Research Paper

The "human community" in the eye of the future cities' vision

The VARCITIES Project approach

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Abstract

In an increasingly urbanized world, governments and international corporations strive to increase productivity of cities, recognized as economy growth hubs, as well as ensuring a better quality of life and living conditions to citizens. Although significant effort is performed by international organizations, researchers, etc. to transform the challenges of cities into opportunities, the visions of our urban future are trending towards bleak. Social services and health facilities are significantly affected in negative ways owed to the increase in urban populations while issues such as air pollution and urban heat islands are being exacerbated. Nature will struggle to compensate for this in future cities, as rural land is predicted to shrink by 30% affecting livability. VARCITIES puts the citizen and the "human community" in the eye of the future cities' vision. The vision of VARCITIES is to implement real, visionary ideas and add value by establishing sustainable models for increasing H&WB of citizens that are exposed to diverse climatic conditions and challenges around Europe through shared public spaces that make cities livable and welcoming.

Keywords

Nature based solutions, health and wellbeing, smart cities

1. Introduction

The main concept behind the VARCITIES[1] project is to provide innovative solutions to redesign various urban spaces hand in hand with local stakeholders profiting from an innovative combination of nature-based solutions coupled with digital technologies and sensors. Such actions are going to be implemented in cities by means of sustainable models for increasing the health & well-being of citizens including children, young people, middle aged, and the elderly, who are exposed to diverse climatic conditions and challenges. VARCITIES advances innovation across different urban scales by fully exploiting nature-based solutions from a digital, social and cultural perspective, shifting the focus of the action from a "nature centered" vision (as usually NBS target ecosystem services) to a "human community centered" one.

[1] https://www.varcities.eu/

Public spaces are envisioned as people-centered areas to be exploited by adopting a co-design process that supports creativity, inclusivity, health and happiness for the citizens. Thus, the project will:

- Translate into practice a set of visionary solutions already envisioned by cities to re-design urban spaces;
- Monitor and evaluate the sustainability and the impact of interventions through advances in KPIs (Key Performance Indicators) inspired by a holistic approach and strongly linked to health and well-being and SDGs;
- Improve the sustainable transition to smart and future cities by creating a framework of locally adapted GBF (Governance, Business, Financing) models;
- Include various stakeholders in the co-design process and inspire sustainable and resilient future smart cities, looking at the multiple benefits approaches(Bisello, 2020);
- Achieve knowledge exchange, maximum EU investments, and advancement beyond the state of art through clustering with other European initiatives and platforms;
- Transfer, upscale and sustain best practices from VARCITIES through to the development of a **Healthy Cities Helix** and a replication toolkit

VARCITIES has identified eight European municipalities as the Pilot Cities of the project. Integrated and sustainable initiatives that increase the health and well-being of citizens will be implemented, supporting both municipal actions and local SMEs in meeting credible opportunities to grow and generate revenues. Each Pilot City has identified a pilot site for implementing local actions. These cities differ in geography, climate conditions and the challenges they face, but share the same vision of a healthier and sustainable urban future.

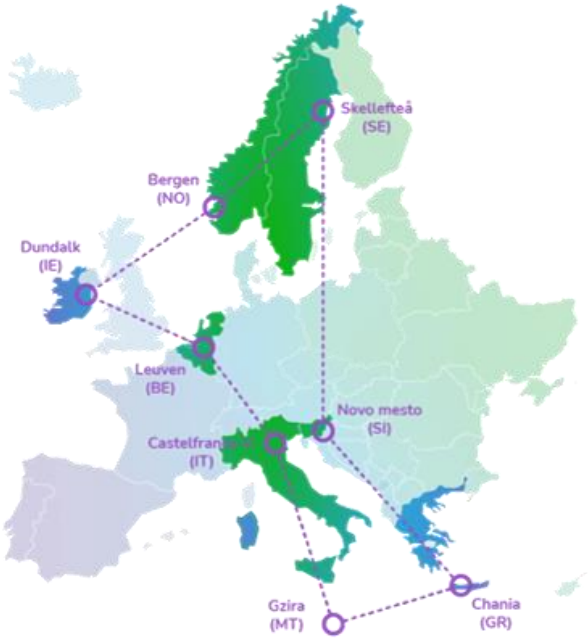


Figure 1 The map of VARCITIES pilot cities

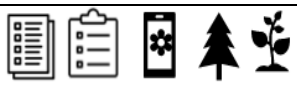
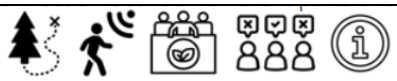
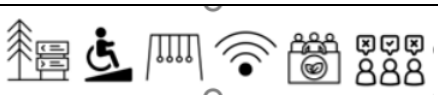
The eight Pilot Cities and related demo cases are:

- Skelleftea (SE) - Transforming old land fill area into a residential and educational area
- Bergen (NO) - Sustainable re-establishment of an urban water park
- Dundalk (IE) - Dundalk Library and Museum Quarter
- Castelfranco (IT) - A "Healing Garden" for elderly and people suffering from Alzheimer
- Novo mesto (SI) - Sports and recreational park
- Gzira (MT) - Regeneration of a high traffic road

- Chania (GR)- Creation of a Mobile Urban Living Room in open public spaces
- Leuven (BE) - Regeneration of former hospital site

1.1 VARCITIES Visionary Solutions

Visionary Solutions (VS) are challenging by definition, because they aim to tackle well known issues from a new perspective, combining groundbreaking technologies and/or testing innovative approaches for the first time ever in a specific urban context or community. A clustering of VS with common criteria was needed in order to have a shared and clearer reference framework for their subsequent design, implementation, monitoring, and assessment. The new taxonomy of VS encompasses the following four categories: Nature Based Solutions (NBS), Energy-IoT, Mobility and Knowledge/ Awareness. Table 1 represents the VS for each municipality and the components of them. It is important to mention that there are some VS that may belong to more than one of these categories. A detailed list with the explanation of each icon is described in Annex.

Type of Visionary Solution	Municipality	Visionary Solution
	Skelleftea, Sweden	Build natural infrastructure to create urban resilience
		Creation of a wetland bed to increase biodiversity
	Bergen, Norway	A digitalized urban water park including city beach
		Bergen City Beach Health Effects Assessment
	Dundalk, Ireland	Outdoor Urban Green Learning and Sensory Garden for H&WB
	Castelfranco, Italy	Creation of garden access routes and of an additional healing garden
		Full monitoring of microclimatic conditions in the different areas of the garden
	Novo mesto, Slovenia	Brownfield remediation and greening with plant species indigenous to the nearby Natura 2000 areas
		Creating sustainable forest trails
		Interconnectedness of sports, recreational and therapeutic facilities

	Gzira, Malta	Rue D'Argens: From busy to green using a participatory design process
		Urban Biodiversity, Education and Engagement through a Co-Created Community Garden Project
	Chania, Greece	Mobile urban living room
	Leuven, Belgium	Riverside urban living room linked to culture and heritage
		Health trail with the "moving Bench", therapeutic sensory garden for elderly people
	Skelleftea, Sweden	Installation of smart lighting to contribute to an inviting environment and encourage activities in the park
	Bergen, Norway	AR applications for inspiring more physical activities and area exploration
		Optimized urban park biodiversity
	Castelfranco, Italy	Analysis and monitoring of psychological and physiological well-being for elderly people and people affected by Alzheimer
		Development of a green public spaces (re)design toolbox and establishment of the "Local observatory on therapeutic effects of the landscape
		Implementation of virtual and ICT tools to ensure a rewarding experience of garden users and for the assistance of visitors with disabilities
		Adaptive and intelligent lighting systems / energy data management
	Novo mesto, Slovenia	Integrated management of the facilities

		IoT solutions for measuring the H&WB-being of visitors
	Leuven, Belgium	Sensors for health & water measurements
		infrastructure for smart lighting and noise management
	Skelleftea, Sweden	Educating and engaging citizens in the area to level up their awareness of climate change and the importance of biodiversity
	Dundalk, Ireland	Creation of Outdoor Learning Pod between Dundalk Library & Museum Quarter to showcase the newest technologies and host shared functions
	Gzira, Malta	Citizen Science on Air/Noise quality to increase H&WB awareness
	Dundalk, Ireland	Sensors on Bikes and Bike-stations
	Chania, Greece	Sensors on Bikes and Bike-stations
	Leuven, Belgium	Mobility-sensors

Table 1. Type of Visionary solutions

2. VARCITIES sensors and impacts of VSs

The link between monitoring measurements (sensors, wearables, etc.) and the assessment of the future impacts on H&WB of VSs implementation has not been operatively defined in detail yet. This will be done through the definition and calculation of a set of KPIs and the implementation of the H&WB platform that will display them. At present, such link can be described only in a qualitative way, based on the preliminary descriptions of the expected impacts on H&WB of the VSs provided by each pilot. In particular:

- Micro-climate sensors will help monitoring the VSs impacts in terms of micro-climate regulation (e.g., mitigation of diurnal temperature peaks and UHI effects)
- Air quality sensors will support the monitoring of impacts in terms reduction of local air pollution levels
- Noise sensors will help measure the reduction of noise pollution
- Water level & flow sensors will monitor the improvement of surface water quality and management

- Sensors for the number of visitors and their tracking will allow measuring the increase in the number of users of public spaces and the level of usage
- Wearables will monitor the increase in physical outdoor activity levels
- Energy meters will measure the reduction of energy consumption and/or the increase in renewable energy production.

2.1 Assessing the impact of VARCITIES implementation

In order to effectively assess the impacts of the VARCITIES project, a preliminary list of KPIs has already b een drafted in the project proposal by the consortium. Any NBS directed towards a given challenge is associated with a set of objectives and actions, which in turn are associated with expected impacts. The latter can be assessed by means of a set of indicators, with specific assessment metrics and methods. A new handbook was taken into account in order to provide a comprehensive NBS impact assessment framework, and a robust set of indicators and methodologies to assess impacts of NBS across the following 10 societal challenges. (Directorate-General for Research and Innovation (European Commission), & Arnbjerg-Nielsen, 2021)

The 10 societal challenge areas across (Figure 2) which methods of indicator determination are grouped as follows:

1. Climate Mitigation and Adaption
2. Water Management
4. Green Space Management
5. Air Quality
6. Urban Regeneration
7. Participatory Planning and Governance
8. Social Justice and Social Cohesion
9. Health and Wellbeing
10. New Economic Opportunities and Green Jobs

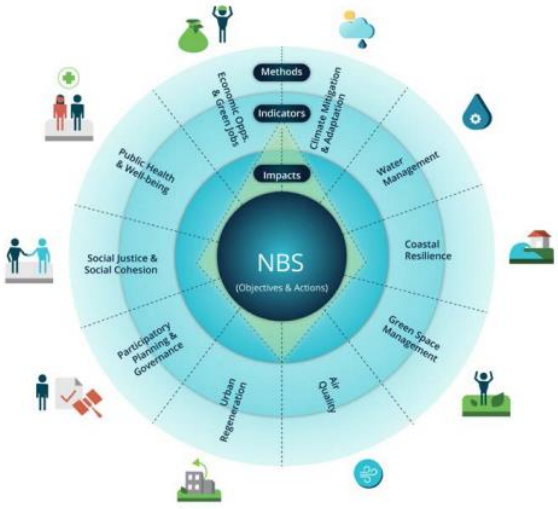


Figure 2. The 10 climate resilience challenges foreseen (Eklipse & Working, 2017)

Based on this reference framework the VARCITIES project aims also to develop a holistic assessment approach, by linking KPIs with recognized multiple benefits arising from NBS and smart city development. By doing so, the contribution of the Visionary Solutions implementation to the achievement of SDGs at the local level will become clearer.(UNEP, 2021)

3. Health and Wellbeing

Health and wellbeing are not synonym and their meanings should not be confused. According to the World Health Organization (WHO) in 1940, health is referred to as, "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"(Kelley, 2008). Also, from the other hand, wellbeing is people's satisfaction with life, an overall balance of physical, social, spiritual, emotional, environmental, and occupational status of living, that make people feel comfortable and happy with. (Stoewen, 2015)

3.1 Health and Wellbeing indicators

The VARCITIES project focuses on specific health and well-being indicators, taking into account to be all specific, measurable and realistic for achieving project objectives. The link between KPIs that are used in VARCITIES and Health and Well-Being indicators is not straight-forward and the methodology ensures that these links are established in a clear manner so that they can then be evaluated following project execution. In particular, psychological indicators are related to improvement in behavioural development and symptoms of attention deficit/hyperactivity disorder, measurements of mental health by the level of support needed by citizens, noise reduction, indicators about anxiety levels, hours of time spent outdoors.

An assessment of the personal satisfaction about life, emotional competences (ability to understand one's own and other's emotions) and coping strategies regarding everyday problems in healthy older adults, are created, using questionnaires. It should also be mentioned that portable electroencephalography (EEG) system and a wearable eye-tracker (i.e., glasses) will be used to record physiological parameters and to assess physiological changes due to exposition to natural environment in patients with dementia. Questionnaires about the quality of life and the perception of loneliness are taken into consideration, respectively. Apart from the psychological indicators, VARCITIES considers both physiological indicators and Health indicators related to physical activity. In particular, these indicators focus on children obesity, cardiovascular morbidity and mortality events. Measurements of thermal comfort will also be created as far as the health indicators related to ecosystem service provision, concerns. It also should be noted, that sensors for measuring wellbeing of visitors with disabilities will be included. Physiological and psychological well-being will be assessed using questionnaires, cognitive tests and physiological measures (e.g., eye-tracking) as part of health and wellbeing indicators.

In general, the methodology used in VARCITIES will support the transformation of various wearables to integrated telehealth devices that can be used in the future in open spaces or indoors. Specially designed Android and IOs apps, digital twins and games will be developed to acquire specific information from Citizens. Data collection and integration of local databases and Citizen Observatories for creation of a Knowledge Base is initiated while connectivity with global databases is planned. These methodologies will allow for rigorous monitoring and eventual evaluation of the outcomes from the pilot studies.

3.2 Health and wellbeing in ageing

Generally, ageing involves physical and cognitive fatigue, and brings with it an increased incidence of disability and the need for assistance in daily activities. Some main problems that the elderly face include isolation, bereavement, inadequate health status, thus many elderlies suffer from Alzheimer's disease and dementia(Levy et al., 2002). The society should promote the mental health and wellbeing in the elderly, taking into account that this will be beneficial, minimizing the costs care and improve the quality of life. (Michele Lee, 2006)

At the same time, VARCITIES project deals with health and wellbeing in the elderly since some pilot cities take into consideration older age, designing Visionary Solutions around these needs. Specifically, Castelfranco Veneto (IT) is a middle-sized city located in the central area of Veneto Region. The site is centered on Villa Revedin Bolasco and its 8 hectares garden with a lake, owned by the University of Padova (UoP), recently restored. Furthermore, the garden borders the main city hospital and a dedicated house for elderly people and an Urban Day Care Center for people affected by Alzheimer's disease, opened in 2016. Considering the mobility requirements of the guests of both the retirement home for the elderly and the day care center for Alzheimer's patients and the Venetian Institute of Oncology a specifically designed access route will be designed to improve and facilitate the movement of people. Moreover, analysis and monitoring of psychological well-being and quality of life for healthy individuals (young and elder), and physiological changes in people suffering from dementia will also take place, as wearable eye trackers and portable electroencephalograph (EEG) system.

Apart from the case study of Castelfranco, the Leuven pilot will create a Health trail with the "moving Bench", therapeutic sensory garden for elderly people, former hospital-site, in the historic center of the densely populated student-city. An innovative concept offering a complete exercise package thus contributing to an integral, smart, local health, sports and exercise policy. The moving bench (ip-it-up) is a concrete example of this. With sensors, wearables, IoT or apps the use and impact of the measures along the health trail on the health and well-being on users can be checked and stimulated. Specific measures will be taken to stimulate movement, for example regular resting points.

4. The role of COVID-19 in Health and wellbeing

Of concern to many cities, health and well-being during COVID-19 was a trigger to move from awareness to local action, as the importance of puplic space access as a driver for prevention of tranmissions and improving Health and Well-Being(Yıldırım et al., 2021). Specifically, the transitions are more limited in outdoor environments and the public spaces are key for a rapid economic recovery. Therefore, the need to provide citizens with pleasant, safe and multipurpose public space is gaining relevance on the political agendas and a wide range of stakeholders, from local associations to enlightenend investors, are increasingly turning attention to this topic.

Health and Well-Being were already part of the urban design agenda in a number of cities around the world. Cities, especially after the Covid-19 outbreak, are more than ever prepared to be engaged in the policy debate as these areas are the ones most severely affected by the pandemic(Sepe, 2021). This is not only the case from the health perspective but also from the economic and social perspective. People in cities are severely isolated from other people compared to the suburban and rural areas.

The COVID-19 pandemic on the other hand stimulated the increase of recreational activities for all citizens(Venter et al., 2020). Therefore, the experience of COVID-19 has stimulated awareness on how the cities function and what types of services they can offer to citizens. Specifically for Health and Well-Being, this can be related to open public spaces, the availability and accessibility of opportunities for leisure, sports, access to green and transportation and mobility, such bike routes and pedestrian routes(England, 2020).

5. Conclusion

The VARCITIES project provides a vision which holistically incorporates NBS by means of digital, social and cultural perspective providing the citizen with an opportunity to be at the center stage of the project inception, planning and execution. This is done within the backdrop of improving health and well-being through using novel urban spaces.

Each pilot in the VARCITIES project addresses very specific challenges, some of which with a direct relation to Health and Well-Being. Through carefully selected KPIs, linked to the latter, monitoring and evaluation of the outcomes can be carried out in a rigorous manner. The COVID-19 pandemic has added new dimensions and considerations that need to be made when addressing challenges and this will provide a set of insightful "lessons learnt" which can be replicated in future cities.

6. ACKNOWLEDGMENTS

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Annex

	User centric design methodologies		Physiological measures		Toolbox
	For limited mobility individuals				Co-design process
			Sensors		Educational material
	Questionnaires/Surveys		Tool for data analysis		Digital twin
	Public consultation		Ground and water measuring stations		Geo-localization of data
	Visual system/Screens		Sound system		Apps
	PV systems		Weather station data		Public bikes
	Data from observatories		Record keeping		Meetings/Workshops with citizens/STKs
	Social & Spatial analysis/Mapping		Outdoor lighting		Movement sensors
	Thermal imaging		Educational installation		Digital Wi-Fi/Bluetooth device
	Face recognition		Cameras		Sensor and satellite measurement
	Radar based motion detectors		Interactive information		Micro-greening interventions
	Cognitive tests		Environment measurements		Learning activities
	Interviews/Focus groups		Wi-Fi hotspots		Forest trails
	Air measurements		ICT platform/Usage of data		Environment programmes
	Information campaigns		Software installation		Wearables
	Common resources and facilities		Duration stay		Rainwater harvesting
	Planting species		Benches		Resting points
			Low energy lighting		Inventory species tool