






The Circular City Implementation: Cultural Heritage and Digital Technology

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Abstract. In a world that is increasingly facing issues related to climate change, environmental degradation, economic crisis and social inequalities, rethinking the urban development models is becoming an “imperative”. Furthermore, the COVID-19 is accelerating this necessity. In fact, the health emergency has affected almost all sectors, determining radical change in economic and social systems. Tourism and culture are among those most affected and therefore they require strategies to support their recovery and to strengthen their resilience for the future. The closure of cultural venues has highlighted the importance of finding alternative ways to join cultural heritage and to allow it continuing to develop its productive potential. In this context, the importance of the opportunities offered by digital technologies for conservation, valorization and enjoyment of cultural heritage has emerged. This study proposes the circular city as a new urban development model to achieve a more sustainable future, focusing in particular on cultural heritage as an entry point to implement this model. Furthermore, the role of technology is investigated as “enabler” of inclusive and sustainable culture-based development processes for supporting the implementation of the circular city model.

Keywords: Circular city · Cultural-led urban development · Digital technology

1 Introduction

In a world that is increasingly facing issues related to climate change, environmental degradation, economic crisis and social inequalities, rethinking the urban development models is becoming an “imperative”. Urban activities (construction, energy production, industrial production, etc.) are increasingly degrading urban space and producing negative impacts on ecosystems and quality of life.

Cities represent 85% of global GDP production and are collectors of materials and nutrients, accounting for 75% of natural resource consumption. Cities are also responsible of 60–80% of greenhouse gas emissions and produce 50% of global waste. These are signs of its organization, of its linear “take, make, waste” economy.

Considering their high concentration of resources, materials, data and talent, they are among the “best candidates” to lead the transition to new development models, such as the circular economy model¹.

Today, urban development models are even more investigated because of the pandemic due to COVID-19. The health emergency has changed the way all populations live and work and is having impacts on all sectors. It is also forcing a reformulation of urban studies. In fact, the spatial organization of the city, as well as specific aspects related for example to mobility and production systems, have to be reformulated to meet the changes due to the health crisis.

The crisis due to the COVID-19 pandemic has affected almost all sectors. Tourism and culture are among those most affected and therefore they require strategies to support their recovery and to strengthen their resilience for the future.

Today it is the pandemic crisis, but in the future, other phenomena can “put cities in crisis”. Therefore, urban development models capable of making cities resilient and ready to manage their own fragilities are needed.

In this perspective, the United Nations has drafted in recent years the 2030 Agenda [1] and the New Urban Agenda [2], two important strategic documents to guide the achievement of sustainable urban development. The 2030 Agenda includes 17 Sustainable Development Goals (SDGs), for a total of 169 targets. Among the various goals, closely interconnected, there is one that refers explicitly to cities, Goal 11: “Make cities and human settlements inclusive, safe, resilient and sustainable”.

Furthermore, the New Urban Agenda, adopted in 2016 during the Habitat III Conference, represents a “translation” of the principles of the 2030 Agenda in space, that is in the city and the territory, representing an interesting opportunity to address the role of cities in sustainable development.

Here the circular city is proposed as a new urban development model to achieve a more sustainable future. In this model, the importance of assuming the organization of natural systems (in which “nothing is waste”) as a paradigm to organize the city’s systems is highlighted. The circular city model is characterized by the principles of the circular economy making an urban system more regenerative and accessible [3, 4]. However, the circular city cannot be considered as a simple sum of urban circular economy projects [5], but it is linked to a systemic vision of the city as a “complex system” [6].

In particular, the attention is focused on cultural heritage, as an entry point to implement the circular city model [7]. The role of technology is investigated as “enabler” of inclusive and sustainable culture-based development processes able to implement the circular city model.

Today, that is in this moment of crisis due to the health emergency, the green and digital transition (which represent our generational challenges) become even more important than before [8]. In fact, there are many investments foreseen in the European recovery plan in this perspective that guarantees an acceleration in this direction, always ensuring that people are at the heart of the recovery [8].

Also in one of the two recent documents of the European Commission on the human-centred city, digitization is presented as one of the “three issues that cut across and shape the overall dynamic landscape of cities and their potential futures” (p. 25) [9].

¹ <https://www.ellenmacarthurfoundation.org/explore/cities-and-the-circular-economy>.

Indeed, digitization is a phenomenon that is already showing its impacts at different levels and in different sectors [10, 11]. It is therefore necessary to fully understand and exploit its potential to facilitate the transition to a circular city model capable of “make cities and human settlements inclusive, safe, resilient and sustainable” [1].

The use of digital technologies for the implementation of the circular model requires a paradigm shift in which all economic values co-exist and co-evolve with ecological values and with social/human ones, thus allowing the implementation of a human-centred strategy [12, 13].

After an analysis of international documents about the use of digital tools in cultural field (Sect. 2), the circular city model and the cultural heritage as the entrance point for its implementation are proposed (Sect. 3). The attention is then focused on the role of digitalization in cultural heritage conservation and valorization (Sect. 4) and on the experience of urban regeneration held in the cultural site of Catacombe di San Gennaro (Naples, Italy) (Sect. 5) in which digital technologies have played a key role for the success of the conservation and valorization strategies. Thus, the importance of value-centred approach in urban circular strategies is highlighted to emphasize the multidimensional productivity of the conservation and valorization of cultural heritage through digital technologies (Sect. 6).

2 Digital Technologies for Cultural Heritage

Cities are particularly rich and diverse in terms of culture. This aspect has influenced the elaboration of development strategies which, over time, have increasingly emphasized the central role of cultural heritage as a driver of development [14–17].

Furthermore, cities change and evolve over time. So, it is necessary to develop strategies capable of adapting over time to the dynamics of change, adopting approaches and tools able to meet community’s need [18, 19]. Digital technologies can play a central role in supporting the culture-led development strategies and thus, in conservation, valorization and enjoyment of cultural heritage.

In recent times, the European Commission has supported the culture-based development policies of the Member States with strategies aimed to favor the use of digital technologies both for virtual enjoyment and conservation and valorization cultural heritage activities [11]. Underlying the many projects undertaken is the view that the use of digital technologies can play an essential role not only in fostering cultural experiences, knowledge creation, conservation, valorization and enjoyment of cultural heritage across borders, but also in producing wider social and economic benefits, positively influencing other sectors such as tourism, education and the creative industries².

The European Year of Cultural Heritage 2018 and the recent European Framework for Action on Cultural Heritage [9] have highlighted the importance of digital solutions to make cultural heritage more accessible to all, putting this goal at the centre of policy initiatives and legislations [20, 21].

In order to monitor progress in the implementation of policies established at European level, the European Commission has set up an Expert Group on Digital Cultural Heritage

² <https://ec.europa.eu/digital-single-market/en/news/eu-member-states-sign-cooperate-digital-cultural-heritage>.

and Europeana (DCHE) which, continuing the work of the Member States' Expert Group on Digitisation and Digital Preservation, reviews and discusses the choices made in the area of digitization, online accessibility of cultural material and digital preservation. Indeed, the creation of the Europeana platform (<https://www.europeana.eu/it>) aims to strengthen the “cultural heritage community” [22] through a renewed cultural supply favored by digital technologies and by partnerships with key players in the cultural sector.

Through the DCHE, following the clear need to widen online access to cultural heritage highlighted also by COVID-19, the Commission has defined “Basic Principles” [11] to enable all actors in the cultural sector in 3D digitization processes. The Principles emphasize that the digital technologies have the advantage that they can be implemented at several levels and for different purposes. Particularly for cultural heritage, their use opens up new horizons both from the point of view of conservation, use, valorization and transmission for future generations.

Considering the advantages of the use of digital technologies, they should be incorporated into future strategies for the conservation and valorization of cultural heritage, fostering 3D digitization processes, strengthening cross-sectoral cooperation, developing new skills, improving citizen engagement and supporting spillovers in other sectors [9].

New technologies can offer an opportunity to creatively regenerate tangible and intangible values of cultural heritage, also stimulating the emergence of new organizational forms for the management, conservation and valorization of cultural heritage³. Indeed, digital technologies have the advantage of both enabling institutions to renew their approaches and tools for the preservation, knowledge, use and management of cultural heritage, and of increasing people's interest by fostering greater cultural accessibility [23].

The creation of heritage communities [24], which until now has been experimented in the spatial dimension of cities, during the pandemic has found in the virtual dimension a new space in which to stimulate the sharing of values and facilitate cultural exchange and enjoyment [25, 26]. The heritage community is linked to the concept of “culture as a common good” [27–29], that is emerging as the product of a group of people or a community sharing this resource on the basis of common interests and values [30]. The “cultural commons” [29] - unlike the common resources described by Elinor Ostrom [31] - consist mainly of and therefore have the advantage of being an unlimited resource as they are mostly information content and therefore their use by one person does not affect the possibility of others using it as well (non-rivalry). However, for cultural goods the problem arises of their management and protection [32] to ensure their transmission to future generations.

The definition of “cultural commons” [29] highlights the close relationship between culture, space and community. Indeed, community members are directly involved in the cultural process as, through the relationships they establish among themselves in the environment in which they live, they produce and manage the cultural resource in a shared way, contributing to strengthening the identity and symbolic dimension [27, 33] of the community.

³ <http://www.rinascimentodigitale.it/new-technologies-for-culture-and-heritage.html>.

The recognition of the interaction between the tangible and intangible components of cultural heritage and the increasing role of communities in co-production processes [34–36] are elements underlying the definition of “cultural commons”. In “cultural commons” the constitutive elements of a community would be identified in the common cultural orientation, in the identity based on shared interests or common projects [37], in the sense of mutual dependence and in the active involvement of at least a minority of members who indirectly conduct the activities of the community [29].

Besides cultural commons rooted in physical space, new spatial conditions are emerging [38] for which spatial proximity or direct interaction are no longer necessary conditions for a community to develop a common culture [22, 26]. In some cases, space loses its physical dimension and communities are born whose identity is based simply on sharing interests and points of view rather than on physical proximity (e.g. platforms such as Wikipedia, open source software or social networks, where users express cultural interests and points of view). The analysis of this kind of links between community members thus becomes a tool to understand what the common cultural dynamics are.

Consequently, even the concept of community no longer indicates a static structure but is an expression of relational dynamics that are built up over time.

In this perspective the concept of “digital commons” is emerging⁴ to indicate a category of open resources, freely used and democratically shared by people which have also the opportunity to further develop them and to intervene in their management. The binomial between producer and consumer is progressively diminishing and users are becoming active participants in the production, consumption and management of cultural content [34, 39], assuming the role of so-called “prosumers” [40, 41].

In this way digital technologies allow people to be easily connected with their cultural roots and thus increase their awareness of the value of their cultural heritage.

It is evident that the use of digital technologies also concerns areas that do not originate in this field, as in the case of cultural heritage, but which are nevertheless increasingly based on digital infrastructures [42] for the achievement of the goals of sharing, participation and inclusiveness [39, 43]. They are therefore only one aspect of a vision of human-centred development for a participatory, democratic and ecological society in which the objective of the common good is capable of rebalancing the relationship between individual and collective rights.

In order to take full advantage of the great opportunity offered by the use of digital technologies, it is necessary to take a systemic view, as it does not in itself replace physical conservation and does not imply digital preservation in the long term (European Commission 2020).

3 The Circular City Model Implementation: Cultural Heritage as Entrance Point

The circular economy represents a great opportunity for increasing urban productivity. To date, there are some good practices of circular processes implementation at different

⁴ <https://www.igi-global.com/dictionary/social-technologies-digital-commons/7581>; <https://whatis.techtarget.com/definition/digital-commons>.

scales in which some benefits are achieved (i.e. reduction of materials and energy costs, reduction of carbon emissions) [44].

Today there are many cities that are defining themselves as a “circular city”, but today a clear definition does not exist. Cities are implementing this new urban development model in different ways [45].

The circular city is a metaphor for a new way of looking at the city and of organizing it, transforming city linear processes in circular processes establishing long-term connections and flows (of people, food, waste, etc.) [45–47].

The circular city is a model of urban development that allows to face together, in a systemic perspective, the social inequalities and the ecological crisis that represent two fundamental nodes of today’s city. It aims to manage in a systemic way the dichotomy between environmental issues (goal of ecological sustainability) and social issues (goal of social justice), to ensure the social well-being and quality of life of all its inhabitants.

In the circular approach, resources are re-used, recycled, recovered, regenerated and shared. The construction sector is one of the most involved in the circular transition of cities. Cultural heritage represents a part or the built environment characterized by particular values and attributes that, to date, is almost lacking in the circular strategies of the city (both in literature and in concrete experiences).

Cultural heritage conservation/valorization and circular economy are intertwined, in fact both of them aim to prolong the values of a resource over time, decoupling “growth from resources consumption” [3]. The conservation and valorization of cultural heritage can be achieved through circular economy processes, and vice versa, the circular economy model can be implemented through the conservation and valorization of cultural heritage.

In particular, the conservation and valorization of cultural heritage allow conserving its use values, but also the other values as for example the intrinsic one. Conserving and valorizing cultural heritage allows to adapt the heritage to the changing needs of the community (within a threshold that does not compromise its “complex value”), guaranteeing also to future generations to join it [48].

There are many experiences related to circularization of the processes in cultural heritage field (such as in Dublin, Liverpool, Hamburg, Rijeka, Salerno, etc.), demonstrating that circular economic processes can contribute to reduce costs (i.e. management and operating costs) and that the underused or not-used cultural heritage is a “cost”.

Conservation and valorization of cultural heritage can produce multidimensional benefits: economic benefits (i.e. in terms of productivity), social benefits (i.e. in terms of employment and generation/regeneration of relationships), environmental benefits (i.e. in terms of reduction of energy consumption, waste reduction), cultural benefits (i.e. conserving “alive” a symbol of community identity) [49].

4 The Role of Digitalization in Cultural Heritage Conservation and Valorization

The role of technology in the circular city implementation is highlighted in all the definitions of “circular city”, both in literature [3, 49] and in the reports of concrete experiences [50–54]. As recognized in many scientific contributions, it can be considered

an “enabler” of that city [45]. The use of digital technologies a vital process enabler in the circular city [4]. Technology can create opportunities for innovation and the development of new products and production techniques [50].

However, the technologies, although they play a fundamental role in the implementation of circular city, they are a mean and not the aim and thus they necessarily require a strong cultural base [45].

The transition towards a more sustainable city also “passes through” the protection and valorization of cultural heritage, that are intrinsically ecological policies [8].

In fact, these activities contribute to the limitation of land consumption, the minimization of the use of natural resources and energy and they can be carried out with low environmental impacts. Both physical and cognitive accessibility to cultural heritage has to be improved.

To date, digital access to public information about cultural heritage is limited, thus reducing the opportunities for a wide use by a large number of users.

New digital platforms and strategies for accessing cultural heritage are needed to enable new experiences for citizens and operators and to improve service supply.

The development of digital technologies (increasingly rapid) also requires specific skills and new professional profiles. Therefore, investments in the training of such profiles are necessary.

As above mentioned, digital technologies have the advantage of being inter-scalar and cross-cutting across different application domains [11, 55].

From a social point of view - especially in times of pandemic - it has shown the great advantage of being able to overcome distances, ensuring continuity in both formal and informal relationships. Especially in cities, virtual relations have favored the increase of networks of active citizens on urban regeneration issues (i.e. Digital Social Innovation, Smart Citizens, Digital Commons, ecc.), leading to the authorities’ awareness about the importance of the opinion expressed by these increasingly influential social groups. In this perspective, digitization has also opened the horizons to new models of governance based on inclusion and collaboration of different stakeholders categories in decision-making. At the social level, digitization has also had another aspect relating to employment. In fact, if on the one hand it entails the ‘substitution’ of certain jobs with robot, determining unemployment, on the other it also offers the opportunity to create new jobs characterized by new skills and professional profiles [55–57].

In the economic field, digitization, thanks to the possibility of reducing the costs of shared information and managing information over large distances, has made it possible to reorganize the global economic value chain, relocating advanced economic activities to low-cost locations [58, 59].

From an environmental point of view, digital technologies are creating more and more opportunities for the improvement of the quality of environment (and consequently of quality of life), through solutions that allow a better management of resources and control of waste production and energy consumption.

At cultural level, the increasing use of digital technologies as a tool to join and share knowledge has favored the start of processes of democratization of culture, through an opening towards an increasing number of users and the involvement of the same in processes of co-production of cultural contents [34]. These new forms of interaction and

cultural experience have fostered an increase in people's awareness of the value of their cultural heritage, reinforcing the perception that it is a common and shared resource. But, in spite of these positive aspects, digitalization can be considered also as a "social divide" [60–62]. In fact, digital tools are not accessible to all: some age groups (children and elderly) and some countries (the poorest) often do not have equal access to digital goods and services and this makes social differences more distinct [63, 64].

Thus, based on the above considerations, the implementation of digital technologies represents an opportunity to improve the quality of life of citizens and increase economic prosperity while respecting European values of sustainability, prosperity and inclusion. While on the one hand this is a phenomenon that should be managed with caution in order to avoid potential risks (e.g. mismanagement of data, lack of privacy, etc.), on the other hand it is certainly a tool to address and manage the current dynamics of change at both global and local level, facilitating a fair, democratic and inclusive society, ensuring the protection of fundamental freedoms and rights, ensuring the common good through fair and transparent public institutions.

In this perspective, the goal of "circular cities" is not only to use digital technologies for waste reduction [3, 47], but it is above all to achieve human-centred development, ensuring and expanding access and use of both services and digital tools to as many people as possible, towards a more inclusive city in which citizens are "not just a resident but an actor, a stakeholder to be empowered" (p. 38) [9].

5 Cultural Heritage and Digitalization: The Italian Experience of the Catacombs of San Gennaro (Naples, Italy)

There is an increasing number of researches focused on practices that use digital technologies as a tool for valorization, conservation and innovative enjoyment of cultural heritage [26, 38, 65–77].

In this research, the case of the Catacombs of San Gennaro in Naples (Italy) was identified as a good experience.

The Catacombs of San Gennaro are ancient cemetery areas that are located underground in Naples and date back to the 2nd and 3rd centuries AD. They represent one of the oldest monuments of Christianity in Naples. The Catacombs of San Gennaro cover approximately 5600 m² excavated in the tufa of the Capodimonte hillside. They are the largest in southern Italy, are located under one of the most densely populated and characteristic neighborhoods of Naples, the Sanità District, and are an important part of the city's history, strongly intertwined with that of its patron saint, San Gennaro, whose remains were moved to the existing catacombs in the 5th century. Since then, these cemetery burial places became a place of pilgrimage until the end of the 9th century. Forgotten over the centuries, they have been rediscovered in recent times.

The recovering process of the Catacombs had to face cultural barriers that affected the entire Sanità District. Within the Ward there was maximum support because the community of the neighborhood has seen this project as an opportunity, a positive alternative for their future. It was difficult to work on the bad "reputation" of the Sanità District and the negative image that the Ward had and that blocked tourism.

Residents have increased their awareness of the value of their heritage, of the favorable strategic position of Sanità District with respect to the centre of Naples (re-establishing a connection rather than feeling isolated). The Catacombs have entered in a symbiotic relationship with the neighborhood, entering into dialogue and supporting initiatives and encouraging the creation of other activities and, at the same time, the neighborhood has reacted well by connecting with the city. This double circular process between the archaeological site and the neighborhood and between the neighborhood and the city is one of the main success factors of this experience.

This experience has had positive impacts not only on the asset itself but also on the context.

In this case of urban regeneration, digital technologies were used to respond to several needs:

- make the “visit” accessible to an increasing number of users through 3D digitization processes,
- encourage a more correct analysis of the spaces that can be used by archaeologists working on the site,
- to ensure better conservation and valorization of the site;
- reduce environmental impact by controlling energy consumption;
- enhance the values of the asset;
- foster the creation of a “heritage community” through user involvement and inclusion initiatives.

Regarding the first two aspects, in 2019 an international team elaborated the 3D model of the Catacombs of San Gennaro and the Capodimonte Observatory for the development of a virtual digital tour. This was an opportunity to experience a fruitful collaboration between different entities: Global Digital Heritage (GDH), a US-based NGO, coordinated and funded the project, establishing as its mission to democratize science and make data freely available to the world in support of cultural heritage, heritage management, education, public access and scientific research. The team also included a working group from the ‘Zamani Project’ - a non-profit organization that aims to acquire spatial information on tangible cultural heritage sites in Africa and other parts of the world for the creation of permanent digital records for future generations - and the Interdepartmental Centre for Archaeological Services of the University of Naples ‘L’Orientale’. The acquisition work, carried out in ten days, enabled the elaboration of a 3D model that served a dual purpose: it was put at the service of the archaeologists working at the site as a tool for greater knowledge of the spaces and also formed the basis for allowing virtual navigation of the site. The latter is now possible through the Google Arts & Culture app.

As mentioned before, in this practice digital technologies were also used as a tool to ensure better conservation and protection of the property and to reduce the environmental impact through the control of energy consumption. In particular, a lighting system has been elaborated through a collaboration between different bodies and professionals for enhancing the historical/artistic value of the frescoes and mosaics on the site, ensuring the conservation of the different surfaces. The system was entirely made with LED technology both for the considerable energy saving and for the ability to protect the

frescoes and mosaics from the microclimate and light, or rather the associated radiation, mainly ultraviolet and infrared. As well as being determined by the choice of LEDs, the focus on reduced environmental impact is also reflected in other measures such as the management of the on/off system via an app. During the tour, the guides turn on the lights, progressively revealing the rooms while at the same time making visitors aware of the importance of using electricity correctly and sparingly. All the rooms are also equipped with radon and humidity detection systems.

Although this project is already remarkable for its attention to reduced environmental impact and the perfect integration of the modern high-tech installation in the particular spatial setting of the early Christian Catacombs, a further important benefit is in social terms. In fact, the installation was carried out by exploiting the potential of the neighborhood, entrusting the work to “Officina dei Talenti”, a cooperative of young electricians from the Sanità District, formed thanks to the support of the Association. In this aspect, the great potential of digital technologies to offer new job opportunities through the creation of new skills emerges.

The installation of a lighting system specifically designed for the spatial peculiarities of the Catacombs, characterized by irregular shapes and strong contrasts between light and shadow, has also encouraged the organization of attractive initiatives, capable of attracting tourists and generating more income for the site. For example, in the winter of 2014–2015, the show “Le luci di dentro” was organized, part of a wider project called “Sanità A.ppI.L.” supported by MIUR (Italian Ministry of Education, University and Research), in which multimedia and new technologies play a fundamental role in enhancing the historical and artistic resources of the Sanità District in an innovative way, putting culture, beauty and humanity at the centre of development.

Finally, the recent “Global Remarkable Venue Awards 2020”, awarded by the online booking platform Tiqets, recognized that the experience of the Catacombs goes beyond the “guided tour” in that it is based on a process of development born of the local community and which, thanks to its authenticity, is able to involve users as an active part of an ongoing project of conservation, valorization and enjoyment. In this case, the Tiqets platform was recognized by the project leaders themselves as a useful tool to reach broader categories of users, but above all more predisposed to a more authentic enjoyment of the asset.

Between November 2018 and October 2019, the Departments of Economics of the University of Campania Vanvitelli and of Social Sciences of the University of Naples Federico II conducted a study to assess the social and economic impact generated on the city of Naples by the activities carried out by the cooperative “La Paranza” (which has managed the property since 2006) for the enhancement of the Catacombs of Naples.

The survey conducted on 765 visitors interviewed in 2019 shows that the degree of satisfaction of visitors is particularly high for the relationship established with the guides, whose courtesy and competence they appreciate. In addition, those interviewed say that the Catacombs represent a memorable experience, to be shared and recounted above all because of the involvement of the community and the inhabitants of the entire neighborhood who, through a process of cultural empowerment, have improved their services and skills to guarantee the visitor a complete experience. In this way, not only is the sense of identity strengthened among the local inhabitants, but a virtuous mechanism

of involvement of the tourist is created, nourishing his sense of belonging to the heritage even if it does not belong to his cultural identity.

Indeed, some positive trends [78] confirm the above: in 2006, the cooperative managing the site was composed of 5 volunteers and welcomed 6,000 visitors. Today, direct employees of the cooperative “La Paranza” increased from 5 to 40, while 217 people were indirectly employed. 43 cultural sites were regenerated, with a further 260 employees and contractors involved [79]. In 2019, 150,000 visitors were welcomed [78]. These activities have allowed the development of a social economy that has created a network of small cooperatives and artisans. The visibility of the Catacombs and the reputation of the Paranza have led in a few years to a profound change in the safety perception in the neighborhood, with the direct effect of a multiplication of commercial and tourist activities (pizzerias, bars, b&b’s, pastry shops, etc.).

In the 10 years of operation, thanks to private donations, 13,000 m² of frescoes, mosaics and places of art have been brought back to light.

The perception of Sanità District in the mass and social media, analyzed through a survey media, analyzed through a survey conducted in the main Italian newspapers (1,450 articles) and on Google Trends [79], thanks to the reopening of the Catacombs and the activities of the cooperative in the neighborhood, has profoundly changed, giving the neighborhood an image and reputation strongly characterized in a negative sense by the presence of the Camorra phenomenon. More and more space is given to “good news” and to stories of social rehabilitation.

The perception of Sanità District by inhabitants and traders, analyzed through interviews in the field, has significantly changed, recording a clear and indisputable improvement in the sense of belonging, community identity and general climate. These factors are fundamental, as shown by many studies, to foster processes of entrepreneurial genesis in difficult areas and ‘hostile’ environmental contexts.

The success and media visibility acquired by the Catacombs has rapidly enabled the site to become one of the must-see tourist destinations in Naples, as demonstrated by the survey conducted on TripAdvisor, benefiting from the large flow of international tourism that has affected the city in recent years (visitors come from about 40 different countries) that the city has experienced in recent years. In particular, an analysis of travelers’ comments and reviews, in both English and Italian, shows that visitors are extremely appreciative of the immersive experience in the district. Satisfaction with the experience led to an increase in tourist spending and encouraged positive word of mouth, amplified by the spread of social networks, with a very high impact on attracting new tourist flows. The annual variations in the number of visitors to the Catacombs of San Gennaro between 2006 and 2018 have always been in double figures, ranging from a low of 16% to a high of 54% [78].

The success and visibility achieved by the Catacombs is reflected in the increasing attention that tourist guides, specialized magazines, social media and mass media devote to the site and to the Sanità District, with numerous other related effects (e.g. by urging the CitySightSeeing bus line to include the Catacombs as a stop on the route, thus encouraging the influx of other tourists).

This case is the demonstration that digital technologies at the service of innovative and creative solutions can offer great development opportunities in facilitating the

participation of communities [39] in cultural and heritage-related activities, fostering community digital heritage initiatives [69, 80].

The activities mentioned above, together with other initiatives disseminated through social and other communication channels, have had the capacity to stimulate the regeneration not only of the site but of the entire neighborhood, increasing the number of tourists and thus increasing the economic attractiveness of the place for the birth of new activities, improving the quality of life of the local community through the physical regeneration of the context and the creation of new job opportunities, gradually reducing the condition of marginalization that existed until about ten years ago.

The case of the Catacombs, like many other recent experiences, shows that, in order to implement culture-based valorization and development processes with truly significant and long-lasting impacts, it is necessary to develop strategies based on the needs of users [18, 19], including them in the co-production processes of cultural contents [34] assuring, at the same time, the respect of local cultural identity. Digital technologies can be used as enablers of new organization, management, training, information and financing model in which participation, innovation, cooperation have represented the major success factors [81] contributing also to create community life.

The capacity of digital processes to influence socio-spatial dynamics in urban planning strategies, has highlighted the importance of adopting an approach aimed at making culture increasingly democratic and inclusive, capable of stimulating collaborative partnerships between different stakeholders (e.g. among bodies responsible for managing assets, companies, districts, business networks, local institutions and social organizations, universities and research bodies) [82].

In many of these cases it is possible to speak of a “Digital Cultural Heritage Community”. Many projects (i.e. Digital Cultural Heritage Community Project (DCHC)⁵, Open-Heritage.eu⁶) and courses (such as the one organized by Leuven University MOOC “Creating a Digital Cultural Heritage Community”⁷) have been set up on this topic, aiming at developing theoretical approaches and practical solutions to understand how digital technologies can play a fundamental role in contributing to the interaction between different actors and to the creation of collaborative relationships between them for the initiation of valorization processes of tangible and intangible cultural heritage.

Some apps, created with the aim of fostering community participation in heritage knowledge sharing and contribution [83, 84] have shown that digital technologies offer not only the opportunity to be used as a knowledge tool, but they become a real means to reconstruct a collective cultural identity and memory [33, 85] through the sharing of values, contents and visions.

⁵ The Digital Cultural Heritage Community Project (DCHC) was one of the first grants awarded by the Institute of Museum and Library Services (IMLS) under its Model Programs of Cooperation program. The primary goal of the DCHC project was to develop a model framework for collaboration on digitization projects between museums, libraries, and K–12 schools. The DCHC project was set among a group of central Illinois museums, libraries, and elementary schools. (<https://firstmonday.org/ojs/index.php/fm/article/view/872/781>).

⁶ <https://www.open-heritage.eu/>.

⁷ <https://www.edx.org/course/creating-a-digital-cultural-heritage-community>.

An example in this perspective is the platform “MUSEIDE”, founded to “give voice” to a community made up of “lovers” of cultural heritage. Born in 2017 from the idea of an Italian architect, today it is a digital platform funded by Mibact (Ministry for Cultural Heritage and Activities and Tourism) for the valorization of cultural heritage.

This community, whose name comes from the union of “Muse” and “Eneide”, aims to support the sharing of knowledge and the improvement of cognitive accessibility to cultural heritage.

Therefore, a micro-community of people who are passionate about cultural heritage is being built around Museide. Actors who play a fundamental active role in the community are the “Storytellers”, those who “tell” the cultural heritage contributing to the sharing of knowledge.

Museide makes use of a website, a specific app, an Instagram page and a Facebook page as platforms for sharing content and discussion among users.

Storytellers can “tell the story” of a cultural asset, tangible or intangible, by sharing a significant photo and description of the asset itself. After sharing, on the Museide social page, a “dialogue” is activated among the members of the community who comment on the “post” with their opinions, questions and curiosities.

There are different skills, and therefore professional figures, involved in the development and operation of this platform: programmers, translators, graphic designers, art historians and tour guides.

Considering data referring to the Instagram app, analyzing the gender of users who shared cultural content, it emerges that 55.4% of them are female.

Regarding the age of the users, the statistics show that the app is mostly used by young people, especially in the age group between 25 and 44. Most of the reviewed heritage is located in Italy (52.7%). However there are also reviews referring to international heritage: United States (4.3%), Spain (3.7%), France (3.6%), Brazil (3.5%). Surely these data depend on the fact that Museide was born in Italy, but probably they will change with the evolution and the spreading of the platform.

Analyzing the type of cultural heritage, it emerges that most of the assets reviewed are physical cultural assets and very few are related to intangible heritage, as traditions, customs, etc. This clearly reflects a cultural aspect related to the lack of awareness of users with regard to the recognition of the intangible component of cultural heritage.

6 A Value-Centred Approach for the Conservation and Valorization of Cultural Heritage Through Digital Technologies

As emerges also from the aforementioned Italian experience of the Catacombs, the success of the practices of conservation and valorization of cultural heritage depends also on the ability to adopt a systemic perspective that respects the “intrinsic value” of the asset. In other words, it is necessary to analyze and interpret its values, the characteristics of the impacts determined by culture-based development strategies, in a perspective that is as inclusive as possible and based on the expressed needs of the local community [18, 19].

The use of technology makes it possible to implement the principle of ‘integrated conservation’ expressed by the Historic Urban Landscape (HUL) approach [86], combining conservation and valorization and overcoming the dichotomy between ‘heritage

to be conserved' - as only historical evidence without significance in the present time - and 'resources to be enhanced'. This approach, stressing the importance of innovation in conservation strategies, allows to interpret it in a dynamic and creative perspective that, going beyond the prescriptive approach of the various conservation charters [87], stimulates new productive synergies between different sectors and actors. In this perspective, cultural heritage conservation becomes a "productive activity" [6] not only of contents but above all of values, both material and immaterial, preserving the existing ones and producing "new" ones in multiple dimensions.

In fact, the HUL approach, assuming a multidimensional point of view, recognizes the links, relationships and connections (even latent) within the same system, interpreting reality in a global/holistic perspective that integrates different values.

This approach aims to promote the complementarity of heterogeneous elements/components (e.g. between a site and its general urban/territorial context, etc.), enhancing those particular conditions that determine a positive interaction between them that leads to a mutual valorization [88] and to an improvement of productivity also at an economic, social and environmental level.

In this perspective, it becomes crucial to assess the multidimensional impacts of the implementation of the circular economy model in cultural heritage conservation and valorization processes.

The circular economy model and the HUL approach offer a perspective to orient cultural heritage strategies towards an increase in productivity at a multidimensional level through the use of digital technologies, while seeking both the "maximization" of intrinsic value and the maximum congruity between it and possible other values [89].

The complexity of this approach has repercussions on the evaluation level. Indeed, considering all the values of a resource, implies the adoption of value-centred valuation methods able to "capture" the value produced thanks to the circular model.

In particular, we refer to the "Complex Social Value" (VSC) [90, 91] to emphasize the multidimensionality in the evaluation process through the combination of use and non-use values. Complex Social Value, recognizing the relationship of continuous co-evolution between these two categories of values, is congruent with the multidimensional idea of sustainable development [90] in which man is at the centre of a system of relationships both with the ecological context in which he lives and with the other members of the community to which he belongs.

Embedded in the Complex Social Value there is the "intrinsic value" [91], i.e. a value in itself that a resource possesses regardless of the presence of man. Therefore, the challenge of heritage conservation and valorization strategies is to preserve the "intrinsic value" over time through the regeneration of "instrumental values" for local communities (ecosystem services - provisioning, regulation and maintenance, cultural services [92]).

The importance of recognizing this intrinsic value and granting it continuity lies in the fact that it represents the link that over time has bound man to his context, giving physical-spatial form to cultural heritage [12, 93]. It is therefore a relational value that binds the cultural asset to the context in which it arose and to the community that recognizes it as such. This relationship in the digital environment becomes interactivity [94] and expresses the capacity of digital technologies to strengthen the role of cultural heritage

as a driver for human-centred development processes, preventing it from becoming a mere consumer good.

This interdependence, i.e. this conscious mutual interaction between the asset, the tool and the user, is capable of generating a value that goes beyond mere fruition and is based on relational and circular dynamics. Indeed, digitization applied to cultural heritage contributes to the preservation and regeneration of values.

If on the one hand digital technologies are able to guarantee the preservation of the “use value” of the heritage asset, prolonging its life cycle, on the other hand they contribute to generating and regenerating its social value, fostering relationships and nurturing the construction of micro-communities based on shared values and visions [37, 69]. The ease and speed with which digital technologies enable cultural exchange, increases people’s knowledge of their cultural heritage and strengthens their awareness of the importance of passing it on to future generations, the so-called “bequest value” [95]. In this case, digital technologies are increasingly used as tools not only for transmission but also for collection to build permanent archives.

Digitization applied to cultural heritage, by increasing the opportunities for its conservation, valorization and enjoyment, increases the “option value” [96] for those who, although not having direct access to the resource, see the advantage of its possible future use and are therefore willing to pay to ensure its preservation over time. This aspect is linked to the importance that people attach to the existence of the good, regardless of whether they enjoy it directly or not. This “existence value” [97] exists especially for cultural goods, as their contribution to the formation of the cultural identity of a community [33] or country enhances the well-being of even those who would not attribute any use, option or legacy value to that good.

It is evident that the richness of the value-centred approach implies a notion of value that is not limited to the economic aspect but is able to consider also other values that include cultural, social and environmental components. This is why it is preferable to speak of Total Economic Value (VET) [98–101], expressing an economic value in which non-economic values are integrated. The integration of use value, indirect use value, option value and existence value determine the general VET equation in which option value and existence value represent the rates of the so-called “independent of use value”.

Based on these considerations, it is necessary to operationalize this value-centred approach to guide and support decision-making processes for the conservation, valorization and enjoyment of cultural heritage through the circular economy model, considering the specific attributes of digitization in these processes.

Indeed, as demonstrated by the Catacombs experience, digital technologies can contribute to the achievement of the objectives of the circular economy model and its implementation in the physical space of cities for conservation and valorization of cultural heritage.

In fact they are able to:

- activate symbiotic relationships between cultural heritage and its context through complementary systemic interdependencies, both economic, social and environmental;

- increase the capacity to make more regenerative the implemented activities (autopoietic capacity), improving their ability to self-sustain themselves through virtuous circular processes able to generate plus value at economic and social level;
- favor the establishment of a network of direct and indirect relationships with other activities;
- stimulate the activation of cooperative and collaborative processes among different stakeholders involved in a dynamic and adaptive perspective;
- implement actions for the reduction of energy and resources consumption for conservation and valorization of cultural heritage.

These attributes correspond to some of the objectives of the circular city to which the use of digital technologies [10] is able to contribute. Therefore, it is important to integrate the value-centred approach with specific evaluation methods capable of analyzing the multidimensional impacts of digitization in heritage conservation and valorization processes. In the transition towards the circular city and in its implementation, tools (i.e. evaluation, governance, financial, business tools) play a fundamental role.

The evaluation tools are important to assess and monitor the impacts of the circular projects/strategies, that is to evaluate the efficiency of this new urban development model.

To date, an officially recognized evaluative framework for assessing the circular city still does not exist. However, there are several studies that are moving in this direction⁸ [45]. A set of indicators capable of capturing the multidimensionality of the impacts that this model of urban development is able to produce is needed, while at the same time considering all the actors and stakeholders involved in the process.

In fact, these evaluation methods must be able to incorporate both quantifiable benefits (more related to economic and financial aspects) and non-quantifiable qualitative impacts that concern subjectively perceived impacts related to the well-being of inhabitants, improved quality of life and increased social capital.

In this framework, evaluation methods should be people-oriented [45] to ensure the sustainability of development processes in the medium to long term.

7 Conclusions

The crisis caused by COVID-19 showed the weakness of a world based on hyper-connection but totally disconnected with the ecosystem networks of life, ecology, biology. The ever-increasing development of digital technologies and their application in different sectors has on the one hand improved and fostered development processes, but on the other hand it has created an ever-increasing gap between humans and the ecosystem, turning the dream of a desirable future into an unsustainable world.

The current generations are strongly feeling the problem of not being able to guarantee a sustainable world for future generations and, for this reason, the need to protect the current cultural heritage to ensure its transmission is increasingly emerging.

In this perspective, the importance of the role of digital technologies in the conservation, valorization and enjoyment of cultural heritage emerges. Indeed, the usefulness

⁸ <https://www.clicproject.eu>.

of digital technologies in the service of cultural heritage, already widely acknowledged in the field of conservation and valorization (3D modelling, virtual tours, cataloguing of assets, diagnosis of pathology problems, etc.), has been enriched by a new vision in which they, rather than replacing traditional methods of conservation, valorization and enjoyment of cultural heritage, complement, support and improve them in order to make “cities and human settlements inclusive, safe, resilient and sustainable”.

Finally, a future perspective is attempted, in order to foresee the path that the implementation of these technological advances will take to the worldwide effort to document and preserve our cultural heritage.

For this reason, it has been internationally recognized that a digital transformation is needed to support the ecological transition, exploiting the potential of digital technologies to achieve the sustainability goals of the Green Deal in many different sectors [102].

In the perspective proposed by the New Green Deal, digital technologies (i.e. artificial intelligence, G5, cloud, edge computing and the Internet of Things) are fundamental to implement the circular city model, establishing a new relationship between city and periphery, city and nature.

On this basis, it is clear that there is a need to go beyond the interpretation of digital technologies as a tool for maximizing use and to re-interpret them considering their potential for implementing the ecological and circular economy model, assuming the human being at the centre of this new development model. To operationalize this vision is necessary to recover all forms of interconnection with the ecosystem, establishing a new human-earth symbiosis.

In this perspective, the interpretation of cultural heritage as part of the wider “dynamic complex adaptive system” [6] of the city, implies to consider that its evolution is closely linked to society’s one, reflecting its changes and responding to the new needs of the inhabitants, in an adaptive and circular way.

The assumption of a systemic logic and the ability to “read” complex systems, through the recognition of the interdependencies that occur within it, reflects a cultural point of view based on the principle of relationality that represents the conceptual foundation of the integrated conservation approach.

In this perspective, the role of digital technologies becomes fundamental in the realization of this principle and in the enhancement of complementarities, underlining the need to use digital tools following a broader vision than their use only for the purpose of fruition and communication.

It is therefore necessary to consider digital technologies as an opportunity to make concrete the principle of relationality that is the essence of both the HUL approach and the circular economy model. They are fundamental for circularizing the traditional economic model, promoting new forms of economy based on technology, creativity, human capital, and the capacity to innovate [103], fostering interaction and inter-institutional cooperation and stimulating forms of public-private partnership.

On this basis, it is clear that there is a need to go beyond the interpretation of digital technologies as a tool for maximizing use and to re-interpret them considering their potential for implementing the ecological and circular economy model. In fact, if on the one hand digital technologies have increased the expectations and possibilities of public

use of cultural heritage, in many cases facilitating and contributing to the valorization of intangible heritage, on the other hand it is also true that they have promoted new organization, management, training, information and financing model based on innovation and inclusion as their major success factors. The creative integration between conservation and development, from a dynamic and proactive point of view [88], contributes to the elaboration of innovative conservation strategies that, in addition to increasing the attractiveness of cultural heritage, prefigure new perspectives of rights and responsibilities of users, who from “consumers” of the good become “prosumers”, which means producers as well as users, contributing to actions of co-creation of values and meanings.

In general, digital technologies open very interesting perspective for joining and sharing knowledge, but live cultural experience is not assimilable to digital fruition because it is not capable of reproduce the multisensory perception of cultural heritage. The additional possibilities offered by such tools represent a great opportunity to implement the circular city model without abandoning the importance of putting people at the centre of development strategies.

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