MANAGEMENT AND CONTROL TOOL FOR HEALTH EMERGENCIES IN THE URBAN ENVIRONMENT

MARIO RAINALDI
University Gabriele D'Annunzio Chieti – Pescara, Italy

ABSTRACT

Recent "health disasters" call for reflection on the reduction of the public health risk brought about by the disaster and the response dispensed to pandemic outbreaks, which have revealed organisational and health gaps including global coordination and mobilisation to the event. It is therefore necessary to provide a response to a pandemic by adapting it to the specific characteristics and needs of a specific territory, preparing targeted actions and interventions to contain possible risks to the population and safeguard the maintenance of general activities and services. The objective of this study is to establish a methodology, incorporating risk reduction and preparedness in the design and planning to increase the resilience of local communities, providing guidelines for the drafting of specific area emergency plans. It is necessary to fully optimise the use in emergencies of the resources present on the territory by putting them into a system with local civil protection organisations and to maximise the use of the various assets in relation to the possible evolution of critical situations, directing the activities of forecasting, prevention, rescue and overcoming assigned to several bodies and structures. This is done by applying an innovative methodology, through the use of BIM, which must compose a database useful both for tactical-operational coordination bodies in intervention activities during the management of a crisis, and in the facility management of settlement assets, helping in the planning of technological/environmental maintenance and management activities. Acquisition and sharing of structured data in order to maximise and make more efficient the smart governance and smart economy process of the city, technologically synthesised in a three-dimensional and interactive image of the urban environment.
Keywords: pandemics, risk, management, tool, health emergency plan, BIM, CIM.

1 INTRODUCTION

Evidence suggests that the likelihood of pandemics has increased significantly due to global integration, urbanisation and changes in land use [1]. Current "health disasters" call for reflection on the risk reduction brought about by disaster and the response dispensed to pandemic outbreaks, which have revealed organisational and health gaps including global coordination and mobilisation for response [2].

Risk reduction is structured through the reduction of the vulnerability of communities affected by a possible pandemic event that exposes them to the possibility of potential dangers not only to public health but would also affect various economic, physical, environmental and social coefficients that are articulated in the community. The latter are dynamic factors that affect the varying susceptibility and sensitivity of an individual, a community, assets or systems to impacts from catastrophic events; elements, such as social inequalities, levels of urbanisation, economic vitality, growth rates, that shape a community's ability to respond to damage.

In the literature of emergencies there are a variety of techniques for examining vulnerability with methods applied in assessment that relate to risk perception and vice versa. Scarce, on the contrary, is the bibliography on vulnerability in health emergencies, i.e. the possibility of potential exposure to dangers: health, economic and social, influenced by different physical, environmental coefficients that are articulated in the community. The latter factors are dynamic, affecting the varying susceptibility and sensitivity of an individual, community, assets or systems to impacts with catastrophic events. Elements, such as social

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inequalities, levels of urbanisation, economic vitality, growth rates, that shape a community's capacity to respond to damage [3]. Thus, vulnerability can be stated in mathematical terms as the product of two factors: susceptibility and susceptibility. Susceptibility is envisaged as the intrinsic aptitude to adapt to variations derived from events, sensitivity on the other hand is understood as the celerity of the mutation through which the equilibrium of the system changes in relation to extraordinary interference.

2 CURRENT CRITICS

Carrying out a study on the Italian territory, hard hit by the Sars COVID-19 pandemic, comparing the various analytical data of recent events, through a global and multi-sectoral approach, serious critical issues emerge. For several years now, social awareness of the increased fragility of the environmental system with respect to the impacts of anthropisation has been acquired and consolidated [4], which would suggest intervening on prevention by building an interdisciplinary strategy between the programming, planning and management tools of the social, territorial and environmental systems [5]. The State-Regions Conference in its session of 25 January 2021 sanctioned the agreement, pursuant to Article 4 of Legislative Decree 28 August 1997, no. 281, between the Government, the Regions and the Autonomous Provinces, on the document "National Strategic – Operational Plan for Influenza Pandemic Preparedness and Response (PanFlu 2021–2023)", following a series of preparatory acts of the procedure leading to the adoption of the plan. The document was published in the Official Gazette No. 23 of 29 January 2021.

This is the tool through which the response to the health emergency in Italy has been based, a guideline for the drafting of regional pandemic plans contextualised to the national pandemic preparedness and response plan. A plan adapted to the specific characteristics and needs through which targeted actions and interventions were prepared, aimed at containing possible risks to the population, useful for safeguarding and maintaining general activities and services. But like the entire multitude of regulations concerning risk, they are characterised by a sectoral approach, by specific relevance to certain phenomena and by a disconnect between processes of territorial government and territorial risk reduction.

The relationship between the concept of sustainability and the government of territorial transformations is increasingly consolidating in contrast to the issues that concern the interpenetration between risk forecasting, prevention and management and the processes that govern a given area. A lack of planning of risk prevention and mitigation interventions and the definition of choices concerning land use planning lead to a series of problems at the emergency management level. Risk mitigation plans and programmes continue to constitute themselves as sectorial instruments capable of affecting planning processes only when they succeed in expressing constraints directly referred to single parts of the territory [6].

A major critical issue is the absence of zoning instruments and organic regulations concerning security in certain districts. The inherent character of a given territory calls for reflection, urban planning disciplines highlight the fact that each territory is an individual, with its own peculiarities and prerogatives that distinguish it as a unicum. The peculiar qualities thus become a characterising factor for the different geographical extensions city, urban area, suburban area, district [7]. In order to optimise the resources of a given territory, to establish rescue actions, to plan containment initiatives for the critical phase, to initiate the transcendence of the emergency and to coordinate the men and means of the local voluntary organisations present on Italian territory. The National Civil Protection Service provides a capillary network system to issue directives and unify the representatives of each operational function of the various levels: the Regional Operations Centre (COR, for emergencies involving several provinces, chaired by the president of the region or his delegate), the Relief

Coordination Centre (CCS, the main body at provincial level and chaired by the prefect or his delegate), the Municipal Operations Centre (COC) and the Mixed Operations Centre (COM, mix operation centre), thus initiating immediate decision-making and collaborative processes.

3 ANALYSIS OF A HEALTH EMERGENCY SITUATION

To better understand the management criticalities of a given territorial system, it was necessary to analyse asset management from the inside. A specific area in central-southern Italy, the Alto Sangro territory, was analysed; in the town of Castel di Sangro, the main municipality in the area, and therefore a reference point for the others, through the activation of the municipal operations centre (C.O.C.), it was possible to plan the organisational and preventive measures to be adopted for the management of the health emergency "covid-19 coronavirus epidemic" which, due to the lack of personnel, funds, structures and means of the smaller municipalities, extended its range of action outside the municipal territory for specific actions. The management of the F1 technical and planning function, through trade union decree no. 29/2020 of the municipality of Castel di Sangro through Law 225/1992 – Art. 15, allowed a process of inspection to highlight and suggest strategic conclusions to support the matter.

The immediate task of applying the aforementioned "Civil Protection Operational Measures for the management of the epidemiological emergency from COVID-19" issued on 3 March 2020 by the Department of Civil Protection of the Presidency of the Council of Ministers indicate the primary and following activities for which the COC is responsible: (a) information to the population; (b) activation of local volunteers, in agreement with the superordinate levels of coordination; (c) organisation of actions at municipal level, in agreement with what has been prepared at regional level, of actions aimed at ensuring the continuity of the supply of essential services, as well as the collection of waste in the areas affected, or that could be affected, by urgent containment measures; (d) organisation of actions at municipal level, in liaison with what has been prepared at regional level, of actions aimed at ensuring the continuity of the supply of essential goods (including fuel supplies) in the areas affected, or that could be affected, by urgent containment measures; (e) planning, or possible activation, of actions to assist the population of the municipalities affected, or that could be affected, by urgent containment measures; (f) planning and organisation of home assistance services for people in home quarantine (e.g. basic necessities, medicines, pre-packaged meals, etc.), possibly carried out by the staff of voluntary organisations, suitably trained and equipped with PPEs.

In the next phase, suitable facilities are identified:

(a) Residential facilities capable of housing COVID-19 patients who do not require hospitalisation, in order to prevent the spread of the infection and enhance the related care setting.
(b) Facilities ready to receive a large flow of people for the diagnosis of COVID-19 positivity, to control transmission; monitor incidence, trends and assess severity over time; mitigate the impact of the virus in health and social care facilities; detect clusters or outbreaks in specific settings; prevent (re)introduction in areas that have achieved sustained control of the virus.
(c) Premises where a territorial vaccination point can be set up, following the indications provided by the National Civil Protection Department with a view to promoting maximum adherence to the COVID-19 vaccination campaign, and respecting the needs of people with disabilities, located in areas that can be easily reached by local public

transport services or provided with ample parking space. All this in order to guarantee a widespread and capillary vaccination system that is necessary to ensure the rapid overcoming of the pandemic situation.

The designated locations for the "drive through" screening campaign have been identified as a number of school complexes and the largest inside the "Teofilo Patini" municipal stadium (Fig. 1), which are functional in the immediate term but lack adequate risk prevention and protection services.

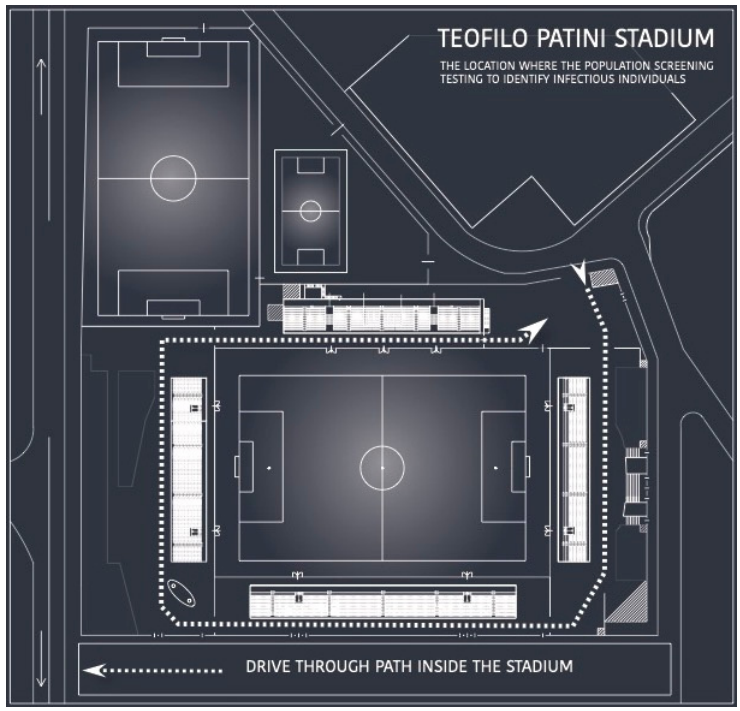

Figure 1: Layout of the location where the population screening testing to infectious individuals.

Prior and proper planning would certainly have entailed a drafting of the Risk Assessment Document (DVR) pursuant to Articles 28 and 29 of Legislative Decree 81/2008 in order to identify risk factors, assess them and understand what measures to adopt for the safety and healthiness of the work environment, in compliance with current legislation. Drawing up preventive regulations to protect users and volunteers by informing them about exposure to risks and measures to contain them.

In view of the high concentration of cars inside the facility, it would have been necessary to assess specific aspects regarding the management of emergencies and fire prevention in sports facilities, as defined in the Decree of the Minister of the Interior of 18 March 1996 and amended by the Ministerial Decree of 6 June 2005, with regard to the organisation and management of emergencies in workplaces.

It is therefore necessary to designate in advance the workers and/or volunteers in charge of implementing fire prevention and fire-fighting measures, evacuation of workplaces in the

event of serious and immediate danger, rescue, first aid and, in any case, emergency management (letter b, paragraph 1, Article 18 of Legislative Decree no. 81/2008); inform all workers who may be exposed to serious and immediate danger of the measures taken and the behaviour to adopt; plan interventions, take measures and give instructions so that workers and/or volunteers, in the event of serious and immediate danger, can cease their activities and move to safety, leaving the workplace immediately; take the necessary measures so that any worker, in the event of danger, can take appropriate measures to avoid the consequences of that danger, taking into account their knowledge and the technical means available; ensuring the presence of extinguishing media appropriate to the class of fire and the level of risk present at the place of activity, also taking into account the particular conditions in which they may be used, an obligation that also applies to fixed, manual or automatic extinguishing equipment, identified in relation to the risk assessment.

A disused public building belonging to a former Mountain Community (local bodies set up between mountain municipalities for the development of mountain areas for the exercise of their own and conferred functions and for the associated exercise of municipal functions) underwent a change of use, without following a precise procedural procedure, and changed into an extraordinary territorial vaccination point.

4 METHODOLOGY

Based on the above, it is necessary to establish a methodology, incorporating risk reduction and preparedness in planning to increase the resilience of local communities. Providing guidelines for the drafting of the emergency plan with a constructive and environmental vision, based on the development of settlement uses, using process innovation and social organisation through the analysis of the transformation processes specific to a place and time, which provide a response to a series of variable needs [8]. This is in order to fully optimise the use in emergencies of the resources on the territory by putting them into a system with the local civil protection organisations and to maximise the use of the various assets in relation to the possible evolution of critical situations, by targeting forecasting, prevention, rescue and overcoming activities assigned to several bodies and structures. In fact, the complexity of the risks requires the coordinated use of all the professional skills and resources available, as established by the regulations in force on the subject (law no. 225 of 24 February 1992); inevitably addressing the issue of emergency planning, which must no longer be of a "compilative" type but a tool for knowledge of the territory, oriented both towards risk reduction and therefore planning, and operational [9] investigating at the same time the lack of connection between "ordinary" and "emergency" planning, which, despite being joint, move on different levels, sometimes presenting considerable distances with respect to common objectives [10].

To address this issue, it is proposed to use a reformatory methodology of the city's asset data acquisition system, i.e. a new working tool for the knowledge and management of both public and private real estate assets.

The representation of urban models is implemented with a geographic information system designed to manage the territory, useful for acquiring, managing, and visualising data acquired from a given land surface in order to elaborate thematic maps that are fundamental for understanding the patterns and relationships between the various elements that make up the system. Through the use of certain software, one is able to manage a myriad of geo-referenced information, related to a tranche of territory, which can be defined in cartogram or schematised in tabular form. This technology has undergone considerable evolution in recent decades, just think of the Google Earth systems and Maps geographic Internet services that allow the search and display of maps through a link of alphanumeric and geometric data

that, through the superimposition of satellite images, constitute a planetary geographic atlas, but this structure does not allow to respond to the complex physical interactions such as human resources, procedures, tools, organisational aspects, complementary to the previous data, it is therefore necessary to resort to Geographical Information Systems [11] that are fundamental for the involvement of the stakeholders in the decision-making processes, defining forecasting activities and intervention options in a smooth way.

In order to channel all these data into a single information system, it is necessary to integrate the system and resort to a process of intelligent digitisation of the environment that involves the Building Information Modelling methodology, which can support the in-depth semantics of urban volumes, infrastructures and other functional parts of the area [12], resorting to a methodology that involves the generation and management of digital representations of the physical and functional characteristics of the building [13]. In order to perfect facility management, a grafting of data is required that generates a rapid consultation and immediate understanding of the mass of data, dissimilar to each other and acquired through different logics, coming from a given area. Taking data concerning buildings as an example: typology, geography, intended use, period of construction, construction materials, plant engineering, flexibility, a timely reading becomes impractical; as in most cases, the data of individual elements are managed within spreadsheets, project reports or in floor plans (paper or digital) without an organised information management system [14]. Research on the 3D moderation of the urban environment has mostly focused on the representation of geometric models but has generally neglected other topological and semantic aspects [15]. Recently, many researchers have paid attention to the development of 3D urban moderation, acting increasingly in certain applications such as urban planning, land-use management and flow studies [16].

This dynamic, implementable and conspicuous data should be channelled into a system, as it defines all the information concerning a characteristic component of a building, infrastructure or other, so as to compose a database useful both for tactical-operational coordination bodies in intervention activities during crisis management, analysing information and thus helping to concert strategic decisions, and in facility management of settlement assets, as well as helping in planning maintenance activities and technological/environmental management.

Acquisition and sharing of structured data with a view to maximising and enhancing the smart governance and economy process of the city, technologically summarised in a three-dimensional and interactive picture of the urban environment, useful in scenario analysis, being concretely a digital cadastre containing a myriad of information of the city, defined as C.I.M. Civil or City Information Modelling, resulting from the integration of BIM, GIS and IoT. Thus, it is possible to move from the simple concepts of GIS and BIM to that of City Information Modelling (CIM) (Fig. 2), which is characterised by a multidisciplinary union of all spatial model data [13]. An innovative system that aims to regulate the entire urban planning process through the application and use of tools applied to the optimisation of procedures, with intrinsic potential that can be extended to various types of emergency plans, not only health.

In Italy, there are types of municipal and inter-municipal emergency plans, consisting of the set of procedures to be implemented in the event of a disaster, in order to guarantee the coordination of the structures, men and means set up to manage the emergency. The essential activities to be carried out are covered, and the main actors operating in the territory and actions to ensure immediate communication to the population are indicated.

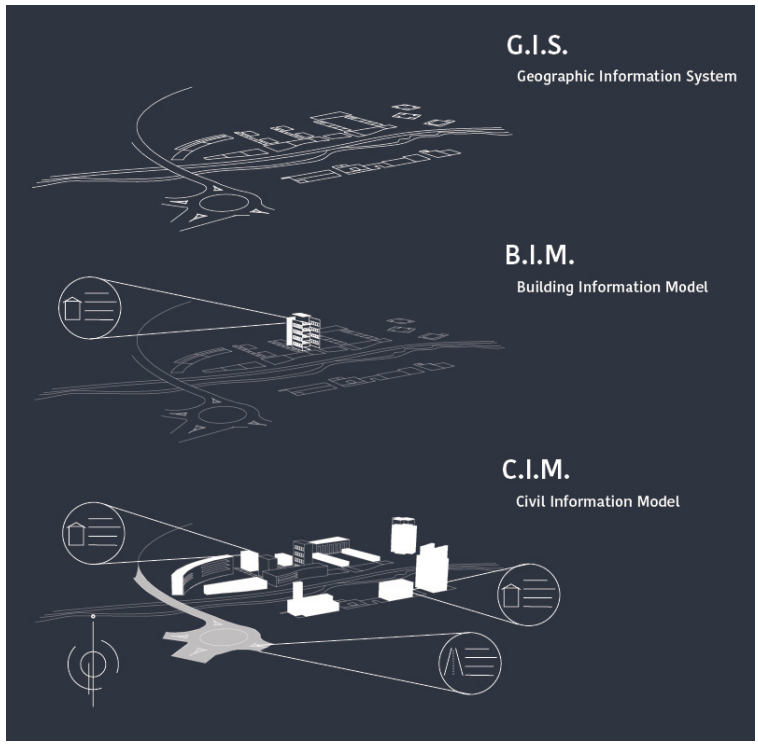

Figure 2: GIS, BIM and CIM, details of the different representations.

Generally, municipal emergency plans are structured in four sections:

1. Territorial framework, i.e. data concerning the settlement and demographic structure: number of residents, with the relative number of people with disabilities and fragility; building and infrastructural heritage, in particular information on strategic and relevant buildings, receptive structures useful for guaranteeing shelter and assistance to the population with reference to the decree of the Head of the Civil Protection Department no. 3685 of 21/10/2003 where the elements of the strategic building and infrastructural heritage are listed: hospitals, schools, universities, rest homes, places of worship, places of mass aggregation (stadiums, cinemas, theatres, shopping centres, etc.), tourist facilities (hotels, resorts, campsites, etc.), assets of artistic and cultural interest, areas of particular environmental interest; sites of Institutional bodies such as the Region, Territorial Government Offices, Town Halls, sites of Operational Structures such as the Fire Brigade, Armed Forces, Police, State Forestry Corps, Red Cross, National Alpine and Speleological Rescue Corps, National sites of Scientific Research (INGV, CNR), sites of voluntary organisations; sites of production activities, industries at risk of major accidents, landfills, hazardous waste disposal plants, plants, depots, storage sites containing radiological material; road and motorway networks, railway networks, railway stations, ports, maritime stations, airports, helicopter landing zones; telecommunications infrastructures; power stations, electricity, gas, water distribution networks; hydraulic works and interventions in progress or planned (embankments, expansion tanks, weirs, etc.); road and railway infrastructure works and crossings

(bridges, overpasses, tunnels, retaining walls). The Civil Protection Department requires the inclusion of this information in the plan, which will make it possible in the emergency phase to have the factors needed to implement the intervention model.
2. Section dedicated to the study of the hazard conditions and risk exposure of the municipal territory in order to define probable scenarios.
3. Operational Procedures i.e. the intervention model to be implemented in the event of an event. With relevant outline indications of the actions to be implemented in the first phase of the emergency.

The parametric model that is suggested to be applied, used to find and survey the urban environment, opens an interoperability between ordinary and emergency planning, opening an interesting link between the urban and building scale using only one software. The data to make up the City information Model from the GIS and BIM environment by integrating can also guarantee coordinated management in the emergency phase.

5 STRATEGY IN HEALTH EMERGENCIES

At present, the pandemic health disaster is not contemplated in the risk scenarios to which a given area is subject, i.e. explanatory documentation, of the possible effects on man, or on the infrastructures present in an area, and any possible description of generic, or particular, events that may affect an area. However, the problems described above highlight the need to prepare and organise a plan that allows a judicious choice of actions to be taken, a health emergency plan applied with CIM methodology would first of all allow the identification of areas and structures necessary to deal with the emergency and increase operational efficiency. Consider the establishment of an extraordinary territorial vaccination point following the organisational and structural guidelines related to the sars-cov-2/covid-19 vaccination campaign, the main functional characteristics and equipment, in terms of furnishings and sanitary material, of the different areas/spaces foresee:

(a) Car park located in the immediate vicinity of the vaccination site, with appropriate signage to guide the flow and behaviour of users, with particular regard to spacing and anti-COVID-19 hygiene rules;
(b) Entrance first area of the premises, in which the user's presence on the appointment list is checked; body temperature is checked; sanitisation is carried out prior to entry; vaccination documentation is handed over, or the correctness and completeness of its compilation is checked, if received in advance of the appointment (with possible support for situations of particular psycho-physical discomfort);
(c) Acceptance, an open space possibly with a suitable view of the other areas of the vaccination site. It is responsible for verifying the user's generalities and acceptance of the completeness of the documentation and its taking over and transfer to the pre-vaccination history collection and clinical assessment area; equipped with a computer workstation, internet access, telephone station;
(d) Anamnesis and pre-vaccinal clinical assessment, in linear sequence with the reception and possibly with a suitable view of the other areas of the vaccination site: technically checks documentation to define suitability for vaccination and the relevant observation time; gives the vaccinee the documentation to be handed over later to the vaccination staff for completion of the relevant fields; equipped with computer workstation, internet access, telephone station;
(e) Waiting area in front of the vaccination lines is dedicated to waiting for the vaccination, with appropriately spaced out and adequate number of seats;

(f) Preparation of vaccine doses, arranged in the immediate vicinity of the vaccine lines, separate from the waiting and observation areas, provides, in accordance with current standards and scientific guidelines: all the useful phases up to the preparation of the individual doses/syringes for each vaccination, using an aseptic technique to guarantee the sterility of each dose; the delivery of the doses/syringes to the various vaccine lines. Equipped with a refrigerator (with ensured electrical continuity where the organisation and the types of vaccine used require it), containers in accordance with the law for special waste and the safety of operators, sanitary material useful for preparing the individual doses/syringes for each individual vaccination;
(g) Administration, consisting of one or more vaccination lines and provides for: receipt of documentation and further verification of correspondence between user and documentation; carrying out the vaccination in accordance with current standards and good practice; accurately informing the user of what to do during the observation time; each vaccination line is equipped with special waste containers, sanitary material useful for vaccination;
(h) Computerised registration of the vaccinated user's data on the vaccination registry portal (or other regional information system in application cooperation) and the printing of the relevant vaccination certificate is preferably carried out by the administrative staff once the vaccination has been administered, at the time of access to the observation area. This does not exclude the possibility of registration at the same time as the vaccination, in particular where there are two operators per vaccination line. In the latter case, if at least one of the two operators is a doctor, the anamnesis, the administration of the vaccine and finally the computer registration can be carried out in sequence. Equipped with a computer workstation, internet access, telephone station;
(i) Observation, separate from the waiting area, facing the vaccination lines and the exit, is used for post-vaccination observation, for a minimum of 15 minutes. It is as close as possible to the medical care area. It is equipped with appropriately spaced seating in a suitable number taking into account the spatial criterion for defining needs (4 sq. m/person);
(j) Medical assistance, a room or space separated from the rest of the areas of the vaccination site, is dedicated to the medical assistance the user may require at any stage of the vaccination process. Where physical space does not allow for wall separation, the use of screens is useful, with the equipment of the area is specified in an annex;
(k) Exit to facilitate the rapid outflow of vaccinated users and any accompanying persons at the end of the observation period, separate from the entrance. Entry/exit routes must be clearly indicated and differentiated, avoiding overlapping. Equipped with containers for general waste.

In addition to descriptive descriptions of specific functional characteristics and personnel, equipment, devices, health care furnishings and drugs.

Foreseeing, planning and identifying a priori strategic buildings suitable for this function is fundamental to avoid unnecessary waste of money by following a circular economy model of production and consumption that implies sharing, lending, reusing, repairing, reconditioning and recycling existing products for as long as possible, without resorting to maxi-projects, as happened, to build 3,000 circular halls investing 8 million euro. This would increase the resilience of an area understood as the system's ability to adapt to conditions altered by disruption and the ability to develop and adopt alternative response strategies.

In the building context, an inability to manage the uncertainties of the changing context, i.e. the fickle environmental requirements and the equally variable requirements of the users

in that context, tends to render the "building system" obsolete and reduce its useful life. Generally by flexibility we mean the ability of a system to be easily modified so as to respond to changes in the context in a timely and convenient manner, then it can be considered in the emergency phase as a benefit for management and operational efficiency and reduces the obsolescence of such buildings guaranteeing their function and increasing the permanence of the system over time. It is necessary to set up a different vision of structures and move from the static dimension (the building as a finished product) to a dynamic and transitory vision of living in a given environment, i.e. the availability of volumes capable of evolving according to the uncertainty and variability of the users [17] (Fig. 3).

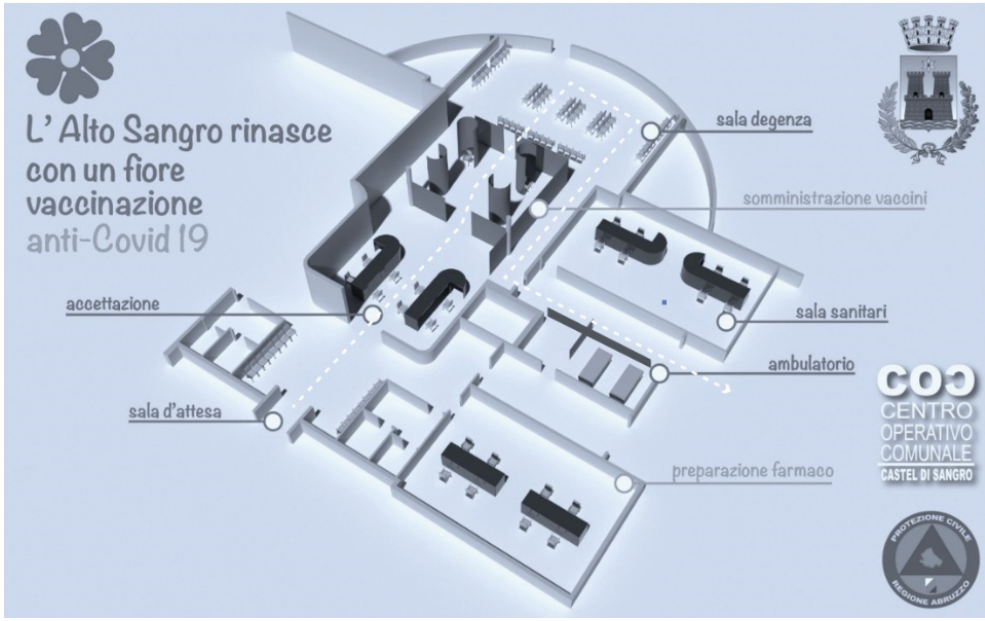

Figure 3: Representation of the extraordinary vaccination centre in the town of Castel di Sangro.

The study aimed at defining the criteria for the implementation of the flexibility of adaptability and changeability is therefore part of the ordinary and emergency planning that can be carried out through the CIM system, which is realised through the property census and three-dimensional BIM modelling of the buildings whose development will have to follow a certain LOD (level of detail and development) that defines the hierarchy of information and priorities of a single element in order to facilitate the reading in the emergency phase such as installations, maintenance, space management, safety, equipment, building geometry, height, construction material; by defining a methodology on which to base the realisation of a three-dimensional urban system, in constant update, it is possible to start a regeneration of an area through facility management as BIM provides opportunities for the management of elements by automatically making available a considerable amount of data giving an account of the real estate and its peculiarities, the number of users of a given building, the cognitive layers on land use, morphology and geology of the soil, thus becoming an indispensable control and coordination system.

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