Sustainable Data-Driven Strategies and Active Well-Being: A Case Study

Giuseppe Mincolelli
Università degli Studi di Ferrara
giuseppe.mincolelli@unife.it
ORCID 0000-0002-9336-8466

Gian Andrea Giacobone
Università degli Studi di Ferrara
gianandrea.giacobone@unife.it
ORCID 0000-0002-2258-5359

Michele Marchi
Università degli Studi di Ferrara
michele.marchi@unife.it
ORCID 0000-0001-6984-690X

Abstract
Nowadays the world is characterized by an increasingly aging society. This phenomenon represents a risk for the sustainability of the healthcare system. One of the factors that can accelerate the consequences of the aging process is sedentary behavior. Currently, there is a large availability of wearable smart devices and mobile applications, that can collect data.

However, some social and functional problems were observed, therefore we believe that there is great room for improvement (Mincolelli et al., 2018).

In addition, the paradigm of the Internet of Things is enabling those applications to share data with other programs and smart devices, which, in turn, can generate an ecosystem of services that can improve the quality of life, not only of the single user, but of many groups of a determined social context.

The contribution presents a case study (PLEINAIR project) that focuses specifically on the development of Human-Centered outdoor smart technologies that can adapt themselves to the necessities of people of all ages and abilities in order to encourage them of taking care of their health.

Keywords
Internet of things
Active well-being
Human-centered design
Health data
Self-tracking

Introduction

Many communities and governments around the globe are increasingly paying more attention to people's well-being because it is an essential value for policy-making, due to its significant impact on economic, health, social and cultural facets of life (Adler & Seligman, 2016). Physical activity is one of the most important elements contributing to enhancing positive benefits on well-being, including physical and psychological health (Biddle & Ekkekakis, 2005). However, rapid technological and social advances in modern society are causing radical changes in people's lifestyles, influencing their behaviors, increasing the time they spend staying still in front of a display, causing poor participation in physical activities.

Several multiple cultural and environmental factors – such as high urbanization, including urban pollution and congestion, shortage of green parks or pedestrian walkways, inaccessibility of sports or leisure facilities (Gupta & Bansal, 2020; Park et al., 2020), and misusing of technologies (Barnett et al., 2018; Fennell et al., 2019) and aging population (Aguiar & Macário, 2017) – are contributing to adopting a sedentary lifestyle, which is negatively affecting economic assets and welfare of many countries (ISCA, 2015). As reported by WHO (2020), around 30% of the global population – one in four (27.5%) adults and more than three-quarters of adolescents – engages in insufficient physical activities (Bull et al., 2020; Park et al., 2020). Additionally, recent phenomena caused by the Covid-19 pandemic, such as social distancing, smart working and self-isolating, exacerbate this trend (Zheng et al., 2020). For this reason, it is crucial to reduce sedentary time as much as possible to decrease its negative health impact on society.

Active well-being: to cure to care

Considering a behavior can be influenced by a series of individual, social and contextual factors (Sallis et al., 2008), effective interventions at the environmental level (the city) determine more opportunities to trace a new urban model (new set of behaviors) that enables citizens of all ages and abilities to be physically active day-by-day (Edwards & Tsouros, 2008; Krupat, 1985). In this perspective, the concept of the active city or healthy city emerges as a new cultural paradigm capable of fostering an enabling built environment that encourages the use of the body in everyday life through equitable access to urban public spaces (Dorato, 2020).

In this term, that strategy can transform the curative and medicalized idea of health into a preventive approach that enables citizens to grow consciousness around the benefits of taking care of their bodies and adopting active behaviors (Dorato, 2020).

IoT, data, and new smart citizens

In that new socio-ecological scenario, the Internet of Things has the opportunity to foster active well-being by encouraging citizens to engage in physical activities where data themselves are utilized as

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a raw material for producing new design strategies (Zannoni, 2018). This helps to generate new adaptable and inclusive urban spaces accessible for a heterogeneous category of people, including even the most fragile. During a particular physical activity, data collected by the smart things can stimulate and nudge users to change their behaviors. The same data collection also permits smart things to elaborate personalized motivational strategies.

Lastly, the interoperability and scalability of smart objects promote computed civics (DiSalvo et al., 2016), as they are able to provide strategical data collections on citizenship health which can help governments and policymakers to take sustainable decisions and interventions to improve well-being and life conditions of the population and prevent negative impacts of social health.

Based on the above considerations, this paper presents a case study that focuses specifically on developing responsive and inclusive outdoor smart technologies that foster active well-being through data-driven strategies.

PLEINAIR: a case study for active well-being

The PLEINAIR project

The presented case study, named PLEINAIR, acronym for Parchi Liberi ed Inclusivi In Network per l'Attività fisica Intergenerazionale e Ricreativa (Free and Inclusive Parks in Networks for Recreational and Physical Intergenerational Activity), is an interdisciplinary research project financed by the POR FESR 2014-2020 program, regulated by the Emilia Romagna Region in Italy. The project aims at reframing the concept of green public space by developing an inclusive and interactive outdoor park that discourages a sedentary lifestyle through an enabling environment that supports physical activity.

The system is composed of an IoMT-based infrastructure (Internet of Medical Things) and a series of recreative and fitness outdoor furnishings, named OSOs (Outdoor Smart Objects), which foster conviviality, socialization and active lifestyles among different generations of citizens.

On one side, PLEINAIR improves the quality of citizenship's social life by designing an inclusive recreational environment that promotes relaxing experiences, incites social relationships, and collective playful activities among people of different ages, characteristics and skills. In that case, the traditional social barriers are broken down in favor of an intergenerational, equal and shared space in which seniors, adults, teenagers and children can interact to each other without any limitation.

On the other side, the project enhances the citizen's health condition by stimulating people of all ages to perform physical activity around the public space through direct interaction with smart objects. The OSOs can provide citizens with accessible, comfortable and personalized fitness or gaming experiences as they can recognize a specific registered user profile and dynamically adapt their morphological and functional characteristics to her/his performance, skills and personal preferences.

Citizen engagement is sustained and prolonged in a long-term period due to customized and profiled motivational strategies – based on gaming and social elements, such as leveling up throughout different challenges, winning prices, playing or competing with other users, and so on – that provide the users with targeted hints and tips but also with new personal challenges or planned exercises according to their well-being, abilities and behavioral patterns.

General concept

One of the limits of IOT technology, as it has been used up to now, is to establish a one-to-one relationship between user and smart object and to limit the relationship between people to sharing data or interacting in specific digital spaces, inside the applications. So users tend to interact, in these limited spaces, only with users who have skills and abilities in the use of the app similar to theirs. Furthermore, all the time spent using an app, in this scenario, is subtracted from the potential relationship with people in physical space. The reason why this happens is to be found in the fact that the initiative of the smart-object proposal, for now, is for the most part of a private and commercial nature. IOT technology makes it possible to increase the bond between user and product, to build loyalty, and to increase the knowledge of the user's habits, preferences, and behaviors by the producer and supplier of objects and services in proportion to the time and attention the user devotes to the product and service. In this sense, from a commercial point of view, any unmonitorable user interaction outside the system is considered a loss of profit.

The objective of the PLEINAIR project is first of all to increase the user's awareness of the behaviors that can improve their well-being, promote an active life and mitigate the impact of aging on the quality of life, and in this sense, the current approach to the definition of smart-objects would seem sufficient, as it is focused on obtaining significant results for the individual. But a no less important objective of the project is also to foster interaction between users of different generations in the physical space of a public park through the proposal of activities that lead to sharing spaces, building relationships, and promoting communication: in this sense, the current approach to IOT is neither sufficient nor recommendable.

For this reason, great importance has been given to the physical and spatial components of the project, which prevails in terms of perceptibility compared to the digital ones. All the OSOs have been conceived as usable and desirable objects by every user of the park regardless of his age and physical condition, and the dynamics of interaction with the user require an extremely limited need of time spent on the app for mobile devices. On the contrary, they definitely favor direct and sensitive interactions, shareable with other users on the physical environment. The IOT paradigm was mostly used for the personalization of the experience on the characteristics of the users involved in the interactions so that their attention was focused on the experience itself and on the interactions. For this reason, the OSOs have the appearance of simple objects, not hi-tech, they do not involve the use of displays or other distracting elements. The users can evaluate their performance, and customize their preferences in a range of time other than that of the experience.

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The OSOs characteristics

PLEINAIR adopted a human-centered methodology (Mincolelli et al., 2020), speculative design (Mincolelli et al., 2021) and a participatory co-design technique (Mincolelli et al., 2022) to conceive, design and develop the final prototypes. The project consists of an IoT-based system equipped with four different recreational and fitness outdoor smart products that promote active well-being for citizenship. A PLEINAIR application for mobile personal devices acts as the interface between the users and the OSOs, providing many challenging and playful games or fitness activities that deliver tailored experiences and personalized motivation strategies based on the physiological parameters or personal preferences of every user.

The final characteristics of the OSOs are:

- OSO-1: An integrated smart module made up of a green module (OSO-1.1), an interactive table (OSO-1.2), and a fitness bench (OSO-1.3). The green module uses a soil moisture sensor, temperature, humidity and solar light exposure to monitor plants. The latter can be monitored remotely with the PLEINAIR mobile application. A specific digital experience, named Care The Plant, enables users to engage with nature through botany learning activities. The interactive table runs agility and cognitive visual games while the fitness bench provides gymnastic activities. Both OSO-1.2 and OSO-1.3 are equipped with the same smart tiles of the OSO-4.
- OSO-2: a swivel chair equipped with a sunshade for guaranteeing moments of privacy and protection from atmospheric agents to different generations of users Fig. 1.
- OSO-3: A smart chair made up of a stand assist lift (based under the seat), and ergonomic armrests that can recognize seniors or citizens demanding assistance and enables them to sit up independently Fig. 2.
- OSO-4: An interactive floor made up of several smart tiles equipped with sensors and visual feedback for playing different games as well as playful and gymnastic activities.

Fig. 1
PLEINAIR project. Realization of the OSO-2. Credits: Michele Marchi.

Fig. 2
PLEINAIR project. Realization of the OSO-3. Credits: Michele Marchi.

The smart tiles are the core of the entire system because they can communicate with the app and run all the interactive activities. Each smart tile senses weight pressure, weight distribution, tap force, gait speed and execution time, and merges them to build and monitor different game experiences. For example, the OSO-1.2 can be used to play cognitive games such as tap lights. The OSO-1.3 can execute gymnastic activities such as squats, steps, long lunges or jumps. Lastly, the OSO-4 can run many complex games such as The Floor Is Lava, Catch The Mole or the Obstacle course race". Data-merge unit records and processes different parameters to evaluate the final performance of each user while performing a specific activity: the time spent to finish the exercise, error rate, and reaction time spent to tap every tile. The dataset is the source to elaborate motivational strategies, propose new planned exercises or balance the level of difficulty based on users' performance.

Tests

In order to validate but also to improve the morphology, the interactions and the physical exercises hypothesized for the specific OSO, tests with real users were also carried out in the Museum of Rural Life in Bentivoglio (BO). These tests concerned morphological, functional and interaction aspects, as better explained in the description of the OSOs in the previous paragraph.

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The tests lasted, on a non-continuous way, from 23 October to 17 December 2021. Test activities were organized over multiple days which saw the total presence of 114 users.

The purpose of these test days was to simulate real life days in a public park. Due to obstacles related to the safety of the area and the prototypes, an indoor experience was provided inside the museum of Villa Smeraldi. The space was equipped with a large wooden platform, which contained all the designed OSOs. A ramp with 4% degree of slope allowed comfortable and inclusive access to the site; a very large window allowed users to observe the surrounding park and identify with the nature.

The goal of the tests was to understand how users judged the prototypes with regard to some aspects. All the indicators described below, refer to the general and overall experience of the game and therefore include the assessment of the environmental context, the physical activity, and the morphology of the object Fig. 3. The assessed aspects are as follows:

- accessibility;
- usability;
- perceived utility;
- appreciation;
- functionality and safety;
- improvement measures.

Fig. 3
PLEINAIR project. Preparation of the demonstrator inside the Museo della Civiltà Contadina (Museum of Rural Life) in Bentivoglio (BO) with the presence of thean interactive floor (OSO4). Credits: Michele Marchi.

In addition to a critical reading of the non-verbal language (enthusiasm, curiosity, attention; these aspects have been specifically evaluated for people with cognitive disabilities or children)and the specific activity, all users were asked to fill out a specific unified questionnaire using standardized tools (eg. SUS). The performance expectations were measured on the basis of a 5 level Likert-type response scale (1 = disagree; 5 = completely agree). The questionnaire was made more accessible by associating a series of icons to the scale, in order to visually help users with cognitive issues to give the answers. The collected data aim to define the perceived utility,

usability and acceptability of the system by target users. The sessions provided for a free or guided use of the OSOs, according to the users' needs and their familiarity with the use of the device.

As outlined below, the tests saw the participation of diversified users Fig. 4:

- members of the *Bentivoglio nel cuore* association, whose purpose is to disseminate correct information on cardiovascular diseases. The volunteers were divided into small groups of users (3-4), to whom was submitted the prototype.
- Diversified users by age and characteristics (families, children, tourists, adolescents, seniors, ...) involved during the *Festa della Semina* (Sowing Festival), Open Day of the *Gusto di Autunno* (Autumn Taste).
- Expert users who attended a meeting during which PLEINAIR project was shown to stakeholders belonging to the public and private sectors.

The analyzed data of these first three groupings have not been developed in an analytical and scientific way but only at a quantitative level. Effectively, the tests were performed without the constant presence of a moderator. Our goal was to understand, for some types of users, what was the instinctive and emotional reaction using and experiencing PLEINAIR products.

Below are the types of users for which desirability, acceptability and usability tests were performed according to the aspects mentioned above.

- Typical and regular users of the Museum park who may be interested in the permanent installation of the prototype in space. Mainly people over 50 with good motor skills in the lower and upper limbs. The tests were performed on 10 people.
- Users of the Park with physical-cognitive issues. Three different groups of people with disabilities tested the prototypes accompanied by educators and specialized personnel. Tests were performed on 18 people; 10 had medium or mild cognitive impairment; 8 were people with physical disabilities (wheelchair or walker).
- Elderly users who regularly frequent the park.
- Adult users with physical/cognitive disabilities from Day Centers who do not know the park; they were accompanied by the referents in two occasions.15 people with disabilities were involved and were helped as they were not completely autonomous in all phases of the test.
- Teen users. Two days of testing were dedicated to students of three high schools: the Serpieri Institute, the IPAA Ferrarini and the Belluzzi Fioravanti Institute of Bologna. Some of these classes had already been involved during the previous co-design workshops and therefore were able to observe the changes that have taken place.51 teenagers were involved. For us it was important to involve a good number of people for two main reasons: the first one was because we still had not collected data regarding the experiential perception of this specific user; the second one, because we were also interested in observing the dynamics of involvement between different types of users, such as the elderly-adolescents or adolescents-children.

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Fig. 4
PLEINAIR project. Preparation of the demonstrator inside the Museo della Civiltà Contadina (Museum of Rural Life) in Bentivoglio (BO) with the presence of thean interactive floor (OSO4). Credits: Michele Marchi.

Results

As mentioned in the paragraph above, the results of the tests are processed thanks to 3 application and methodological tools:

- direct critical observation during the activity (having the role of active moderator or passive observer);
- multiple choice questionnaire with closed answers (appreciation);
- ideas, comments or suggestions clearly expressed in the questionnaire.

The questionnaire was structured into three subparagraphs:

- information regarding the usability of OSOs;
- information concerning the usability of the App;
- information relating to the perceived utility.

The data were collected using a Likert scale from 1 (strongly disagree) to 5 (strongly agree).

Information regarding the usability of OSOs:

- I was able to use all OSOs;
- the exercises are easy to do;
- I think I do not need the support of someone else to use OSOs (Device Interaction);
- I felt safe while using the park's OSOs;
- surfaces are stable;
- surfaces are regular;

Information concerning the usability of the App:

- the App communicates well with the OSOs;
- the texts are well written, I can understand immediately what I have to do;
- the app graphic is intuitive, I can immediately understand how to use the app in order to play and interact with the OSOs;

- icons are representative of what they refer to;
- I guess most people can learn how to use the system very quickly;
- information relating to perceived utility;
- I think I would like to go often to this Park if it is available;
- I feel more motivated to do physical exercise or go to the park;
- I am more aware of my state of health;
- I had fun;
- I like the activities proposed by the OSOs.

As better specified above, the questionnaire aimed at providing punctual and general answers regarding the aesthetic, functional and motor appreciation of the PLEINAIR OSOs. Users expressed a positive opinion (4 or 5 of the Likert scale) to all the questions with an average of 68%. On the other hand, only an average 3% expressed a rating of 1 or 2.

The quantitative and qualitative answers of the questionnaires confirm the empirical evaluation obtained thanks to the critical vision during the performance of the same activity. Trying and testing new playful and physical activities, or even just updated with innovative technology or interfaces, has intrigued all users, from children to the elderly.

One of the critical issues identified was related to strengthening the visual and luminous language together with the sound. Elderly or people with mild visual impairment are unable to distinguish colors or do not have the cognitive speed to observe them. In this case, having the possibility of being informed also through the sound and voice, can certainly facilitate some activities. The project implication is that the planned design is to implement the electrical system with the acoustic one, so only the person carrying out the activity can hear the information received avoiding to cause disturbance to other people who are carrying out other activities.

Even the activity Care The Plant was not very empathetic and immersive. However, this activity was specifically designed for the elderly and children with the idea of carrying out therapeutic workshops or awareness raising workshops on nature, even remotely and observe the evolution of nature over time. It was an activity conceived with outcomes in the medium-long term and not to be developed in punctual and sporadic episodes.

In conclusion, we are quite sure to confirm the pleasantness of the experience with respect to all the users involved.

Conclusions

Thanks to the PLEINAIR project and to the applied and experimental research carried out to achieve the above-mentioned results, it is possible to disseminate some evaluations and conclusions. This information can be useful both for a possible continuation of the research and facilitate a critical reading on the status of the topics mentioned.

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Hereinafter, are some evaluations:

- Integrating the strategies of traditional games with technical and technological innovations has found good results with the ultimate aim of encouraging people to go to the park, improve their health and trigger socializing and challenging dynamics, suitable for all ages, abilities and needs.
- Data collection and elaboration can help to provide inclusive and customizable experience to all users at any stage of life by adapting the OSOs to their capabilities and habits.
- Data collection and elaboration can help to sustain active lifestyle by stimulating people through tailored motivational strategies based on their capabilities and health status.
- Nowadays, the chance of processing the collected health data, is leading people of different ages and abilities to access a more efficient and informed management of their health, thanks to the support of wearables, mobile Apps, smart environments and social networks.
- By validating some physical exercises, for example with the physician or physiotherapist, the person can perform an accurate and specific physical activity, aiming to improve their performance and/or their health status.
- The data collected from the recreational equipment can help Public Administrations to have a picture, as accurate as possible, of the health condition of their citizens and their public parks. This can help the better management of green spaces at the level of urban planning and regeneration of spaces.
- In order to manage the cultural and environmental transformations of a given context, the active involvement of the citizens and the organizations who live and frequent a specific area is a good approach. Only in this way we can be sure that the project will satisfy the real needs of people. Involving people in a participatory design, exponentially increases the perceived utility and triggers virtuous dynamics regarding the maintenance and the positive and proactive management of the area.

Author Roles Acknowledgment

This contribution was redacted by the authors in this order:

Giuseppe Mincolelli is responsible of project funding acquisition, research direction, and concept design; he contributed to editing and reviewing the paper and wrote the section about general concept and part of the abstract.

Gian Andrea Giacobone contributed to editing and reviewing the paper structure and drew up the section Introduction; active well-being: to cure to care; IoT, data, and new smart citizens; the PLEINAIR project; the OSOs characteristics.

Michele Marchi a contributed to editing and reviewing the paper structure and drew up the section Tests, Results, Conclusions

Giuseppe Mincolelli
He's an Architect and designer, specializing in HCD and Inclusive Design. He is an Associate Professor of Design at the University of Ferrara, he is the coordinator of the MSc in Innovation Design. Numerous patents, publications, and awards in Italy and abroad.

Gian Andrea Giacobone
He's a Ph.D. and a product-interaction designer. He works as a research fellow and lecturer at the University of Ferrara. He contributes to different projects at the national and European levels. His areas of expertise are Human-Centred Design, Human-Machine Interaction, UX, UI, IoT and Transportation Design.

Michele Marchi
He's an architect and Ph.D. He is author of essays and articles, speaker at National and International Conferences, consultant for public and private Bodies and Associations on topics concerning the physical, cognitive and social accessibility for buildings. As research fellow within the Department of Architecture of Ferrara

References

Adler, A., & Seligman, M. E. P. (2016). Using wellbeing for public policy: Theory, measurement, and recommendations. *International Journal of Wellbeing*, *6*(1), 1–35. https://doi.org/10.5502/ijw.v6i1.429

Aguiar, B., & Macário, R. (2017). The need for an Elderly centred mobility policy. *Transportation Research Procedia*, *25*, 4355–4369. https://doi.org/10.1016/j.trpro.2017.05.309

Barnett, T. A., Kelly, A. S., Young, D. R., Perry, C. K., Pratt, C. A., Edwards, N. M., Rao, G., & Vos, M. B. (2018). Sedentary Behaviors in Today's Youth: Approaches to the Prevention and Management of Childhood Obesity: A Scientific Statement From the American Heart Association. *Circulation*, *138*(11). https://doi.org/10.1161/CIR.0000000000000591

Biddle, S. J. H., & Ekkekakis, P. (2005). Physically active lifestyles and well-being. In *The Science of Well-Being* (pp. 140–169). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780198567523.003.0006

Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., Carty, C., Chaput, J.-P., Chastin, S., Chou, R., Dempsey, P. C., DiPietro, L., Ekelund, U., Firth, J., Friedenreich, C. M., Garcia, L., Gichu, M., Jago, R., Katzmarzyk, P. T., … Willumsen, J. F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine, 54*(24), 1451–1462. https://doi.org/10.1136/bjsports-2020-102955

DiSalvo, C., Jenkins, T., & Lodato, T. (2016). Designing Speculative Civics. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 4979–4990. https://doi.org/10.1145/2858036.2858505

Dorato, E. (2020). *Preventive Urbanism: the Role of Health in Designing Active Cities*. Quodlibet Studio.

Edwards, P., & Tsouros, A. D. (2008). *A Healthy City is an Active City: a Physical Activity Planning Guide*. World Health Organization. Regional Office for Europe.

World Health Organization. (2020). *WHO guidelines on physical activity and sedentary behaviour*. World Health Organization. https://www.who.int/publications/i/item/9789240015128

Fennell, C., Barkley, J. E., & Lepp, A. (2019). The relationship between cell phone use, physical activity, and sedentary behavior in adults aged 18–80. *Computers in Human Behavior*, *90*, 53–59. https://doi.org/10.1016/j.chb.2018.08.044

Gupta, S., & Bansal, S. (2020). Effect of Urbanization, Sedentary Lifestyle and Consumption Pattern on Obesity: An Evidence From India. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3741382

ISCA. (2015). *The Economic Costs of Physical Inactivity in Europe* (ISCA / Cebr report). Centre for Economic and Business Research CEBR. https://inactivity-time-bomb.nowwemove.com/download-report/The%20Economic%20Costs%20of%20Physical%20Inactivity%20in%20Europe%20(June%202015).pdf

Krupat, E. (1985). *People in Cities: The Urban Environment and its Effects*. Cambridge University Press.

Mincolelli, G., Imbesi, S., Giacobone, G. A., & Marchi, M. (2018). Internet of Things and Elderly: Quantitative and Qualitative Benchmarking of Smart Objects. In G. Di Bucchianico (Eds.), *Advances in Design for Inclusion* (pp. 335–345). Springer. https://doi.org/10.1007/978-3-319-94622-1_32

Mincolelli, G., Giacobone, G. A., Imbesi, S., & Marchi, M. (2020). Human Centered Design Methodologies Applied to Complex Research Projects: First Results of the PLEINAIR Project. In G. Di Bucchianico, C. S. Shin, S. Shim, S. Fukuda, G. Montagna, & C. Carvalho (Eds.), *Advances in Industrial Design: Proceedings of the AHFE 2020 Virtual Conferences on Design for Inclusion, Affective and Pleasurable Design, Interdisciplinary Practice in Industrial Design, Kansei Engineering, and Human Factors for Apparel and Textile Engineering* (pp. 3–9). Springer. https://doi.org/10.1007/978-3-030-51194-4_1

Mincolelli, G., Giacobone, G. A., & Marchi, M. (2021). Project PLEINAIR: Discovering User Needs Exploring a Non-conventional Human-Centered Approach. In C. S. Shin, G. Di Bucchianico, S. Fukuda, Y.-G. Ghim, G. Montagna, & C. Carvalho (Eds.), *Advances in Industrial Design: Proceedings of the AHFE 2021 Virtual Conferences on Design for Inclusion, Affective and Pleasurable Design, Interdisciplinary Practice in Industrial Design, Kansei Engineering, and Human Factors for Apparel and Textile Engineering* (pp. 363–370). Springer. https://doi.org/10.1007/978-3-030-80829-7_45

Mincolelli, G., Giacobone, G. A., & Marchi, M. (2022). PLEINAIR project: participatory methodologies to validate and integrate product concepts with young users. In G. Di Bucchianico (Ed.), *Design for Inclusion: Proceedings of 13th AHFE International Conference on Design for Inclusion, New York, USA, July 24-28, 2022* (pp. 45–53). AHFE Open Access. https://doi.org/10.54941/ahfe1001868

Park, J. H., Moon, J. H., Kim, H. J., Kong, M. H., & Oh, Y. H. (2020). Sedentary Lifestyle: Overview of Updated Evidence of Potential Health Risks. *Korean Journal of Family Medicine*, *41*(6), 365–373. https://doi.org/10.4082/kjfm.20.0165

Sallis, J., Owen, N., & Fisher, E. (2008). Ecological Models of Health Behavior. In K. Glanz, B. Rimer, & K. Viswanath (Eds.), *Health Behavior and Health Education: Theory, Research, and Practice* (pp. 465–482). Jossey-Bass.

Zannoni, M. (2018). *Progetto e interazione. Il design degli ecosistemi interattivi*. Quodlibet.

Zheng, C., Huang, W. Y., Sheridan, S., Sit, C. H.-P., Chen, X.-K., & Wong, S. H.-S. (2020). COVID-19 Pandemic Brings a Sedentary Lifestyle in Young Adults: A Cross-Sectional and Longitudinal Study. *International Journal of Environmental Research and Public Health*, *17*(17), 6035. https://doi.org/10.3390/ijerph17176035