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Sustainable cities and communities — Case studies in how smart city operating models support an effective public-health emergency response

Villes et communautés territoriales durables — Études de cas sur la façon dont les modèles d'exploitation des villes intelligentes soutiennent une réponse d'urgence efficace en matière de santé publique

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Foreword

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This document was prepared by Technical Committee ISO/TC 268, *Sustainable cities and communities*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Dealing with public-health emergencies and eliminating their impact on sustainable development has become a common challenge globally. In recent years, the Ebola virus disease, the Middle East respiratory syndrome (MERS), Zika virus and COVID-19, have caused severe consequences to countries around the world. This has critically challenged the public-health emergency management (PHEM) systems of many countries, especially developing countries. Eliminating the impact of sudden public-health events is an important goal for achieving sustainable development globally.

The rapid development of the Internet, Internet of Things, Artificial Intelligence, Cloud Computing, 5G broadband cellular networks and other information and communication technologies is accelerating change across the economy and society at large. In smart cities and communities, new network facilities, new data environments, and new technology applications offer the potential to transform the effectiveness of PHEM. This enables monitoring and analysis, virus tracing, prevention and control treatment, resource allocation and other aspects of public-health emergencies to be managed at a faster response speed, with more efficient and transparent reporting systems, and more effective medical, social and economic outcomes.

However, technology can only make a difference when accompanied by innovative ways of working (e.g. smart governance processes), supported by interoperable standards, that enable organizations to collaborate in new ways to:

— deliver integrated action, rapidly and at scale;

— engage the public in new and more interactive forms of communication and participation;

— do this through partnership across the public sector and private sector, and collaboration across local, regional, national and international levels of government.

This document is intended to inform the development of future international standards in this area on how community authorities can effectively plan and deliver this kind of smart PHEM, by drawing together and analysing best practice case studies on how cities around the world have responded to the COVID-19 pandemic.

This document has been developed by an ad hoc group bringing together members of the ISO/TC 268 and the IEC Smart Cities Systems Committee (IEC SyC SC). Case studies were gathered by national standards organizations, using an information-gathering framework aligned with the Smart City Use Case framework previously developed by IEC SyC SC; and interviews were held with senior representatives from each city to explore lessons learned and refine the case studies in more detail.

Sustainable cities and communities — Case studies in how smart city operating models support an effective public-health emergency response

1 Scope

This document identifies good practice case studies of smart city responses to COVID-19 through the use of smart technologies, smart data, smart decision-making and smart ways of working. In particular, it aims to demonstrate how the principles for smart city operating models recommended in ISO 37106 can deliver improved outcomes in public-health emergency management (PHEM), at every stage of the command-and-control process for emergency management and incident response set out in ISO 22320.

This document is intended to inform ISO 37113),[1)] which recommends a framework of good practices that can be used in responding to future public-health emergencies.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1 General

3.1.1
open data
data available without restrictions from copyright, patents or other mechanisms of control or costs, regardless of access, or use

Note 1 to entry: “without restrictions” does not mean that there is no copyright, patents, or ownership of the data, simply that users of the data are able to make use of the data under license terms that make clear that there are no restrictions on that use, other than potentially a requirement to attribute the source of the data.

Note 2 to entry: “regardless of access, or use” means that it has universal participation, and it is available to use, re-use and redistribute for any purpose, as long as the integrity of its opening and origin is preserved.

[SOURCE: ISO 37110:2022, 3.1]

1) Under development. Stage at the time of publication: ISO/DIS 37113.

3.2 Public-health emergencies

3.2.1
public-health emergency
PHE
sudden occurrence of major infectious diseases, diseases of unknown causes, major food and occupational poisoning and other events that seriously affect public health that cause or can cause serious damage to public health

3.2.2
public-health risk
likelihood of an event that can adversely affect the health of human populations, with an emphasis on one which can spread internationally or can present a serious and direct danger

3.2.3
public-health emergency management
PHEM
overall approach to preventing a public-health emergency (PHE) and managing those that occur

Note 1 to entry: In general, PHEM utilizes a risk-management approach to prevention, preparedness, response and recovery before, during and after either potentially destabilizing or disruptive events, or both.

4 Case study framework — Smart city approaches to management of COVID-19

This document supports the United Nations Sustainable Development Goals (UN SDGs) of making cities and human settlements inclusive, safe, resilient, and sustainable, and is an enabler for all six strategic purposes of a sustainable community described in ISO 37101. It identifies good practices in how communities have smart technologies, smart data, smart decision-making and smart ways of working to improve the effectiveness of their response to COVID-19. The conceptual framework used to explore these practices is illustrated in Figure 1 below.

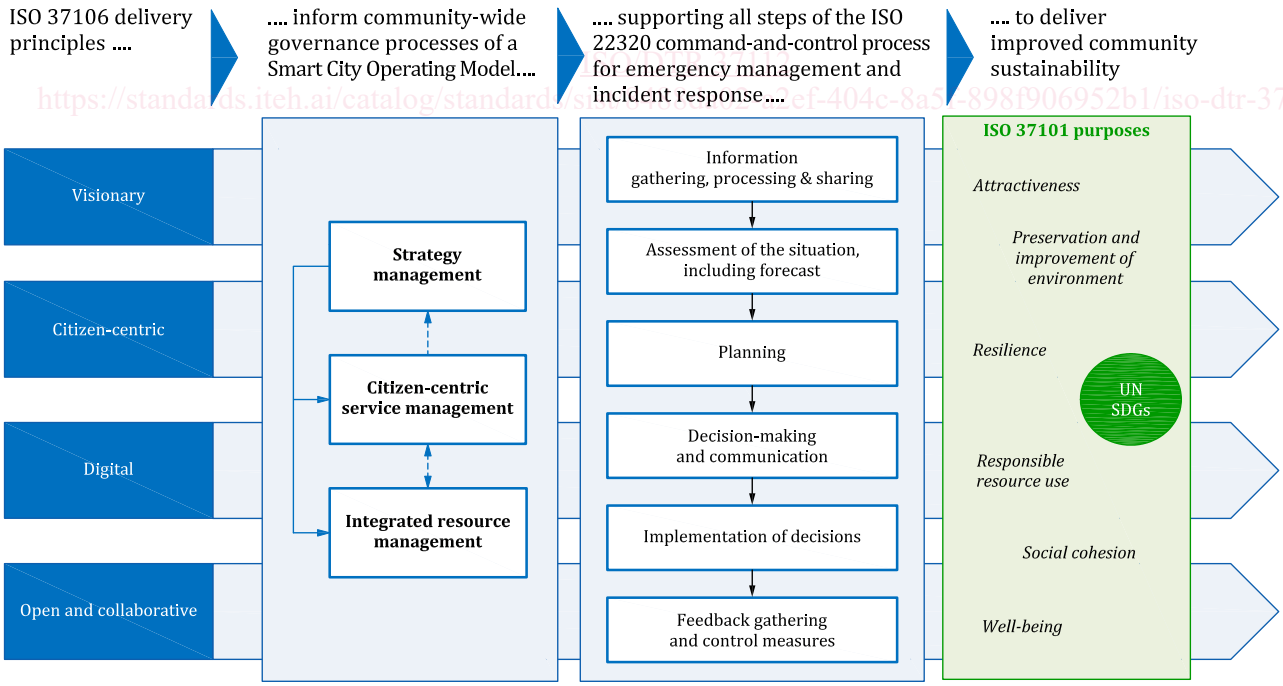

Figure 1 — Framework for Smart Public-Health Emergency Management (PHEM)

In particular, this document:

a) Is informed by

   1) the four delivery principles for a 'smart city operating model' described in ISO 37106:

      i) establishing a clear, compelling and inclusive vision for the sustainable future of the community;

      ii) taking a citizen-centric approach to all aspects of service design and delivery;

      iii) enabling a ubiquitous, integrated and inclusive digitization of community spaces and systems;

      iv) embedding openness and collaboration in the way the community works;

   2) the smart city operating model described in ISO 37106, which enable cities to implement the above principles by addressing city-wide challenges of joining up across city silos, in three areas:

      i) Strategy management: the key aspects of governance, planning roadmap development and decision-making that need to be managed at a whole-of-city level in order to provide effective responses to community-wide challenges

      ii) Citizen-centric service management: the provision of public services for citizens and businesses that are built around user needs, accessibility, inclusivity and co-created with users.

      iii) Integrated digital and physical resource management: ensuring that data on the performance and use of the community's physical, spatial and digital assets is available in real-time and on an interoperable basis, in order to enable real-time integration and optimization of city resources; and opening up community data (in secure and privacy-protective ways) in order to enable innovation by citizens, businesses and civil society.

b) Provides good practice case studies for community authorities on how these ISO 37106 delivery principles and smart city operating models can support more effective PHEM at each stage of the command-and-control process for emergency management and incident response set out in ISO 22320.

Although Figure 1 illustrates the ISO 22320 command-and-control process as a simplified, linear one, in practice it is a non-linear process with multiple feedback loops across multiple stakeholders, as illustrated in Figure 2.

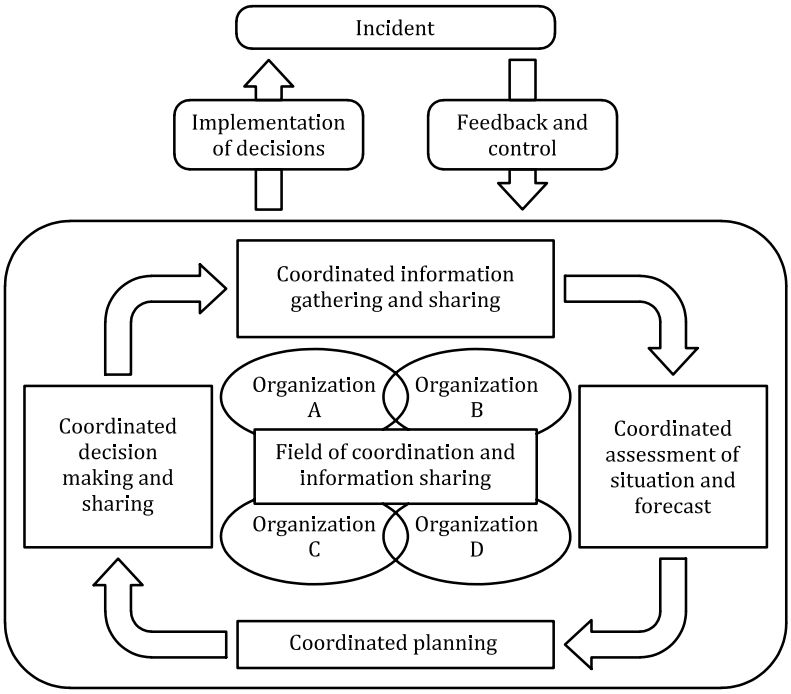

Figure 2 — Multiple stakeholder coordinated command-and-control process for emergency management and incident response

Smart PHEM uses new technologies and new ways of working to help improve each step of this process, and to facilitate speedier and more effective collaboration across the wide range of stakeholders that need to be involved at each step. Case studies on how cities have done this during COVID-19 are described below. The case studies were selected in collaboration with national standards organizations and through outreach to cities in collaboration with the IEC SyC SC and were documented in consultation with senior officials from the different cities.

5 Good practice cases across all phases of the ISO 22320 command-and-control process for emergency management

5.1 General

This clause highlights six good practice case studies. Each one focuses on a separate aspect of the ISO 22320 command-and-control processes for emergency management and incident response (as shown above in Figure 1) and demonstrates how the case study implements the ISO 37106 principles of visionary, citizen-centric, digital, and open and collaborative.

5.2 PUTRAJAYA — Observation, information gathering, processing, and sharing

5.2.1 Overview — Using the city command centre to provide integrated data sensing and sharing across all agencies involved in COVID-19 management

Putrajaya is the new Federal Government Administrative Centre for Malaysia, with a population of 109,000 and an area of 49 km^2. The Putrajaya Command Centre is an integrated data centre that monitors the city 24/7 to promote the safety and wellbeing of the community, from routine traffic management through to disaster relief. The Centre collates data from across the city, including through sensors, panic buttons and a network of CCTV cameras, and applies AI analysis of video and other unstructured data to allow for easier processing and decision-making. In doing so, it allows information to be shared between key agencies with the city, including the police, fire, and hospital emergency departments.

The Centre was core to the city's COVID-19 response. During COVID-19, the Putrajaya Command Centre became the focal point of the city's response to COVID-19, integrating data sources from across the city's infrastructure and agencies into a central location.

5.2.2 Objectives of the initiative

The Putrajaya Command Centre had three key objectives in the city's management of COVID-19:

a) To collate and interpret data points from across the city's smart city infrastructure and from the city's key agencies (e.g. police, health, transport and emergency response) into a central location for smoother and more intelligent data processing and decision making.

b) To facilitate communication and engagement between the main organisations working to control the spread of COVID-19 through the shared use of that integrated data.

c) To use insights to develop and implement a cohesive response to the PHE. This includes both:

   — coordinating actions across all relevant city agencies;

   — direct deployment of the Command Centre's own response system (a network of speakers allowed the City Command Centre administration to broadcast personalized warnings to individuals violating Putrajaya's social distancing guidelines).

5.2.3 What was achieved

Putrajaya's response to COVID-19 was informed and enabled by the Smart City Blueprint for Putrajaya, published five years previously in 2017. Informed by extensive dialogue and engagement with city stakeholders, this established a comprehensive framework to achieve the city's transformational goals by 2025. The Smart City Blueprint sets out 93 initiatives across seven smart city domains:

— smart transportation and mobility;

— smart home and environment;

— smart government services;

— smart infrastructure and utilities;

— smart safety and security;

— smart economy; and smart community.

These initiatives are citizen-centric and aim to improve urban sustainability and quality of life through the use of innovative technology as an enabler. They are prioritized along an implementation timeline divided into quick wins, short-term, medium-term, and long-term priorities, with an initial focus on prioritizing smart city security and the enabling infrastructure.

The City Command Centre was established as a key early initiative in delivering the Smart City Blueprint. A centre for all data across the city, it also built a comprehensive set of 'standard operating procedures' (SOPs), enabling a unified and collaborative response to city incidents by police, fire, hospital and other services. These SOPs cover both daily incidents, e.g. traffic accidents, and environmental disasters such as flood or fire.

The City Command Centre quickly became the centre of Putrajaya's COVID-19 response; multiple data sources were pulled into a single dashboard and COVID-19 case information was used to populate a map of the city, providing easily visualised ways of processing and analysing the information. Daily meetings were held with the mayor, hospitals, and the public-health department to share aggregated data around case numbers, locations, and potential hot spots. This integrated approach allowed the city to make informed decisions and a number of SOPs were developed to allow rapid response to new challenges.

The Centre was also used to co-ordinate related work between key city agencies. For example, if the police needed to block a road in order to minimise entry and exit to Putrajaya, this could be managed collaboratively across the related agencies to ensure a smooth response. The Command Centre also played its own role in the enforcement of social distancing protocols, allowing administrators to administer warnings to individuals violating these protocols. Nearly 100 % of people amended their behaviour to obey the social distancing guidelines following the verbal warning over the speaker system.

Through the smart integrated response to COVID-19, Putrajaya was able to effectively control the spread of the disease. Apart from a few instances when the whole nation was under lockdown, Putrajaya navigated the pandemic without needing to implement a city-wide lockdown. Instead, Putrajaya was able to implement specific, localized lockdowns in areas of high infection.

5.2.4 How the project applied ISO 37106 guiding principles

Table 1 below summarizes the core ways that the Putrajaya Command Centre put into practice the guiding principles for a 'smart city operating model' set out in ISO 37106.

Table 1 — Mapping the actions taken by Putrajaya against the guiding principles of ISO 37106.

Guiding principles of ISO 37106	Putting principle into practice
Visionary: **Establishing a clear, compelling and inclusive vision for the sustainable future for a community**	The Putrajaya Command Centre is an integral part of Putrajaya's broader ambition to become a leading example of smart city best practice. The Centre features prominently in the city's Smart City Blueprint document and promotes the smart operation of the city. It also has clear leadership support and the Mayor interacted with the Command Centre daily during COVID-19.
Citizen-centric: **Taking a citizen-centric approach to all aspects of service design and delivery**	The Command Centre has several citizen-centric design elements, including panic buttons that are available at key locations around the city or within the city's mobile app. Citizen privacy is a core consideration. Clear strategies are put in place to safeguard personal data within the City Command Centre and the technology itself was designed with citizen privacy in mind. For example, the CCTV coverage is restricted to public areas, and is equipped with a privacy-masking function which automatically blocks doors and windows from being monitored, apart from some notable exceptions such as children's playgrounds.
Digital: **Enabling a ubiquitous, integrated and inclusive digitization of community spaces and systems**	The Command Centre leverages a wide array of technologies to process multiple data streams. This promotes faster decision-making and facilitates greater collaboration between city agencies through technology-enabled communication. The use of artificial intelligence, in tandem with aggregated data dashboards, allows the Command Centre administrators and city leaders to identify new trends and to respond rapidly and appropriately.
Open and collaborative: **Embedding openness and collaboration in the way the community works**	The Putrajaya Command Centre promotes co-operation between core agencies within the city, such as the mayoral team and the police, fire, and hospital departments. This integrated way of working allows for faster and more effective response times by ensuring that accurate information about an emerging crisis is shared with the relevant agencies, allowing them to co-ordinate their response more effectively.

5.2.5 Lessons learned

Table 2 summarizes the key lessons that the Putrajaya Command Centre administration have identified in order to better inform the management of future public-health crises. It also highlights the relevant components of ISO 37106 that can be usefully applied as these lessons are implemented.