IRIS AperTO

UNIVERSITÀ DEGLI STUDI DI TORINO

AperTO - Archivio Istituzionale Open Access dell'Università di Torino

Big Data, Social Networks and Well-Being

This is the author's manuscript

Original Citation:

Availability:

This version is available http://hdl.handle.net/2318/1735640 since 2020-06-11T08:36:13Z

Publisher:

Eurac Research

Terms of use:

Open Access

Anyone can freely access the full text of works made available as "Open Access". Works made available under a Creative Commons license can be used according to the terms and conditions of said license. Use of all other works requires consent of the right holder (author or publisher) if not exempted from copyright protection by the applicable law.

(Article begins on next page)

15 January 2025

REGENERATIVE
DESIGN IN DIGITAL PRACTICE
A Handbook for the Built Environment

Edited by
Emanuele Naboni
Lisanne Havinga

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

RESTORE
REthinking Sustainability TOwards a Regenerative Economy

Cover Image - The Spiral, New York

Located at the intersection of the High Line and Hudson Park, The Spiral extends the green space of the former train tracks in a spiraling motion towards the sky – from High Line to the skyline. Reminiscent of the city's classic setback skyscrapers, The Spiral stands out for its shared open space on every floor. At each level along the ascending path a terrace connects to a double-height atrium for meetings and events with views across Manhattan.

Courtesy © Bjarke Ingels Group

REGENERATIVE
DESIGN IN DIGITAL PRACTICE
A Handbook for the Built Environment

Edited by

Emanuele Naboni
Lisanne Havinga

Regenerative Design in Digital Practice
A Handbook for the Built Environment
Copyright: COST action RESTORE WG2, Emanuele Naboni and Lisanne Havinga ©2019

All rights reserved. No part of this book may be reprinted or reproduced or utilized in any form or by any means without permission in writing from the copyright holders.

Chief Editors: Emanuele Naboni (KADK) and Lisanne Havinga (TU/e)
Proof Editor: Duncan Harkness
Graphical Editors: Lisanne Havinga (TU/e), Emanuele Naboni (KADK), Cristina Magri (KADK), Alessia Bianca (KADK)
Printed by Esperia
Published by Eurac Research

ISBN 978-3-9504607-2-8 (Online)
ISBN 978-3-9504607-3-5 (Print)

Citation: Naboni, E & Havinga, L. C. (2019) Regenerative Design in Digital Practice: A Handbook for the Built Environment. Bolzano, IT: Eurac

This publication is based upon work from COST Action RESTORE CA16114, supported by COST (European Cooperation in Science and Technology).

Action Chair: Carlo Battisti (Eurac Research)
Action Vice-Chair: Martin Brown (Fairsnape)
Scientific Representative: Roberto Lollini (Eurac Research)
Grant Manager: Gloria Peasso (Eurac Research)
WG2 Leaders: Emanuele Naboni (KADK), Lisanne Havinga (TU/e)

COST (European Cooperation in Science and Technology) is a pan-European intergovernmental framework. Its mission is to enable break-through scientific and technological developments leading to new concepts and products and thereby contribute to strengthening Europe's research and innovation capacities. The COST Association has currently 36 Member Countries.
www.cost.eu

Funded by the Horizon 2020
Framework Programme
of the European Union

REGENERATIVE DESIGN IN DIGITAL PRACTICE

Table of Contents

NOTES ON EDITORS 1

FOREWORD 5

INTRODUCTION 7

SUMMARY 11

ACKNOWLEDGEMENTS 15

REGENERATIVE DEFINITIONS FOR DESIGNERS 18
The Pillars of Regenerative Design
Edited by Martin Brown, Emanuele Naboni, Lisanne Havinga

TOOLS AND DATA FOR HOLISTIC MODELLING 50
Simulating Regenerative Futures
Edited by Emanuele Naboni, Clarice Bleil de Souza, Terri Peters, Lisanne Havinga

CLIMATE AND ENERGY FOR REGENERATIVE URBAN DESIGN 130
Local Context, Adaptation, Resilience
Edited by Emanuele Naboni, Ata Chokhachian, Luca Finnochiaro, Lisanne Havinga

CARBON AND ECOLOGY WITHIN THE DESIGN PROCESS 216
Environmental Impact Assessment
Edited by Lisanne Havinga, Catherine De Wolf, Antonino Marvuglia, Emanuele Naboni

HUMAN WELL-BEING VIA CERTIFICATION AND TOOLS 282
Comfort, Health, Satisfaction, Well-being
Edited by Angela Loder, Sergio Altomonte, Emanuele Naboni, Lisanne Havinga

CASE STUDIES SHOWCASING REGENERATIVE DESIGN 346
From Theory to Realisation
Edited by Emanuele Naboni, Lisanne Havinga

BIG DATA, SOCIAL NETWORKS AND WELL-BEING

Dario Cottafava *University of Turin, Italy*

Social Networks aimed at understanding well-being could sustain the shift in paradigm from Sustainable to Regenerative Design. Well-being, i.e. '*the state of being comfortable, healthy, or happy*', is a concept related to happiness, positive experiences and pleasure with implications on physical, mental, social and environmental aspects [1]. In the built environment, recent works have linked indoor comfort, as well as long-term mental health and illnesses, to Indoor Environmental Quality (IEQ) [2]. Further studies focusing on outdoor spaces were conducted on the relationship between landscape and well-being [3], proving how urban landscapes affect the physical, mental and social well-being and health of citizens. Recent studies have also shown a positive impact of social ties on health [4] and the value of adopting a socio-ecological approach to co-benefit individuals and the ecosystem, thus calling for integrated governance of social-ecological systems [5]. However, there are only a few projects that focus on the integrated governance of a social-ecological system with ubiquitous technologies, and these projects are highly focused on human-centric design rather than on an eco-centric perspective [6]. Ubiquitous technologies, also defined as ambient intelligence [7], refer to sensitive environments where computing is available everywhere at any time and may allow a more regenerative design by taking into account all the components of an ecosystem and their interactions.

FROM HUMAN TO ECO-CENTRIC PERSPECTIVES

The sustainable development definition, officially introduced by the Brundtland Report [8], reflects the anthropocentric view in which rights and duties are only attributed to humans. This view has been criticised since the 1970s when the sustainability debate emerged. According to the Deep Ecology ethics [9] - *the development would not be right if the ecosystem is significantly affected by it* - rights and duties must also be prescribed to smarter animals, sentient beings, living beings and *beings in existence*. In 1984, *'A Cyborg Manifesto'* introduced the Posthuman theory, rethinking the human experience and establishing the idea of a collective nature [10].

It is argued that humans cannot control the ecosystem, but they are a part of it together with non-human entities, living and non-living objects. This new paradigm is embodied in the *Sustainable-Restorative-Regenerative* shift [11]. *Sustainable* represents an old anthropocentric viewpoint that is focused on limiting negative environmental impacts. *Restorative* design highlights an approach to restore eco-, social and economic systems to a healthy state, and the new paradigm represented by the *Regenerative* approach, which aims to enable ecological, social and health co-benefits.

In the next section, three pilot projects explore indoor and outdoor human well-being, comfort and health in parallel to the above mentioned ecological, social and health co-benefits: 1) *ComfortSense* adopted a Mobile Crowd Sensing approach (MCS) for Adaptive Thermal Comfort, 2) *HOME (Human Observations Meta-Environment)* explored the direct interactions between occupants and the building to improve indoor comfort and reduce the energy consumption of Heating, Ventilating and Air Conditioning (HVAC) systems, while 3) *First Life* tested a Neighbourhood Social Network to foster citizens' interactions in identifying specific places within the city with positive or negative implications for well-being and health.

MOBILE CROWD SENSING APPROACH (MCS)

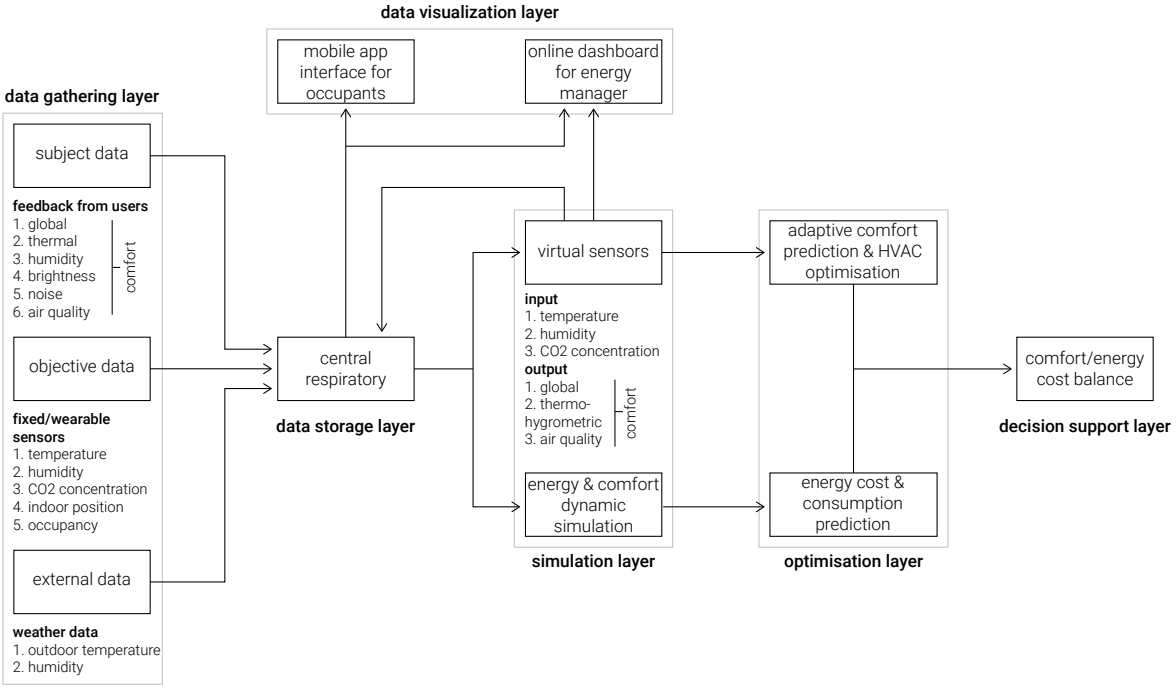
A recent project, *ComfortSense* [12], was aimed at improving users' comfort while reducing energy consumption by exploiting a machine-learning algorithm to correlate Objective variables (Temperature, Humidity and CO_2 concentration) with Subjective feedback from users. The personal feedback was gathered through a mobile app, thanks to a Mobile Crowd Sensing approach [13], to stimulate a behavioural change process in occupants to adapt the building in response to the users' perception. Figure 15 shows the IT infrastructure designed to interact with people (data visualisation) and with the building (optimisation) to improve the whole system (decision support) by reducing the energy consumption and improving occupants' indoor thermal and visual comfort.

ComfortSense was based on an Adaptive Comfort approach [14]. The Adaptive Comfort models are based on the idea that people, by interacting with the building or the environment, can control the environmental conditions, such as the indoor temperature or the relative humidity. In particular, ComfortSense linked users' feedback to Indoor Environmental Quality (IEQ) monitoring in real time by exploiting the smartness of collective intelligence, i.e. a crowd/group may often make better decisions than any single member of the group [15].

A regenerative state can be activated by considering that occupants tend to forgive more, e.g. they may accept higher indoor temperature during the summer if they have more control over the building itself [16]. Taking into account the basic principle of adaptive thermal comfort, ComfortSense showed how indoor comfort could be improved to achieve health co-benefits for humans (reduction in headache, nausea and dizziness) and for the environment (reduction in consumption [12]).

Figure 15

Information flow of the ComfortSense project. The six layers allow interactions among occupants, the building and the energy management. The data gathering layer collects data from sensors and occupants which are first stored into the data storage layer, then used to train the predictive algorithms (simulation and optimisation) and finally organised for users (data visualisation) and energy management (decision support).



HOME (Human Observations Meta-Environment) [17] focused on the use of Social Networks for improving well-being and thermal comfort by exploring the process of *environment-emotions-health* [18], i.e. how the surrounding environment affects, positively or negatively, peoples' emotions and how the latter may affect human health. For this purpose, HOME created an interactive environment where occupants act together with the building via social media feedback. Users control the indoor temperature by sending messages, such as 'up' or 'down', or by writing comments that are captured by the software Human Ecosystem [19]. Signals were correlated to indoor temperature, humidity, occupancy density and users' movements tracked with videos processed by the OpenCV library to transform video information into data. Causes of discomfort and unhealthy states were analysed by looking at the emotions manifested in comments. Figure 16, 17 and 18 show three screenshots of the possible visualisations used to analyse users' feedback and sentiments.

Figure 16

Screenshot from the Human Ecosystem dashboard analysing posts from social networks. The comfort/energy distribution (bottom-left) shows qualitative classifications of comfort/energy. Each post/tweet has been classified by two parameters, comfort and energy, by assigning two values to words within the scraped sentence in order to explore the phase space of the Circumplex model of emotions. The energy parameter defines an active or passive action, while comfort describes a positive or negative concept.

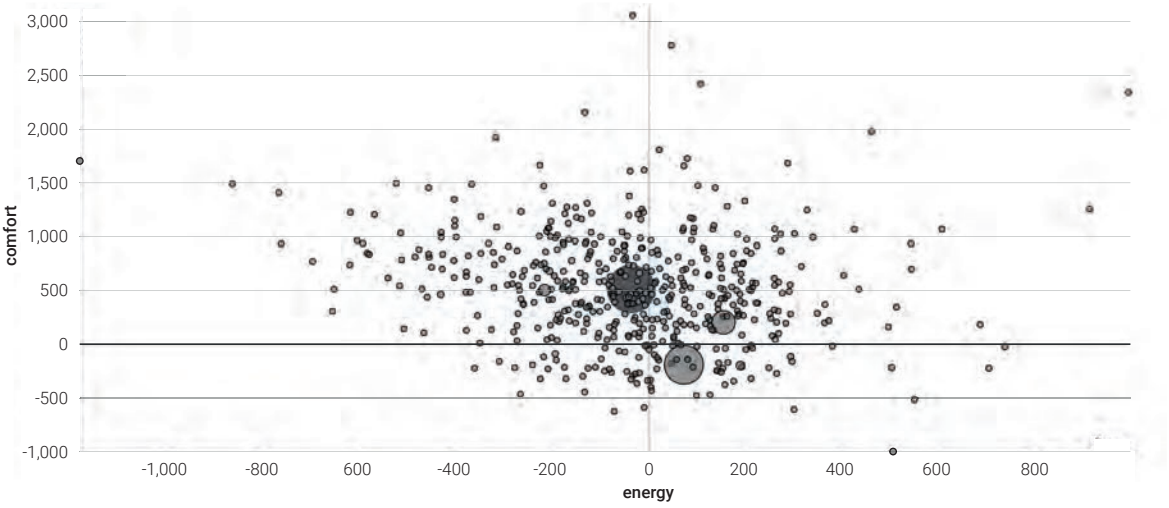


Figure 17

Screenshot from the Human Ecosystem dashboard analysing posts from social networks. The wordcloud highlights the most frequent words appearing in scraped posts and tweets.

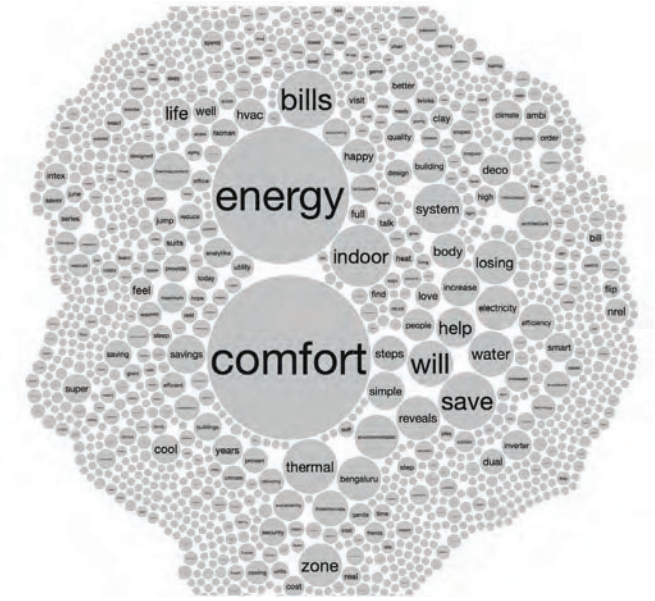
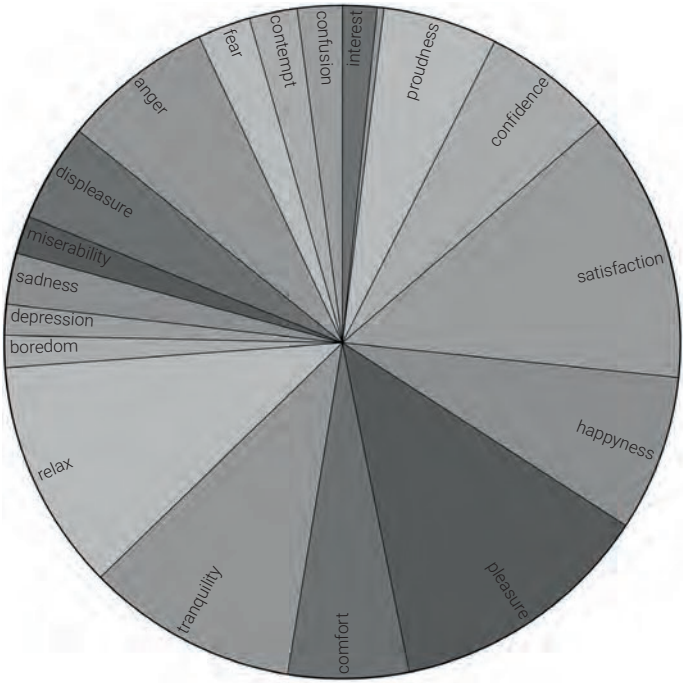


Figure 18

Screenshot from the Human Ecosystem dashboard analysing posts from social networks. The piechart summarizes the most frequent sentiments of the scraped posts/tweets. Emotions are defined with precise keywords belonging to the Circumplex model of emotions such as Happiness, Tranquillity,Displeasure and so on.



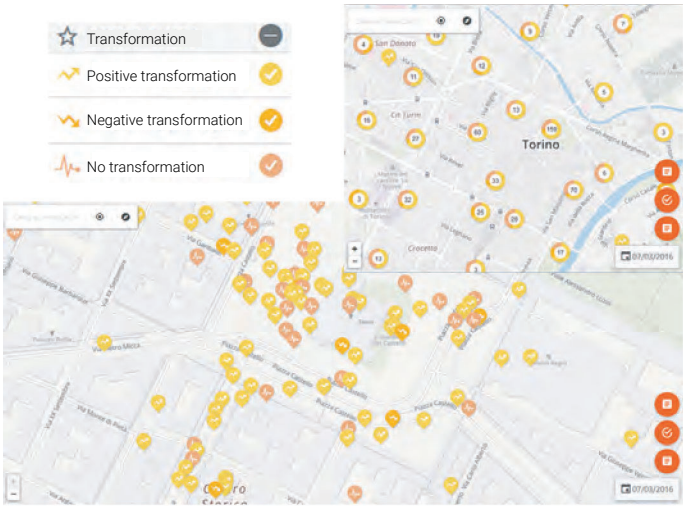


Figure 19

Screenshot from the First Life web platform. The map shows the current transformation occurring in a place within the City of Turin, as perceived by the citizens engaged within the project. This map is only one of the available visualisations of the First Life platform [20].

FirstLife [20] is a web platform for Computer Supported Cooperation aimed at fostering co-production of urban landscape knowledge. It provides a virtual place, a *Neighborhood Social Network*, where citizens can interact and participate in city life. FirstLife can be exploited as a pure Digital Urban Acupuncture (DUA) approach to explore the daily microhistory of citizens. The DUA approach is an innovative approach, introduced by Iaconesi et al. [19], useful in identifying the *Pressure Points* between citizens and the urban landscape, or between occupants and a building.

The Pressure Points are the contact points which cause conflicts among the different actors, i.e. citizens/occupants and the buildings/urban landscape. Indeed, concerning personal indoor comfort and according to the main principle of Adaptive Comfort - *if a change occurs such as to produce discomfort, people react in ways which tend to restore their comfort* [14] - such points represent the most interesting part of the occurring interactions between actors and the environment. Once the pressure points are identified, new punctual strategies may be adopted to improve actors' comfort, well-being and health.

For instance, decision makers could focus on unhealthy places and plan to redesign them in a regenerative way by taking into account natural and artificial places appreciated by the citizens, such as small court gardens or fountains, which have positive implications on community health [3] but are typically underestimated from the decision-makers' point of view. Thus, thanks to this approach, a more Regenerative city, able to co-benefit humans and the environment, can be designed. Figure 19 shows an example of visualisation from the First Life platform, where positive and negative transformations as declared by the citizens, are highlighted and geo-localised to support the decision-making process of urban planners and policymakers.

To sum up, the substantial implications of the surrounding environment on human indoor and outdoor comfort, well-being and health have been widely investigated in the past decades, but previous research has mainly focused on a human-centric perspective. The presented approaches and the use of ubiquitous technologies could help in understanding dynamic relationships between humans and the environment, which would, in turn, allow better applications of Regenerative Design for the built environment and the urban landscape. More in-depth investigations into the adoption of integrated governance, are needed to consider the main dynamic interactions in real-time, i.e. the Pressure Points as defined by the Digital Urban Acupuncture approach.

REFERENCES

[1] L. Lambert, H. A. Passmore, and M. D. Holder, 'Foundational frameworks of positive psychology: Mapping well-being orientations', *Canadian Psychology/Psychologie Canadienne*, vol. 56, issue 3, pp. 311-321, Aug. 2015.

[2] F. Wu, D. Jacobs, C. Mitchell, D. Miller, and M. H. Karol, 'Improving the indoor environmental quality for public health: impediments and policy recommendations', *Environmental health perspectives*, vol. 115, issue 6, pp. 953-957, Jun 2007.

[3] D. Armstrong, 'A survey of community gardens in upstate New York: Implications for health promotion and community development', *Health & place*, vol. 6, issue 4, pp. 319-327, 2000.

[4] I. Kawachi, and L. F. Berkman, 'Social ties and mental health', *Journal of Urban Health*, vol. 78, issue 3, pp. 458-467, Sep. 2001.

[5] M. W. Parkes, K. E. Morrison, M. J. Bunch, L. K. Hallström, R. C. Neudoerffer, H. D. Venema, and D. Waltner-Toews, 'Towards integrated governance for water, health and social-ecological systems: The watershed governance prism', *Global Environmental Change*, vol. 20, issue 4, pp. 693-704, Oct. 2010.

[6] P. Burdon, 'Eco-Centric Paradigm', in *Exploring wild law: The philosophy of earth jurisprudence*, Ed. Kent Town: Wakefield Press, 2011, pp. 85-96.

[7] U. Hansmann, L. Merk, M. S. Nicklous, and T. Stober, *Pervasive computing: The mobile world*. Springer Science & Business Media, 2003.

[8] G. H. Brundtland, et al., 'Our Common Future', World Commission on Environment and Development, New York, May 21, 1987.

[9] P. Singer, *Practical ethics*. Cambridge, MA: Cambridge University Press, 1993.

[10] D. Haraway, 'A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century,' in *Simians, Cyborgs and Women: The Reinvention of Nature, Ed.* New York: Routledge, 1991, pp. 149-181.

[11] M. Brown, *Futurestorative: Working Towards a New Sustainability*, London: RIBA Publishing: 2016.

[12] D. Cottafava, S. Magariello, R. Ariano, et al., 'Crowdsensing for a sustainable Comfort and for Energy Saving', *Energy and buildings*, vol. 186, pp 208-220, Mar. 2019.

[13] B. Guo, Z. Yu, X. Zhou, and D. Zhang, 'From participatory sensing to mobile crowd sensing', in *2014 IEEE International Conference on Pervasive Computing and Communications Workshops, PERCOM Workshops,* March 24-28, 2014, IEEE Computer Society, pp. 593-598

[14] J. F. Nicol, and M. A. Humphreys, 'Adaptive thermal comfort and sustainable thermal standards for buildings', *Energy and buildings,* vol. 34, issue 6, Jul. 2002.

[15] J. Surowiecki, *The wisdom of crowds*. London: Abacus*,* 2005.

[16] A. Leaman, and B. Bordass. 'Productivity in buildings: The killer variables', *Building Research & Information,* vol. 27, issue 1, pp. 4-19, 1999.

[17] G. Sonetti, E. Naboni, and M. Brown, 'Exploring the Potentials of ICT Tools for Human-Centric Regenerative Design', *Sustainability*, vol. 10, issue 4, Feb. 2018.

[18] M. A. Ortiz, S. R. Kurvers and P. M. Bluyssen, 'A review of comfort, health, and energy use: Understanding daily energy use and well-being for the development of a new approach to studying comfort', *Energy and Buildings*, vol. *152*, pp. 323-335, oct. 2017.

[19] S. Iaconesi, and O. Persico, *Digital Urban Acupuncture. Human Ecosystems and the Life of Cities in the Age of Communication,* Springer International Publishing, 2017

[20] A. Antonini, 'First Life', PhD dissertation, Computer Science Dept., University of Turin, Turin, IT, 2016.