futures: Novel Interactions for Futures Scenarios: The D\Tank Case Studies	30
	<i>Anna Barbara and Venere Ferraro</i>	

SECTION II Futures Literacy in HCI

Chapter 3	Futures Thinking and Futures Literacy	43
	<i>Shams Hamid</i>	
Chapter 4	Future of Entertainment Technology Design.....	70
	<i>Nandhini Giri and Erik Stolterman</i>	
Chapter 5	Long-Term Thinking in Digital Product-Service System Design.....	82
	<i>Yanru Lyu and Bowen Zhang</i>	

SECTION III Competence and Practice

Chapter 6	Design Futures Methodologies.....	95
	<i>Qing Xia</i>	
Chapter 7	AI Empathy in the Metaverses	107
	<i>Chiju Chao</i>	

	Chapter 8	Speculative Artifacts in HCI.....	123
		<i>Lin Zhu</i>	
	Chapter 9	Interactive Narrative and Scenario Building.....	139
		<i>Jiawei Li and Yin Li</i>	
	Chapter 10	Digital Curation and Evaluation: Affective Evaluation Strategies under the Perspective of Human-AI Interaction.....	149
		<i>Jiayue Wang</i>	

SECTION IV *Future Influence*

Chapter 11	Design Futures Education in HCI.....	169
	<i>Peter Scupelli</i>	
Chapter 12	Ecological Thinking in HCI.....	183
	<i>Xiaojuan Ma</i>	
Chapter 13	Social HCI.....	209
	<i>Zhicong Lu</i>	
Chapter 14	Digital Wellbeing	224
	<i>Yasuyuki Hayama and Harshit Desai</i>	
Index		243

Foreword

In the 1980s, a group of futurists (James Dator, Lestor Cingcade, Wayne Yasutomi, and myself) explored the futures of robotics/artificial intelligence (AI). As we were working with the Hawaii Judiciary (Cingcade himself was the Administrative Director), we imagined a future where lawyers and judges would first increasingly use AI for minor judicial decision-making (administrative tasks such as parking fines) and eventually adopt it for more complex judicial decision-making. We then asked, what would be the conditions where AI/robotics would become so ubiquitous that robots would have legal rights. Certainly, most judicial leaders could not see the relevance of our speculations. However, they did understand that institutions needed futures literacy to stay relevant to the changing needs of citizens. Thinking of the unthinkable – robotic rights – distances us from the present, allowing us to see the present as not only remarkable, but designable. It spurs creativity and ensures that the outlier is embraced.

Futures literacy is not only about seeing the new possibilities in emerging innovation but also using the future to redesign the present. To think, feel, and act differently. To do this, futurists first challenge the used future – current institutional practices that no longer work but continue because we have always done it that way. Once this used future is challenged, we then anticipate and create alternative futures.

This novel book will help in this task. It explores how the future of human-computer interaction is likely to change and what policies – frameworks, ethical guidelines, narratives – are needed to guide this change. Evolution is moving from random to co-designed: humans with nature with technologies. In this process, merely living the programmed futures of others will not suffice. We need to innovate and co-design with actors and networks, human and non-human to create a transformative future. This book can help us in this process.

Sohail Inayatullah

UNESCO Chair in Futures Studies

Authors

Fu Zhiyong is a tenured associate professor and doctoral supervisor at the Department of Information Art and Design, Academy of Arts and Design, Tsinghua University. He serves as the Director of the Art and Technology Innovation Base at Tsinghua University, Deputy Director of the China Innovation and Entrepreneurship Education Research Center, Secretary-General of the Information and Interaction Design Committee of the China Industrial Design Association (IIDC) President of the International Chinese Association of Human-computer Interaction (ICACHI). He is Co-founder of the Global Design Futures Network (GDFN), the member of the Second Global Important Agricultural Heritage Systems Expert Committee of the Ministry of Agriculture and Rural Affairs and a Director of the China-Europe Alliance for Arts and Humanities Education.

His teaching responsibilities include undergraduate and graduate courses in interaction design, service design, design thinking, and innovation and entrepreneurship. His research interests encompass intelligent product and service design, smart cities and design futures. He is the leader for multiple national and international research projects and published papers in key international conferences/journal in HCI and design. Fu was a recipient of the Ministry of Education's New Century Excellent Talents Support Program in 2006 and was a visiting scholar at the University of Tsukuba, Japan, in 1998, and Carnegie Mellon University, USA, in 2008. He played a key role in planning and organizing the China-U.S. Young Maker Competition under the Ministry of Education from 2014 to 2023 and he currently co-leads GDFN, a future-oriented global creative community that is preparing future-thinking innovators to tackle sustainability challenges with the design futures methodology.

Anna Barbara is Associate Professor in Architecture and Interior Design at Design Department, Politecnico di Milano; President of POLI.design; Member of the Board of Directors of the World Design Organisation; Co-founder of the Global Design Futures Network; Scientific coordinator (with Venere Ferraro) of the DVTank, Design Department, Politecnico di Milano; Italian Design Ambassador (2020, 2021, Kuwait; 2022, Sudan). Graduated in Architecture at Politecnico di Milano, she is teaching as visiting at Tsinghua University, Academy of Art and Design, Beijing (2019, 2024, China); at Kookmin University, School of Architecture, Interior Design and at Master Brain 21 (1999, South Korea). She was Canon Foundation Fellow at Hosei University (2000, Japan), Special Mention of Borromini Prize (2001), Selected by Archmarathon (2018), Selected ADI-Index 2019, 2023, Special Mention Fedrigoni Top Award – Large Format Communication, 2023; Eccellenze della Lombardia 2019, 2023; Exhibited t Biennale di Venezia (2010, 2022), Triennale di Milano (2003, 2016). Author of *Storie di Architettura attraverso i sensi* (2000, 2020), *Invisible Architectures. Experiencing places through the senses of smell* with Anthony Perliss (2006, 2023); *Sensi, tempo e architettura* (2012), *Sensefulness, new paradigms for Spatial Design* (2019), *Extended Store. How digitalization affects the retail space*

design with Yuemei Ma (2021). She designed international sensorial projects for companies in Japan, China, USA, Europe, UAE, and UK as founder of Senselab.

Peter Scupelli is Associate Professor of Design, and Director of the Learning Environments Lab. He was Visiting Professor at Politecnico di Milano (2022-2024) and the Nierenberg Professor at Carnegie Mellon University (2019-2022). Peter's current research focus is on learning environments and sustainable design futures. Peter is co-founder of the Global Design Futures Network (GDFN). Peter was an executive co-chair for the International Conference for Design Futures (ICDF) from 2020 to 2023. He holds a Ph.D. in Human-Computer Interaction, M.S. in HCI, M.Des. in Interaction Design, and an undergraduate Architecture degree. Peter has published over fifty-seven peer-reviewed papers at international conferences and journals. His research has been funded by the National Science Foundation and Institutes of Educational Science.

Peter teaches undergraduate, masters, and doctoral students. His teaching and research focus on three fundamental topics necessary to bring aspects of Transition Design to design practice: (a) aligning short-term design action and long-term vision goals, (b) embedding values into design processes, and (c) creating sustainable futures-oriented design methods. In *Dexign Futures*, students learn to combine Design Thinking with Futures Thinking to align short- and long-term time horizons. In *Design for Zero-Carbon Lifestyles*, he teaches how to live a zero-carbon lifestyle and create zero-carbon organizations. In *Design Your Futures*, students learn to design their life.

His work with Gruppo A12 was exhibited in the Architecture Biennale of Venice; PS1-MOMA, New York; the São Paulo Contemporary Art Biennial; the ZKM Museum of Karlsruhe, Germany, and many other places.

Contributors

Anna Barbara

Department of Design, Politecnico
di Milano
Milano, Italy

Chiju Chao

Academy of Art and Design, Tsinghua
University
Beijing, China

Harshit Desai

MIT Institute of Design, MIT ADT
University
Pune, India

Venere Ferraro

Department of Design, Politecnico
di Milano
Milano, Italy

Zhiyong Fu

Academy of Arts & Design, Tsinghua
University
Beijing, China

Nandhini Giri

Department of Computer Graphics
Technology, Purdue University
West Lafayette, Indiana

Shams Hamid

 AGINE - Institute of Futures Studies
Karachi, Sindh, Pakistan

Yasuyuki Hayama

Department of Strategic Design, Faculty
of Design, Kyushu University
Fukuoka, Japan

Jiawei Li

Academy of Arts & Design, Tsinghua
University
Beijing, China

Yin Li

Academy of Arts & Design, Tsinghua
University
Beijing, China

Zhicong Lu

City University of Hong Kong
Hong Kong SAR, China

Yanru Lyu

Department of Digital Media Arts,
Beijing Technology and Business
University
Beijing, China

Xiaojuan Ma

Department of Computer Science
and Engineering, the Hong
Kong University of Science and
Technology
Kowloon, Hong Kong

Peter Scupelli

School of Design, Carnegie Mellon
University
Pittsburgh, Pennsylvania

Erik Stolterman

School of Informatics, Computing,
and Engineering, Indiana
University
Bloomington, Indiana

Jiayue Wang

Academy of Arts & Design, Tsinghua
University
Beijing, China

Qing Xia

School of Humanities (Dalian), Luxun
Academy of Fine Arts
Dalian, Liaoning, China

Bowen Zhang

Department of Digital Media Arts,
Beijing Technology and Business
University
Beijing, China

Lin Zhu

Academy of Arts & Design, Tsinghua
University
Beijing, China

Section I

Future Trends in HCI

2 Vision of Digital Futures

Novel Interactions for Futures Scenarios: The D\Tank Case Studies

Anna Barbara and Venere Ferraro

BACKGROUND

Futures studies cannot fail to consider the cardinal interaction between humans and computers, but figuring out what the forms, timing, modes, and themes on which these interactions may occur is not yet fully defined (Appadurai, 2014).

The advent of Artificial Intelligence (AI) is now within reach. Speculation exists in every direction: probable, possible futures, but the role of some institutions is to work on desirable scenarios, alternative presents, and innovation trajectories to achieve them.

The tools provided by Futures Studies aim to develop the ability through scenario to see and prepare for the future, to interpret significant changes, whether technological, political, or social and anthropological (Poli, 2017).

In the conventional sense, scenarios are narratives that depict various potential developments in the external environment. Each scenario delves into the possibility of different conditions fostering and adopting innovation. Scenarios can be categorized as either exploratory or normative. Exploratory scenarios begin with past and present trends, envisioning a plausible future, while anticipatory or normative scenarios are constructed based on diverse visions of the future, which can be either desired or, conversely, feared (Mietzner & Reger, 2005).

However, the relationship with the future that is sought to be established becomes more strategic than the future itself. It is no longer understood as a forecast, but as that long-term thinking that helps project design thinking into the future to consider how the context, in its broadest sense, may evolve (Corà, Fazio, & Collura, 2023).

Designing scenarios through Futures Studies methodologies requires disciplinary strengthening and broadening, both in terms of the methods of Design Thinking and the point of observation, which remains extremely human-centered (Inayatullah, Bussey, & Milojevic, 2006).

In this regard, the D\Tank team conducted two simultaneous research, namely “Design for Digital Care” and “Digital for Museums,” with the goal of developing future design scenarios that integrate technologies and prioritize a human-centered approach.

D\Tank is a think tank created by the Department of Design at Politecnico di Milano and aim to promote design as a tool to transform advanced research into

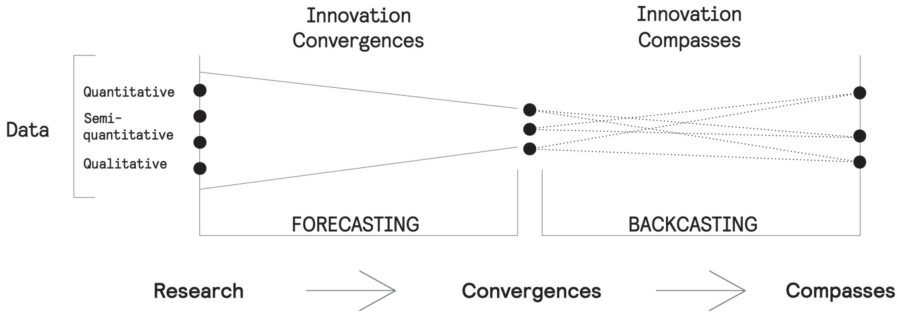


FIGURE 2.1 D\Tank approach and methodology.

innovation convergences for businesses and institutions. D\Tank uses a multiscale and multifocal approach to identify innovation trajectories through design practices and tools as a strategic lever to support the orientation in today’s complexity.

Instead of focusing on “how the future will be like” D\Tank objective is to shape future technologies and re-design them to create “alternative present” (Auger, 2013). To envision such alternative presents D\Tank capitalizing quantitative, semi-quantitative, and qualitative methods likewise, literature review, patents analysis, Delphi method, horizon scanning and other methodologies and speculative practices (see Figure 2.1).

THE CASE STUDIES OF DIGITAL CARE AND DIGITAL FOR MUSEUM

The parallel research mentioned in the previous section engaged a total of 14 and 18 participants, including PhD students, research fellows, researchers, associates, and full professors. Several activities were undertaken to conceptualize these scenarios. Initially, a thorough examination of literature and patents was conducted to identify key challenges and themes in both digital care and digital museum domains. As a result, three primary clusters emerged within the digital care realm: Distributed Care, Self-Care, and Health Booster Technologies.

Distributed Care

Distributed Care involves leveraging digital technologies to optimize care delivery, creating a network that includes the community, caregivers, patients, and infrastructure. This concept introduces the digital caregiver as an intermediary, fostering humanized relationships and improving access to care. Central themes include community-centered care, physical-virtual communities, and the importance of digital literacy (Kringos, Boerma, Hutchinson, & Saltman, 2015; Milligan, 2016; Kor, Yanovsky, Pattinson, & Kharchenko, 2016; Johansson et al., 2021; Hallqvist, 2022).

On the other hand, Self-Care encompasses holistic processes related to hygiene, nutrition, lifestyle, and socioeconomic factors. Health applications, incorporating AI-based recommendation systems and integrated with wearable devices, play a pivotal role in disease prevention and the adoption of healthy lifestyles. Self-Care

extends beyond disease prevention to include mental health and virtuous behaviors (Salim & Lim, 2019; Han, Ko, Jang, & Hwang, 2021).

Health Booster Technologies, particularly Mobile Health (mHealth) and the Internet of Things (IoT), empower individuals to monitor diseases, engage with healthcare providers, and adopt preventive behaviors, transforming healthcare to be more accessible and secure (Paglialonga et al., 2019).

Digital for Museum

Similarly, three main clusters were identified for the digital museum: Extended Rituals Experiences, Inclusive Engagement, and Museum-system management.

Extended Ritual Experiences represent a new paradigm in the museum, enhancing the integration of emerging technologies with exhibited heritage to increase visitor engagement through educational, emotional, and multisensory experiences (Lee, Jung, tom Dieck, & Chung, 2020; Batchelor, Schnabel, & Dudding, 2021).

Inclusive Engagement aims to make museum experiences accessible to a diverse range of visitors by incorporating certain practices and utilizing emerging technologies to enhance cultural accessibility. Participatory design approaches facilitate dialogue with communities and promote greater inclusivity (Cesário, Acedo, Nunes, & Nisi, 2022).

Regarding Museum-system management, the introduction of new technologies presents opportunities for utilization but also poses challenges related to intellectual property, regulation, and the digital transformation of organizational and relational skills within the museum structure (Taormina & Baraldi, 2022).

In conclusion, both digital care and digital museums are multifaceted and strategic topics intersecting advanced research, technological innovation, and a person-centered approach.

Design plays a crucial role in understanding users' needs, aspirations, and motivations.

Afterward, extensive user analysis was conducted in relation to identified macro-areas in both the Digital Care domain and Digital for Museums.

Queries through Google Analytics provided a lens for the analysis, and the identified topics were validated through purposeful focus groups with decision-makers in the care and museum fields.

The trajectories derived from literature review and patents analysis received strong approval and support from both users and experts.

THE NEAR FUTURE INTO DIGITAL CARE AND DIGITAL FOR MUSEUMS DOMAINS

With these initial findings, the authors applied a typical approach, including back-casting and forecasting, to outline future design scenarios. Indeed, to produce systemic visions capable of creating convergences of innovation, DVTank employs a multidisciplinary approach to scenario design.

It starts from the consideration that in the interaction between human and digital technologies, one cannot in fact think that the issue can be resolved solely on the technological level, but social spillovers, cultural matrices, political strategies, etc. must be considered. Through a multidisciplinary approach, the emphasis on

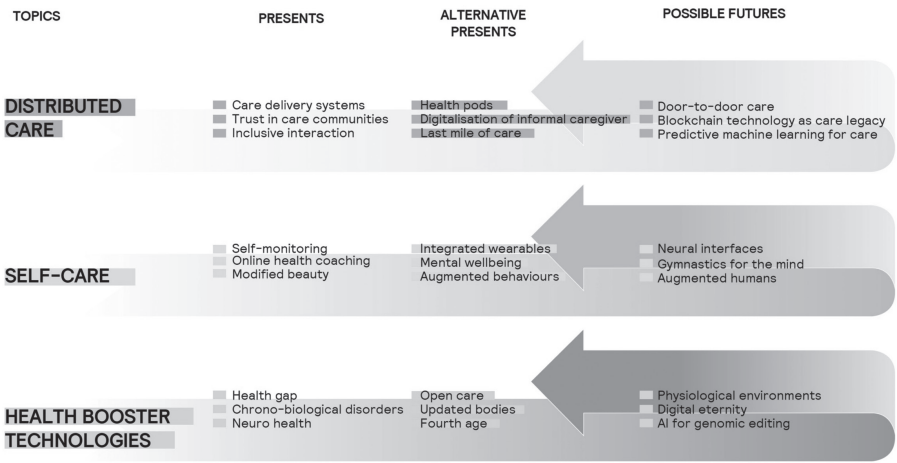


FIGURE 2.2 Digital care: possible futures and alternative presents.

predictions can thus be diminished in favor of greater multiculturalism and plurality (Sardar, 1999). By taking on the above-mentioned approach, the DVTank, started from the present and envisioned possible futures and alternative presents both for Digital Care and Digital for Museum (see Figures 2.2 and 2.3).

The alternative scenarios related to Digital Care have been condensed into three categories: Last Mile for Healthcare, Digital Impatience, and Affordable Care.

In the first scenario, three main trajectories are emphasized: distributed care, healthcare delivery, and home care; they will enable several innovations. In the near future, digitization will facilitate the extension of care to cover the last mile,

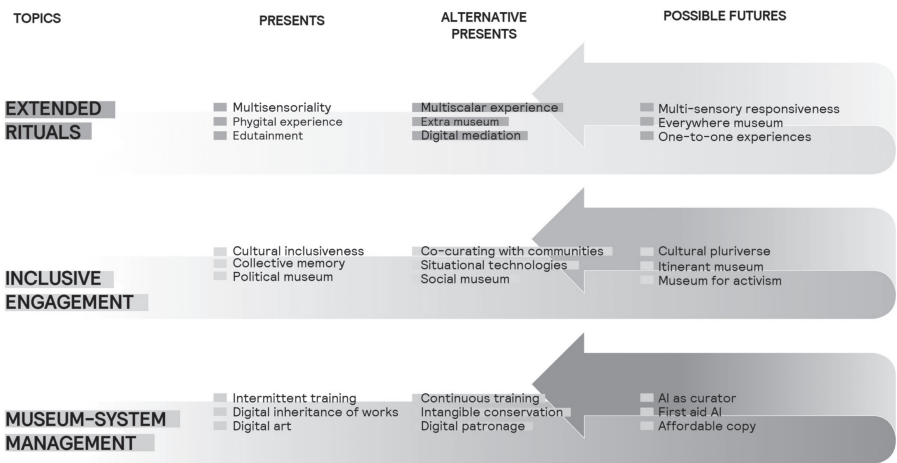


FIGURE 2.3 Digital for museum: possible futures and alternative presents.

reaching decentralized patients by providing care at home. Logistics, transportation, and sorting services will occur on dedicated infrastructures and fast means (including drones) to ensure immediate and widespread delivery. The healthcare network will establish distributed care nodes in the territory to reduce congestion in hospitals. The home will transform into a domestic therapeutic terminal, equipped with technologies to monitor, and connect the patient to the healthcare service network. Rooms will feature integrated sensors, transforming them into physiological environments capable of self-monitoring and managing therapies. However, digitization also necessitates capacity-building activities. Communities and informal caregivers will undergo training to ensure quality and effective communication with doctors, healthcare professionals, digital platforms, and patients.

The Impatient Scenario focuses on Tracking Technology, introducing the concept of the digital waiting room and digital coaching. Digitization enables patients to manage and book services in real-time, creating a digital waiting room that replaces the physical one, thereby changing waiting times, reducing anxiety, and minimizing delays. Apps, chatbots, and blockchain systems will manage appointments, organize care, and facilitate data sharing. Wearable devices for self-monitoring will connect the patient's body to diagnostic terminals through IoT and sensors. Access to real-time health information and the use of machine learning techniques will alter people's awareness and lead to augmented behaviors. Digital technologies will continue to support mental health, bridging physical and temporal distances between doctors and patients through real-time engagement via digital coaching, e-mental health technologies, and digital mental fitness services.

Affordable Care can be summarized in three key points: informal caregivers, digital literacy, and care pit stops. There is still a noticeable gap in access to healthcare delivery between people in different countries. Global health organizations propose addressing this issue through the democratization of healthcare services and equity in care. Creating interfaces using simplified languages and basic technologies will ensure inclusive interaction and literacy for everyone, including doctors, patients, healthcare staff, and caregivers. Overcoming the digital divide will guarantee accessibility and equitable service provision to every territory. This scenario envisions the creation of 24/7 care services offered by internet networks, enabling live and asynchronous communication between patients and doctors, making the relationship more flexible and detached from rigid schedules. The proliferation of hybrid places, facilitated by IoT, includes care capsules for well-being, equipped for quick diagnoses and small-scale treatments, distributed in offices, shopping centers, intermodal transportation hubs, and museums.

The alternative scenarios in Digital Care are represented by the following: Infinite Museum, À la carte Museum, and Next Museum.

The Infinite Museum scenario envisions a multiscale experience and digital mediation. In this scenario, the museum surpasses its traditional boundaries, with artworks dematerializing and collections being exhibited and narrated through new media supports. Extended Reality technologies will engage all senses, leading visitors toward more immersive and memorable experiences. The museum will become infinite, extending beyond its physical walls, and expanding into the network. Technologies such as AI will play a crucial role in delivering content in a versatile

and engaging manner. This approach aims to make cultural heritage more accessible to diverse audiences across different locations and times. Edutainment will facilitate visitor interaction with artworks, ensuring an active and engaging visit. Data analysis, facilitated by machine learning systems, will personalize each visitor's experience by suggesting paths, selecting content, and enhancing the overall experience before and after the museum visit.

The À la carte Museum encompasses themes such as co-curating community, situational technologies, and the social museum. In this perspective, the museum will increasingly integrate with territories and communities. Curation will be a collaborative effort between experts and the community, with activities and programs forming a shared and inclusive project aimed at facilitating intercultural narratives and dialogues. Digital platforms will provide additional opportunities for relationships, interactions, and comparisons. Equity, accessibility, and inclusion will serve as crucial indicators, ensuring the engagement of visitors with physical and cognitive fragilities or belonging to cultural minorities. Extended Reality technologies will enable visitors to immerse themselves realistically in situational experiences, thereby reinforcing the connection with the place itself.

The museum will function as a cultural and democratic agora open to the visitor community. Both physical and digital spaces will be available to welcome proposals, debates, and experiments on social, political, and environmental themes, aligning with the nature of the place.

Last, the Next Museum envisions a future characterized by continuous training processes and immaterial conservation. Digitization is set to revolutionize museum management from within. The introduction of new professional skills will be achieved through ongoing and targeted staff training, alongside the recruitment of experts in emerging sectors. Digital literacy will become fundamental in proposing innovative museum forms and alternative modes of exhibition and interaction. Museum collections and archives will undergo digitization or be replicated through digital twins to ensure enhanced protection of material heritage. Conservation efforts will extend to both digitized and native digital artworks, necessitating the use of advanced technologies and nanomaterials to withstand the test of time and wear. Immovable heritage will also require conservation and active use, demanding an extension of the museum's and its experts' skills.

DISCUSSION

Extremely interesting questions emerged from D\tank's scenario building work on computer-human interaction, both on the scenarios themselves and their temporality, and on the method of constructing them (Amara, 1981).

The first issue concerns the timing of scenario projection. The issues decided by digital require scenarios of near futures, not extensions to 10–20 years as was the case in the past. Digital technologies accelerate changes, but do not necessarily accompany transformations that often have other timescales and speeds.

In human-computer interaction, it becomes clear that one issue concerns precisely the reaction time, involvement, assimilation that humans have with respect to the plethora of innovations and technologies available.

The timing of the projections that D\Tank has considered therefore is a compromise between the urgency of responses from digital technologies and on the other hand the timing of effective assimilation by people and companies.

Downstream of scholarly research on the issues of digital for curation and for museums, capable of having foundations rooted in the scientific disciplines of design the D\Tank has therefore worked methodologically through exercises of speculation on long timescales, and then back-casting with the construction of alternative presents capable of deciding by actions closer to the present what the range of choices might be for one or more of those desirable scenarios to come true (Miller, 2006).

Directly related to this issue is the consideration that at present the available digital technology is in fact hardly ever fully assimilated by potential users. The issue of the need for user literacy that makes the technologies that already exist accessible, understandable, and usable turns out to be an indispensable condition for a relationship with digital technologies to be possible. Indeed, in both research it was found that in the face of technological consistency there is not an equally well-established technological literacy on the part of museum and healthcare workers, visitors, or elderly patients.

In addition to the issue of the knowledge, skills and generation divide, there is also the issue of a still uneven and uneven transition. There are regions of the world and territorial folds, where the absence of an efficient network makes any proposal for innovation inadequate. While there is a concentration of services in some regions of the world, there are others where the infrastructure is either not present, inadequate, or outdated, defining a divide that is sometimes even more dramatic than the generational divide. Digital democratization is not fully accompanied by infrastructure equity making interaction problematic, dispersed, and ineffective (Sardar, 1999).

In this context, interactions need to be seen within a systemic, nonpoint framework that can ensure a homogeneous distribution from the source to the user, including the possibility of relocating services, extending them as far as they have ever been able to go, disseminating performance, and reaching the last mile to the end user without too many intermediaries, wherever he or she may be.

Devices and digital media have changed our relationship with physical space and people. They have changed the forms of time by favoring multi-temporality, simultaneity, etc., but above all they have manipulated the distances between things and people, redefining the organization of time in spaces, relationship, and processes (Floridi, 2015).

Digital changes the role of bodies and senses, which in proportion to the use of technologies, are challenged to compensate for immersive experiences, accessibility in augmented environments, and inclusiveness of frail users. Smart technologies reshape spaces, behaviors, and infrastructures according to needs, desires, and environmental conditions, and personalize the experience (Carpo, 2017).

Indeed, in both research studies it was found that the potential offered in personalization and customization of services is still partly to be explored. Footprint technologies, which require leaving a trace, are increasingly less invasive. They are portable objects used to shop, to navigate, to interface with urban environments, they are wearable computers that we carry with us without discomfort rather with awareness and desire for self-monitoring (Ling & Campbell, 2008).

Through the interaction between humans and computers, the possibility of self-tracking emerged for the first time, which means collecting data about oneself, analyzing it, and diagnosing it. This possibility is a strategic factor both on the level of awareness, on the level of health, and on the level of customization of services and experiences. Real-time monitoring is one of the most interesting frontiers within this interaction that is so close and so intimate between humans and computers (Light, 2006).

The revolution introduced by smart technologies has introduced new temporalities in the interaction between people and services through new forms of mediation, between humans, objects, and spaces, which these digital devices play out in acceleration, compression, dilation and simultaneity between needs and performance. Indeed, the digital can accommodate ever-changing functional, experiential, and emotional needs (Mohamed Hassanein, 2017).

CONCLUSION

This chapter emphasizes the role of Futures Studies in understanding the interaction between humans and computers. While the forms and dynamics of these interactions are not fully defined, the study aimed to work on desirable scenarios, alternative presents, and innovation trajectories related to the advent of disruptive technologies.

To this end, DVTank, conducted research projects on “Design for Digital Care” and “Digital for Museums” employing a multidisciplinary and human-centered approach, aiming to shape future technologies into “alternative presents.”

The research involved case studies in Digital Care and Digital for Museums, identifying clusters such as Distributed Care, Self-Care, Health Booster Technologies, Extended Ritual Experiences, Inclusive Engagement, and Museum-system Management.

Digital technologies have transformed relationships, spaces, and behaviors. They have manipulated distances, redefined the organization of time, and challenged bodies and senses. The generated scenario emphasizes the role of smart technologies in personalization, customization, and self-tracking. The introduction of smart technologies has introduced new temporalities in the interaction between people and services, accommodating ever-changing needs and creating new forms of mediation.

Through the two case studies authors wanted to highlight the strategic and multidisciplinary nature of Futures Studies, the innovative approaches of DVTank, and the transformative impact of digital technologies on various domains, including health-care and museums. Challenges related to timing, user literacy, and infrastructure disparities are acknowledged, emphasizing the need for a comprehensive and inclusive approach to shape the future.

ACKNOWLEDGMENT

Authors would like to express gratitude to the team of researchers who participated in both the research projects Digital Care and Digital for Museums by DVTank.

REFERENCES

- Amara, R. (1981). The futures field: Searching for dimensions and boundaries. *The Futurist*, 15, 1.
- Appadurai, A. (2014). Il futuro come fatto culturale: saggi sulla condizione globale. Raffaello Cortina. (The Future as Cultural Fact. Essays on the Global Condition, Cortina, Milano).
- Auger, J. (2013). Speculative design: Crafting the speculation. *Digital Creativity*, 24(1), 11–35.
- Batchelor, D., Schnabel, M. A., & Dudding, M. (2021). Smart heritage – Defining the discourse. *Heritage*, 4(2), 1005–1015. <http://doi.org/10.3390/heritage4020055>
- Carmo, M. (2017). *The second digital turn: Design beyond intelligence*. MIT Press.
- Cesário, V., Acedo, A., Nunes, N., & Nisi, V. (2022). Promoting Social Inclusion around Cultural Heritage Through Collaborative Digital Storytelling. In International Conference on ArtsIT, Interactivity and Game Creation (pp. 248–260). Springer International Publishing.
- Corà, T., Fazio, L., & Collura, F. (2023). Futures by Design. Progettare innovazione nella complessità (pp. 105–112). Guerini Next, Milano.
- Floridi, L. (2015). *The onlife manifesto: Being human in a hyperconnected era* (p. 264). Springer Nature.
- Hallqvist, J. (2022). The making of a professional digital caregiver: Personalisation and friendliness as practices of humanisation. *Medical Humanities*, 48(3), 347–356.
- Han, W. B., Ko, G. J., Jang, T. M., & Hwang, S. W. (2021). Materials, devices, and applications for wearable and implantable electronics. *ACS Applied Electronic Materials*, 3(2), 485–503.
- Inayatullah, S., Bussey, M., & Milojevic, I. (2006). *Neohumanist educational futures: Liberating the pedagogical intellect*. Tamkang University Press.
- Johansson, V., Islind, A. S., Lindroth, T., Angenete, E., & Gellerstedt, M. (2021). Online communities as a driver for patient empowerment: Systematic review. *Journal of Medical Internet Research*, 23(2), e19910.
- Kor, A. L., Yanovsky, M., Pattinson, C., & Kharchenko, V. (2016, December). SMART-ITEM: IoT-enabled smart living. In 2016 Future Technologies Conference (FTC) (pp. 739–749). IEEE.
- Kringos, D. S., Boerma, W. G., Hutchinson, A., & Saltman, R. B. (2015). Building Primary Care in a Changing Europe; WHO: The European Observatory on Health Systems and Policies: København, Denmark.
- Lee, H., Jung, T. H., tom Dieck, M. C., & Chung, N. (2020). Experiencing immersive virtual reality in museums. *Information & Management*, 57(5), 103229.
- Light, A. (2006). Adding method to meaning: A technique for exploring peoples' experience with technology. *Behaviour & Information Technology*, 25(2), 175–187.
- Ling, R., & Campbell, S. W. (Eds.). (2008). *The reconstruction of space and time: Mobile communication practices*. Transaction Publishers.
- Mietzner, D., & Reger, G. (2005). Advantages and disadvantages of scenario approaches for strategic foresight. *International Journal of Technology Intelligence and Planning*, 1(2), 220–239.
- Miller, R. (2006, December). From trends to futures literacy. In Centre for Strategic Education. Seminar Series Paper. Melbourne.
- Milligan, C. (2016). *There's no place like home: Place and care in an ageing society*. Routledge.
- Mohamed Hassanein, H. (2017). Utilization of 'Multiple Kinetic Technology KT' in Interior Architecture Design as Concept of Futuristic Innovation. *ARChive, Forthcoming*.
- Paglialonga, A., Patel, A. A., Pinto, E., Mugambi, D., & Keshavjee, K. (2019). The healthcare system perspective in mHealth. m_Health current and future applications, 127–142.

- Poli, R. (2017). *Introduction to anticipation studies* (Vol. 1). Springer.
- Salim, A., & Lim, S. (2019). Recent advances in non-invasive flexible and wearable wireless biosensors. *Biosensors and Bioelectronics*, 141, 111422.
- Sardar, Z. (Ed.). (1999). *Rescuing all our futures: The future of futures studies* (No. 30). Praeger Publishers.
- Taormina, F., & Baraldi, S. B. (2022). Museums and digital technology: A literature review on organizational issues. *European Planning Studies*, 30(9), 1676–1694.

