Red health code
(Color#FB382D)

Yellow health code
(Color#FF8F1F)

Green health code
(Color#57AC6C)

Benefit Evaluation of Standards for Digital Economy

Benefit Evaluation of Standards for Health Code Application in Shenzhen

Country: China

ISO Member Body: Standardization Administration of China (SAC)

Project Team:

State Administration for Market Regulation(ISO Member Body of China)
Shenzhen Administration for Market Regulation
National Technical Standard Innovation Base of Shenzhen
Shenzhen Institute of Standards and Technology
Shenzhen Big Data Resources Management Center
Shenzhen Health Development Research and Data Management Center
Tencent

Period: June 2021 to September 2021

Project Team:

State Administration for Market Regulation(ISO Member Body of China)

Ms. Li Yubing (Deputy Director-General of Department of Standards Innovative Management / Secretary-General of ISO Member Body of China)
Ms. Huang Li (Director)
Mr. Ren Yanbo (Vice Director)

Shenzhen Administration for Market Regulation

Mr.LI Jun (Vice-President)
Mr. Shi Shizhen (Chief of the Standards Division)
Mr. Xu Junwei (Deputy Chief of the Standards Division)
Ms. Yao Cheng (Deputy Chief of the Standards Division)

National Technical Standard Innovation Base of Shenzhen

Mr. Lu Hongfeng (Deputy Director)
Ms. Wang Yiqun (Secretary-General)

Shenzhen Institute of Standards and Technology

Ms. Li Yuanhong (Deputy Director, Industrial Standards Innovation Institute)
Mr. Zhang Xujie (Division Director, Industrial Standards Innovation Institute)
Ms. Deng Xuezhi (Engineer, Industrial Standards Innovation Institute)
Mr. Luo Yumin (Senior Engineer, Industrial Standards Innovation Institute)

Shenzhen Big Data Resources Management Center

Mr. Wu Gang (Director)
Mr. Pan Xiaojun (Deputy Director)
Mr. Su Zhenlong (Senior Engineer)

Shenzhen Health Development Research and Data Management Center

Mr. Yao Keqin (Director of the Center)
Mr. Wu Peikai (Director of General Department)

Tencent

Ms. Wang Yongxia (Standards Expert Researcher of Tencent)
Mr. Teng Yifan (Industry Product Director of Tencent Cloud)

Project Paticipants:

In addition to the participants listed on the project team, the following persons also participated in the project.

Shenzhen Institute of Standards and Technology

Ms. Wen lifeng (Director, International Standardization Researh Center)
Ms. Yi Xiaoshan (Engineer, Industrial Standards Innovation Institute)
Ms. Qiu Xiaodong (Engineer, Human Resource Office)
Ms. Zeng Shujun (Divesion Director, International Standardization Researh Center)
Ms. Chen Lei (Research Assistant, Industrial Standards Innovation Institute)
Ms. Hu Lu (Engineer, Industrial Standards Innovation Institute)

Shenzhen Health Development Research and Data Management Center

Mr. Zheng Jing (Chief of Informatization)
Ms. Wang Shuang (Director of Infomation Department)

Preface

With the rapid development of economic globalization, standards have become an important means to promote international trade, foster scientific and technological innovation and achieve sustainable development, and the economic benefits of standards have also won increasingly close attention from the International Organization for Standardization and experts and scholars from various countries. To accurately evaluate and quantify the economic benefits of standards, International Organization for Standardization (ISO) published a methodology for evaluating the economic benefits of standards in March 2010. The methodology provides a quantitative analysis of the impact of standards in different industries and different countries on their economic benefits from a micro perspective, and fully demonstrates the general economic benefits brought by standards through many intensive case studies. In September 2020, ISO published the ISO Strategy 2030 and proposed that all countries should continue to conduct the studies of the benefit evaluation of standards to demonstrate "the social and economic benefits of standards".

China has always attached great importance to evaluating the benefits of standards, and started to participate in and carry out related work in 2011. The Shenzhen Administration for Market Regulation and the Shenzhen Institute of Standards and Technology was entrusted to translate and publish two collections of cases on ISO Standard benefit evaluation and ISO Methodology 2.0. Dalian Shipbuilding Industry Group Co., Ltd. and Xinxing Ductile Iron Pipes Co., Ltd. were selected in the second batch of cases on evaluating the economic benefits of ISO standards. Later, as the first country to conduct the related pilot projects, China carried out a pilot project to evaluate the non-economic

benefits of ISO standards in Shenzhen and other places, with fruitful results achieved. This pilot has provided sound experience and technical support for the promotion of standard benefit evaluation in a larger scope.

To continuously participate in the work concerning the benefit evaluation of ISO standards and provide more Chinese cases and experience, Standardization Administration of China (SAC) and Department of Standards Innovative Management of State Administration for Market Regulation decided to proceed from the digital economy, the key area of the current national development strategy, to carry out a pilot study on evaluating the benefits of digital economy standards in Shenzhen, Shenzhen Institute of Standards and Technology, and National Technical Standard Innovation Base of Shenzhen will be responsible for the specific technical work. Based on the theoretical study on the methods for evaluating the social and economic benefits of standards, this pilot project develops two benefit evaluation cases for standards in the digital economy field – one for the application of health code and that for Artificial Intelligence(AI)–based Pandemic Prevention System for Pharmacies, through the systematic study and analysis of representative and typical enterprises and institutions in this industry.

Through the study of these cases, a set of evaluation methods for the benefits of standards in the digital economy has been initially summarized, and certain research experience has been accumulated, which also provides method guidance and practical reference for further development of the benefit evaluation of standards in the digital economy and other emerging fields in China. This case study, as the starting point of the research on benefit evaluation of digital economy standards, has played

a sound leading and demonstration role. We hope that more standardization experts and institutions will join us in the future, actively provide their opinions and suggestions, continue to contribution the China's experience, and continue to evaluate the benefits of standards in other application areas. Meanwhile, they are expected to promote the international application of relevant results. At last, we hope that all sectors of society can be inspired by this case, and actively pay attention to, support and participate in the international standardization work. Let's work together to promote the innovative development of the international standardization cause in China.

Zhang Xiaogang

Former President of ISO

September 28, 2021

Summary

This case uses ISO Methodology 2.0 to evaluate the impact of standards on the application of Shenzhen health code. By analyzing the value chain within the health code applications in Shenzhen, three types of organization groups were identified as being the most involved and were selected as the evaluation objects. They are the technology provider (Tencent), the data management organization (Shenzhen Big Data Resources Management Center), and the health industry authority (Shenzhen Health Development Research and Data Management Center). The evaluation scope includes the integration of R&D, data interoperability, and social application segments of the health code application value chain.

The results of the evaluation show that the standards have had a positive impact on all parties involved in the health code application in Shenzhen. For technology providers, the impact of the national health code standards is mainly reflected during the research and development integration, and through the application of these standards, it has improved the R&D efficiency of the health code application system; in respect to the data management organizations, the impact of the health code was mainly reflected during data inter-operability and social application, achieving Shenzhen's health code system to be compatible with health code systems throughout China. This was used across the entire population of Shenzhen, saving about RMB 8.2 billion in social liability costs. Technology providers improved the code showing efficiencies (from February 2020 to September 2021). They are also playing a significant role in tracking mobility, for those returning to work, to schools, and to business. For the health industry authorities, the impact of the health code standards and their related system documents were

reflected in the social application. The "yellow code" together with the verification system has improved the targeted pandemic prevention and control measures, allowing citizens to have a safer travel experience. When performing large-scale population screening, the efficiency of nucleic acid sampling with health code registration increased by 19 times; and with the 10-in-1 test method, the daily testing volume reached 4 million, increasing the test efficiency by 6.3 folds, enabling Shenzhen to achieve a round of full nucleic acid testing time that is shortened by 86.1% (from 36 days down to 5 days), significantly minimizing any economic losses caused by the pandemic.

Statement on Data Privacy Security

During the course of the study, full attention was paid to private data security protection and legal and regulatory requirements such as the Cybersecurity Law of the People's Republic of China, the Data Security Law of the People's Republic of China, and the Personal Information Protection Law of the People's Republic of China were strictly observed.

Content

1 Background of the Health Code Application

Our "Personal Health Information Code", also known as the " Anti-epidemic Pass Code" and is referred to as just a "Health Code" for short, in the GB/T 38961-2020 Personal health information code-Reference model, under Section 3.1, where a sequence of numbers or letters are bound to a resident's identity that contains the user's credential for others to view or for temporary access to an organization. Two-dimensional code is usually used as its storage medium,according to the needs of requirement in different scenarios, the health code has been implemented with a "red,yellow and green" colored, two-dimensional code to distinguish individuals with different levels of risk.

The COVID-19 pandemic is a major public health emergency, and the wide and rapid spread of the virus has made prevention and control very difficult. According to the World Health Organization's (WHO) latest real-time statistics, as of September 2021, there have been more than 200 million confirmed COVID-19 cases worldwide, covering across more than 200 countries and regions around the world. Combating the COVID-19 pandemic is becoming more complex, and with it, the ongoing preventative and control efforts must not be neglected.

In the early stages of COVID-19 transmission, travel restrictions and quarantines were urgently adopted throughout various parts of the country so to stop the spread of the epidemic. While these initiatives have been effective in cutting the chain of virus transmission, the progress caused significant economic losses. In order to roll out scientifically proven preventive measures, as well

as to improve the control efficiency of the pandemic, restoring the living standards of those affected, and reducing the impact on the economy, the "Shenzhen-i-You" [1]self-declaration system was officially launched on February 1, 2020, which is able to provide data support for the very first time to identify the health status of citizens in Shenzhen. On February 9, 2020, Shenzhen became the first city in China to implement a "code for travel" during the epidemic by implementing measures to certify the movement of their resident [1]. On February 11, 2020, Zhejiang Province used the "red, yellow and green", a two-dimensional color-coding scheme that acts as a digital health certificate for public areas. These codes were used to enter/exit highways, shopping malls, and various other public places. By February 24, 2020, the health code travel system had become fully operational across 200 cities in China, becoming the main means of digitally preventing the spread of the disease. On March 6, 2020, the company Tencent, together with the Shenzhen Institute of Standards and Technology, published their first domestic health code group standard T/SZS 4010-2020 Reference architecture and Technology guide of Anti-epidemic Pass Code, which provides technical support for the application and implementation of health code for various regions and possible scenarios.

With the rapid popularity of health code in China and to make the necessary adjustments to the application, for example, the inconsistent code composition, the inconsistent data formation, the lack of ability to share data, and absence of structured mechanisms, China's national government service platform launched their own application system on February 29, 2020 along with a guideline documenting the National Integrated Online Government Service Platform for Epidemic Prevention and Health

[1] WeChat applet for Shenzhen citizens to declare their health status.

Information Code Service. This guideline sets precise guidelines in the prevention and control of epidemics, as well as the orderly resumption of work and production, and the data interconnection of the application system. At the same time, China's State Administration for Market Regulation and Standardization Administration of the P.R.C. (SAC) initiated a fast-track procedure for the development of national standards for health code, and released three national standards, GB/T 38961-2020 Personal Health Information Code – Reference Model, GB/T 38962-2020 Personal Health Information Code – Data Format and GB/T 38963-2020 Personal Health Information Code – Application Interface, on April 29, 2020, to unify and guide the construction and implementation of domestic health code application systems.

To some extent, even till now, the health code continues to play a critical role in preventing and controlling ongoing outbreaks. As part of the Government and Enterprise Cooperation exploration, the health code has played a significant role in tracking mobility, getting citizens to return to work, to school, and to business.

2 An Introduction to the Health Code Technology

2.1 The Health Code Architecture

The "Integrated Platform Health Information Service System" refer to Figure 1.

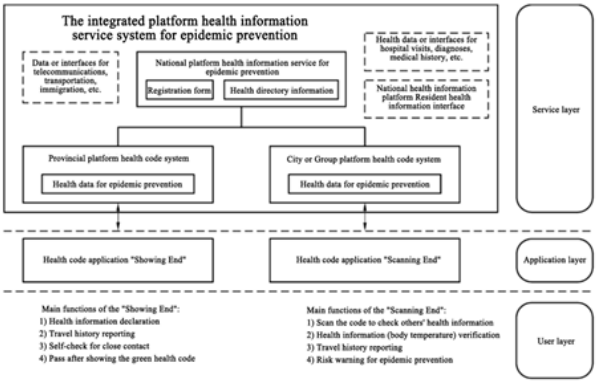


Figure 1 Framework of the integrated platform health information service system for epidemic prevention

At a service level, the State has set up the "Integrated Platform Health Information Service System" on the national integrated online government service platform, refer to Figure 1. Among them, the National Government Service Platform provides health code registration, systematizes local health code directories, and provides information services based on these directories and a consolidated entry point for disputes. The established local health code application systems are respectively interfaced with the National Government Service Platform. To be registered on this platform, individuals are able to obtain a system login, personal verification, and access keys, as well as submitting information and collective data services. Regional health code application systems that have not been built can be used as a health code application system for the region by using the national government service platform health code and combining it with the data resources and management needs of the region. At the same time, the health code application system of the national government service platform is docked with information system interfaces such as telecommunications, transportation, immigration, and

health diagnosis in accordance to the epidemic prevention and control needs, bringing together regional and personal epidemic prevention and control information on multiple dimensions and levels to provide a set of comprehensive data for social governance and permission for personal travel.

On an application level, the software offers two usage modes depending on the user (an individual user mode or a usage mode for social organization groups). Additionally, for individual uses, it provides a "Bright–Code" function and a "Code Scanning" function for social groups. "Bright–Code" is used to provide functions such as health information, trip tracking, close contact self–check, and entering venues where the display of the Code is required. The "Code Scanning" function acts as a code scanner for health information verification of an individual, health status (temperature record) verification, trip tracking, potential epidemic risk alert, and other health–related information.

2.2 The Display Format of Health Code

The health code is composed of numbers and/or letters and is structured into three segments, A, B, and S. Refer to Figure 2.

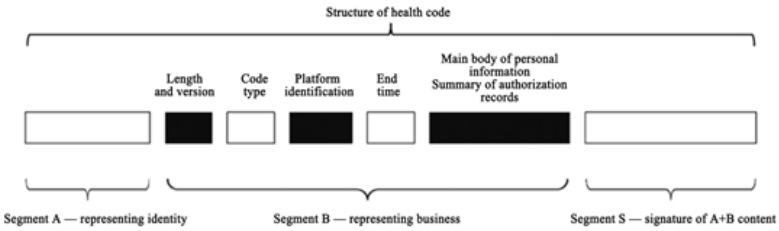


Figure 2 Health code structure

Segment A is the user identification, whose name was obtained after the person is authenticated, and represents the identity of the person's information; Segment B is the service data that represents a specific set of information, for example, the identification of the code-making platform, the cut-off time of the code and a summary of the authenticated record of the individual's information; Segment S is the digital signature value for the content of A+B, signed with a cryptographic algorithm that meets the requirements of the National Cryptographic Administrative Standard.

Once the code is generated, the code can be arranged into a QR code in the corresponding system's health code app or service. The health code format is shown in Figure 3.

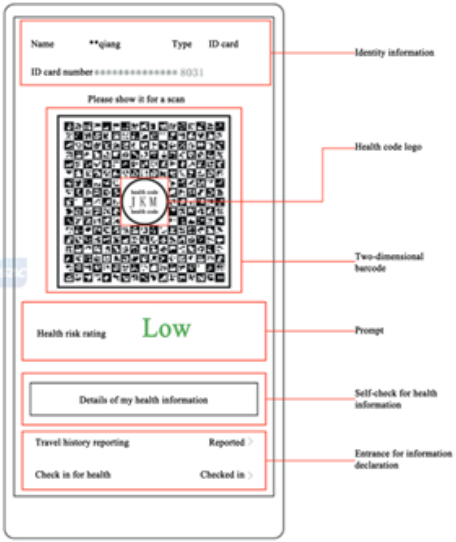


Figure 3 Example of a health code display

According to the needs of epidemic prevention and control

management, the health code has been implemented with a "red, yellow and green" colored, two-dimensional code to distinguish individuals with different levels of risk, as shown in Figure 4. Within which, "RED" represents a high-risk indication, the "YELLOW code" represents a medium-risk indication, and the "GREEN code" represents a low-risk indication.

Red health code (Color #FB382D) | Yellow health code (Color #FF8F1F) | Green health code (Color #57AC6C)

Figure 4 Examples of different health code colors

2.3 Health Code Application System Protocol

2.3.1 Protocol for Individuals

The general steps for individuals to retrieve and use the health code application are as follows.

a. In the national or municipal app or on the webpage, click on the link to retrieve the health information code for vaccination.

b. Register using personal information;

c. After the information is authenticated, individuals are asked to fill in and complete their personal health records on the system to receive their personal health code;

d. Display the "Bright-Code" for travel to show that their health status is suitable for travel.

e. Individual users fill out health information on the Personal Health Declaration page based on their immunization management needs.

2.3.2 Processes Used by Social Organization Groups

The generic steps for the use of the health code application by groups of social organizations are as follows (using public places as an example).

a. Identification of administrators and testers by groups of social organizations.

b. The administrator enters the corresponding page in the APP or application, creates the public place and fills in the place information, and the place name is created successfully after it is confirmed by the industry authority.

c. Administrators access the operations page to manage staff members and testing points;

d. The inspector enters the inspector's end through the appropriate portal and enters the premises declaration code to bind the premises.

e. The assessor carries out identification, body temperature tests on people passing through the venue and scans their health code to register any abnormalities;

f. By setting up different testing points, administrators can scan code, and have users register their travel locations by sweeping the code at public venues;

g. Statistical analysis of data.

Other types of establishments can also create a premise code

according to the corresponding procedure and use it for the registration of health information of the persons on the premises.

2.4 Health Code Application Scenarios

Individual users can apply to open a "health code" after filling in their own health information at a mobile communication terminal or on a special terminal device, and the declared information will be checked to generate a health code, with which individuals can enter a variety of public places, such as communities, traffic checkpoints, public transport, public areas, and so forth, so as to fulfill the needs of social organizations groups to quickly verification an individuals status in different scenarios. Detailed sites as follows:

-- In communities (villages): For those scenarios where traveling between residential zones exists, such as between communities (villages), lite-codes and the scanning of those codes act as digital credentials to enter and leave the place of residence.

-- At traffic chokepoints: vehicle verification for urban traffic chokepoints, requires the display and scanning of code as a declared electronic credential for entering the city.

— Boarding public transport: for passengers boarding at massive terminals with a fixed and enclosed venue, such as coach terminals, depot terminals, airports, and railway stations, passengers are characterized by a single-passage access code to reach the platforms;

— Public venues: Factories, universities, hospitals, shopping malls, marketplaces, hotels, parks, scenic spots, and other crowded areas that have fixed and closed entrance(s) and exit(s), are characterized by single-person access;

— Nucleic acid testing sites: Particularly for settings where residents undergo nucleic acid tests, individual health code are scanned and the nucleic acid test result are linked with the individual's information.

Health information can be filled in by nominated individuals; for the elderly and the young, they can have family members complete the form; and for the widows and orphans, they can have their community lodge this form. After which, a "health code" may be applied on their behalf.

When the elderly and those that are not-of-age, who do not have access to mobile or similar special access devices, they can print a paper format of their health certificate that has an extended validity period of the "Bright-Code" pass.

3 Overview of Evaluation Subjects

Since the spread of the epidemic in China, Shenzhen has quickly adopted technology to help prevent and control the epidemic and resume work and production in the city, becoming the first city in China to establish a "travel-by-code" setting. In the process of developing and applying the health code application system, internet enterprises represented by Tencent, invested a lot of manpower and resources for urgent research according to epidemic prevention and control management needs, and successfully developed the health code application system and promoted its application in the city. As the data management agency for the daily operation of the health code application system, Shenzhen Big Data Resources Management Center picks up the day-to-day operation and reviews data of the health code system ensuring accurate, data-driven management of pandemic

prevention and control. Subsequently, the health code was vigorously promoted and applied in communities, supermarkets, traffic toll-gates, public transportation systems, and public areas, with the general public requiring to "travel with code", and it quickly restored the normal production level and life order in the city. Therefore, three groups that had used the health code the most were selected for this pilot exercise. They are the technology provider (Tencent), the data management organization (Shenzhen Data Resource Center), and the health department authority (Shenzhen Health Development Research and Data Management Center) were selected for the evaluation.

Shenzhen Big Data Resource Management Center (hereinafter referred to as "Shenzhen Big Data Center") affiliated with Shenzhen Municipal Government Services Data Management Bureau, is an independent legal public institution. The Shenzhen Big Data Center is responsible for building and managing constructions, as well as manages, operate and maintain the city's larger data. During the epidemic prevention and control period, the Shenzhen Big Data Center integrated the health code application system to the Shenzhen government service platform and was responsible for the daily operation and management of the health code application system, data aggregation, and analysis, providing accurate technical support for the prevention and control of the epidemic.

Shenzhen Health and Health Development Research and Data Management Center (hereinafter referred to as "Shenzhen Health Research and Data Management Center") is an institution directly under the Shenzhen Health and Health Commission, with the following main functions: they are responsible for the construction, operation and maintenance of the city's health, health data-

platform, information systems, and security work; responsible for the technical support of the city's health and setting up health norms and standards, and the coordination of the city's medical and health institutions to promote the unified collection, sharing, analysis and application of data.

Tencent is a leading web-based technology company. In February 2020, Tencent took the lead in launching China's first "health code" using digital technology. As of February 2021, the "Tencent Health Code" has been implemented in more than 20 provincial administrative units, covering more than 400 cities and regions, and used by more than 1 billion people in China for schools, subways, buses, airports, pharmacies, hospitals, parks, and various crowded sites.

4 Attitudes towards Standardization among Assessment Recipients

Shenzhen Big Data Center has actively carried out standardization works of government services, government data management, and information security, compiled DB 4403/T 113-2020 Code Specification of Public Credit Information, DB 4403/T 114-2020 Specification for directory of public credit information resources and other local standards in Shenzhen; they also formulated and implemented more than 130 quality management-related procedure documents, and fully utilized big data, cloud computing, and other technological means to continuously improve the city's management level in urban management, government services and other areas of refinement, intelligence, and digitalization. To strengthen the preventative measure of the epidemic, Shenzhen Big Data Center gathered internet operators, internet companies,

and other such organizations to develop and launch the Shenzhen Health Code to curb the epidemic. As the managing body of the health code system, Shenzhen Big Data Center is persistent in its standardization to optimize the health code application, such as actively using the National Standard GB/T 38963–2020 to destabilize "data silos" and enabling interconnection between Shenzhen health code application system with the health code application systems of other provinces and cities, making it possible for the activities of healthy people amidst the epidemic.

SHDRDC focuses on improving the quality of health services and standardization of industry supervision, and strengthens the construction of the quality standard system in the health care industry through a series of quality control work such as establishing a full-time standardization team, continuously improving the regulatory standards in healthcare, and proposing and formulating seven ISO international standards; in the aspect of epidemic prevention and control, the public health information platform should be constructed to use information-based means to realize data interoperability and synergistic sharing of information within the health system, taking the symptom monitoring system of COVID-19 as the breakthrough point.

Tencent highly values the standardization of technology, products, and services, in addition to the improvement of service quality, it has set up a dedicated standardization team to act as an organizational guarantee while establishing a standard management mechanism and facilitating the improvement of standardized long-term feedback regime including "development of standards, standard-compliance, standards achievement and declaration". From the perspective of "solidifying technological achievements, standardizing technological applications and

strengthening technological innovation", Tencent has been strengthening its research standardization, participating in more than 60 domestic and foreign standard industry organizations, and currently holds more than 30 standardization technical seats. Tencent formed the Standards Special Committee of Internet+ Development Association of China and developed and released developments such as Health Code, Cloud SaaS, and Zero Trust. During the period of epidemic prevention and control, together with the Shenzhen Institute of Standards and Technology, Tencent took the lead in releasing the first domestic health code group standard T/SZS 4010–2020 (known as the Reference Architecture and Technical Guide for Epidemic Prevention and Passage Code) on March 6, 2020, which provides a guide reference for the technical application and implementation of health code in various regions and sites. At the same time, the company has participated actively in the development of three National Standards for personal health code uses and promote the standardized implementation of these codes in China.

5 Worth–of–Chain Analysis of Health Code Applications

In order to achieve the purpose of the study and to clarify the roles and positioning of each participant in the health code application ecological chain, the study analysis proposed the application value chain of health code, which is shown in Figure 5. Technology providers represented by Tencent carried out health code application developments and integration based on social governance needs. They also provide industry authorities with system operation monitoring, data–encrypted transmission, abnormalities in handling problematic issues, resource utilization,

system update, and other system maintenance work. The data management agency is responsible for the operation and management of the health code application system, providing network security protection, security scanning, and carry out comprehensive analysis on all types of collected data to prevent the potential transmission of the virus and provide comprehensive support and protection on a social level. Industry authorities formulate policies within their industry. They make a significant contribution to consolidate and manage data, and diligently promote social adoption for their responsible areas to combat the epidemic. Social organization groups implement the main responsibility for epidemic prevention and control in accordance with the government's prevention and control policy requirements and the management needs of their units, so to prevent the risk of potential epidemic transmissions. Individuals predominantly declare their healthy information by "Code-Showing End" to facilitate their own travel and check their health status.

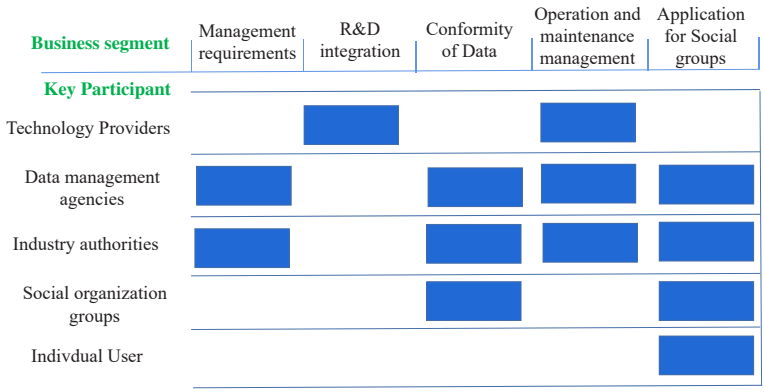


Figure 5 Health code application value chain

6 Critical Value Drivers and Scope of Assessment

6.1 Key Driver of Value

The key-value drivers are the strategic organizational capabilities that empower different parties who are involved in the health code application chain to promote the use of health code. Table 1 shows the key value drivers of the health code application chain.

Table 1 Key value drivers

Affiliates	Key value drivers	Description
Technology providers	R&D Production	To provide an online application system and restores travel freedom for the population using informative technology tools.
Data management agencies	Establishing a wider data interoperability	Through the form of cross-system communication, it enables health code data of different application systems to be interconnected thus achieving "a single entry, cross-province recognition".
	Setting up an even easier user-friendly access	Provide users with an easy-to-access electronic health credential for travel and health management needs.
Industry authorities	To establish a more effective social governance	Through the collection of data, the system analyzes those information to the existing legislations to improve the level of social governance during the epidemic period.

6.2 Scope of Pilot Assessment

The scope of evaluation is limited to those with business processes that meet the standard of yielding demonstrable benefits and is also limited to those where its activities are closely

linked to key value drivers. Based on the health code application value chain, business segments that have a significant impact on the effectiveness of each organization will be selected as research targets. According to the research results and interviews, the scope and manner of impact for standards from different participants within the health code application chain differ, as shown in Table 2.

Table 2 Scope of the pilot assessment

Affiliates	Scope for evaluation	Activity Description
Tencent	R&D Integration	Research development and integration of key technologies, and the development and deployment of health code application systems.
Shenzhen Big Data Center	Conformity of Data	The adoption of a uniform data specification and application interface to interconnect data from other health code application systems.
	Application for Social Groups	Utilize health code for an efficient and cost-effective social governance, provide a convenient way to provide users with verification of their health status, and meet the needs of the elderly and young.
Shenzhen Health Research Digital Management Center	Application for Social Groups	Improve efficiency and reduce administrative costs in the health prevention process through the use of health code.

6.3 Applicable Standards

After identifying the key business aspects of each participant through research data and interviews, this study identifies the standard used within each of these key aspects, as shown in Table 3.

Table 3 Applicable standard for the evaluation

Associated participants	Associated business activities	Standard category	Standard used	Standard description
Tencent	R&D Integration	The National Standards of China	GB/T 38961–2020 Personal health information code–Reference model	Includes the architectural component, coding system and presentation, system reference model and application requirements of personal health information code.
		The National Standards of China	GB/T 38962–2020 Personal health information code–Data format	Data structure, data meta–attributes, data format, and data management requirements of personal health information code.
		The National Standards of China	GB/T 38963–2020 Personal health information code–Application interface	Consists a set of interface rules, interface descriptions, and interface applications for the Personal Health Information Codes Application interface.

Associated participants	Associated business activities	Standard category	Standard used	Standard description
Tencent	R&D Integration	association standard	T/SZS 4010–2020 Reference architecture and Technology guide of Anti-epidemic Pass Code	Architecture, technical requirements, and data protection of the health code.
Shenzhen Big Data Center	Conformity of Data	The National Standards of China	GB/T 38961–2020 Personal health information code–Reference model	Includes the architectural component, coding system and presentation, system reference model and application requirements of personal health information code.
		The National Standards of China	GB/T 38962–2020 Personal health information code–Data format	Data structure, data meta-attributes, data format, and data management requirements of personal health information code.
	Social application	The National tandards of China	GB/T 38961–2020 Personal health information code–Reference model	The architecture, code system and display format, application system reference model, and application requirements of personal health information code.

Associated participants	Associated business activities	Standard category	Standard used	Standard description
Shenzhen Big Data Center	Social application	The National Standards of China	GB/T 38962–2020 Personal health information code–Data format	Data structure, data meta–attributes, data format, and data management requirements of personal health information code.
		The National Standards of China	GB/T 38963–2020 Personal health information code–Application interface	Consists a set of interface rules, interface descriptions, and interface applications for the Personal Health Information Codes Application interface.
Shenzhen Health Research Digital Management Center	Application for Social Groups	The National Standards of China	GB/T 38961–2020 Personal health information code–Reference model	Includes the architectural component, coding system and presentation, system reference model and application requirements of personal health information code.
		The National Standards of China	GB/T 38962–2020 Personal health information code–Data format	Data structure, data meta–attributes, data format, and data management requirements of personal health information code.

Associated participants	Associated business activities	Standard category	Standard used	Standard description
Shenzhen Health Research Digital Management Center	Application for Social Groups	The National Standards of China	GB/T 38963–2020 Personal health information code–Application interface	Consists a set of interface rules, interface descriptions, and interface applications for the Personal Health Information Codes Application interface.
		System Documen–tation	Notices for the issuance of the Technical Specification for the COVID–19 Nucleic Acid 10–in–1 Mixing Assay Joint Control and Prevention Mechanism (JCPM) Medical Development [2020] No. 352[2]	Specify specifications for sample collection supplies, collection site requirements, collection process, specimen delivery, laboratory acceptance, specimen testing, and quality control, test result processing, post–test sample handling, basic technician requirements and biosafety protection.

[2] Issued by: State Council Joint Prevention and Control Mechanism for Response to the New Coronavirus Pneumonia Epidemic Medical Treatment Team

7 Selection of Key Operational Indicators to Determine the Impact of the Standard

Through a number of detailed research on the three types of evaluation targets, combined with data from the relevant individual and authoritative public sources, an activity analysis within the scope of the health code pilot can confirm the operational indicators generated by the health code series, as shown in Table 4.

Table 4 Operating indicators applied in this assessment

Affiliated parties	Associated business segments	Operating indicators	Description of indicators	Standard used	Impact
Tencent	R&D Integration	R&D efficiency	Cost of time spent on the technical development of the health code application according to the prescribed technical route	GB/T 38961–2020 Personal health information code–Reference model	When the standard is used, it will improve the efficiency of the development of health code applications through uniform technical requirements.
				GB/T 38962–2020 Personal health information code–Data format	

Affiliated parties	Associated business segments	Operating indicators	Description of indicators	Standard used	Impact
Tencent	R&D Integration	R&D efficiency	Cost of time spent on the technical development of the health code application according to the prescribed technical route	GB/T 38963–2020 Personal health information code–Application interface	When the standard is used, it will improve the efficiency of the development of health code applications through uniform technical requirements.
				T/SZS 4010–2020 Reference architecture and Technology guide of Anti-epidemic Pass Code	
Shenzhen Big Data Center	Conformity of Data	Cross-regional mutual recognition	Data interoperability with health code application systems across China	GB/T 38961–2020 Personal health information code–Reference model	After the use of the standard, it will promote cross-regional mutual recognition of the data of the health code application system in various places and realize "one code for all".

Affiliated parties	Associated business segments	Operating indicators	Description of indicators	Standard used	Impact
Shenzhen Big Data Center	Application for Social Groups	registration volume	Number of individual users in the city	GB/T 38962–2020 Personal health information code–Data format	Quickly and easily promote health code app registration after using the standards.
				GB/T 38963–2020 "Personal health information code–Application interface	
		number of uses	Number of times an individual has displayed their health code status	GB/T 38963–2020 Personal health information code–Application interface	Using a standardized format to provide individual users with tools to display personal information.
		appropriate for the elderly and the young	Health Code Applications Meeting the Application Needs of the Elderly and Young Children	GB/T 38961–2020 Personal health information code–Reference model	The ease of using the health code application through multiple channels and meeting the needs of users young and old.

Affiliated parties	Associated business segments	Operating indicators	Description of indicators	Standard used	Impact
Shenzhen Health Research Digital Management Center	Application for Social Groups	precise prevention and control	Risk classification and control of populations during outbreak prevention and control	GB/T 38961–2020 Personal health information code–Reference model	Management measures taken to identify potential outbreak risk spread in a timely manner.
		improve efficiency and reduce costs	Change the original business process to achieve higher efficiency and cost savings	GB/T 38963–2020 Personal health information code–Application interface	Update the impact of the original workflow and methods on the efficiency of work, improving efficiency and reducing social costs.
				Notices for the issuance of the Technical Specification for the COVID–19 Nucleic Acid 10–in–1 Mixing Assay Joint Prevention and Control Mechanism (JCPM) Medical Development [2020] No. 352	

8 Qualitative and Quantitative Assessment of Standard Benefits

8.1 Impact of Standards on Tencent

In this pilot project study, the technology providers represented by Tencent were selected for the research work. After communicating with Tencent's health code standards and product team experts, the introduction of health code standards has significantly improved R&D efficiency in the R&D and integration links. The specific analysis is as follows.

Before using the standard, Tencent's development team urgently launched the development of the health code application system during the Chinese New Year in 2020, investing a development team of about 30 people and spending seven days (about 210 person-days) to take the lead in developing the "health code" in Shenzhen. After using the Chinese national standards GB/T 38961-2020 Personal health information code-Reference model, GB/T 38962-2020 Personal health information code-Data format, and GB/T 38963-2020 Personal health information code-Application interface and association standard of Shenzhen Standards Promotion Council T/SZS 4010-2020 Reference architecture and Technology guide of Anti-epidemic Pass Code, Tencent's development team followed the rules of unified technical architecture, data format and application interface to carry out R&D work, which enhanced the consensus on technology R&D within the company as well as external units and improved the R&D efficiency of technology providers. For example, in the 2021 Sichuan Health Code Application System R&D project, only 10 developers were invested to complete the development work in 4 days (about 40 person-days), saving about 170 person-days

and improving the R&D efficiency by 4.25 times, see Figure 6.

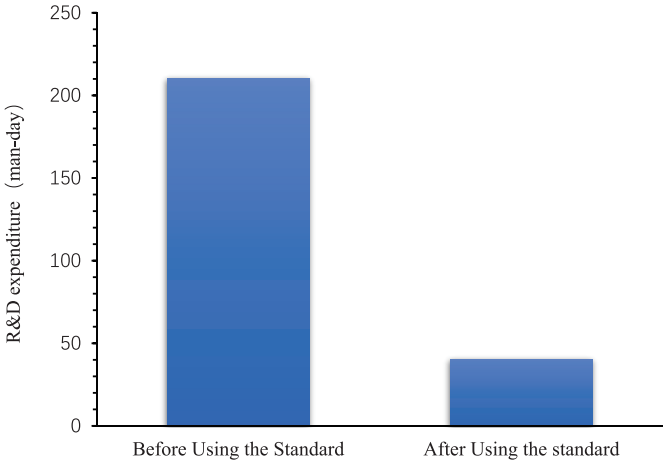


Figure 6 Comparison of Tencent's R&D investment before and after using the standard

8.2 Impact of Standards on Shenzhen Big Data Center

In this pilot project study, the Shenzhen Big Data Center was selected for the research work. After several rounds of communication with experts, they uncovered that the standards had obvious benefits in terms of data interoperability and wider social application of the health code.The specific analysis is as follows.

(1) Cross-regional mutual recognition

According to the experts at Shenzhen Big Data Center, before implementing the standards, Shenzhen has been the first city to use the "travel with code" guideline on February 9, 2020. Those who visited Shenzhen are required to register and use the

Shenzhen health code application system, but at that time the system had not yet achieved data interoperability between cities. With the Chinese national standards GB/T 38961–2020 Personal health information code–Reference model and GB/T 38962–2020 Personal health information code–Data format being in play, the Shenzhen health code application system is now able to follow a unified convergence of health information directory with health code systems across China, and collect personal health data in accordance with a unified data format to facilitate data interoperability of those health code systems between provinces. On April 11, 2020, Shenzhen's health code application system and the health code application systems of Guangdong Province and the national government service platform realized mutual recognition of health code, basically realizing the "one code pass" of health code and ensuring "one entry and mutual recognition across provinces" of data. Individuals with a "No Abnormality" health code of the National Government Services platform or "Green" health code of their own cities, will be able to pass through the Shenzhen traffic gates, residential areas, stations, airports, ports, passenger stations, ferries and opened terminals, hospitals, parks, and other public areas, without the need to repeatedly apply for and show the Shenzhen health code. This played a significant role in residents' mobility, work and production resumption, and returning to school and business.

In terms of cross–border data interoperability, the Guangdong Health Code Application System and the Macao Health Code Application System have formally executed their data transfer and established mutual recognition in May 2020. As of 23 June 2020, a total of 5,817 Macao personnel and 53,120 Mainland personnel have been provided with Guangdong Health Code to Macao Health Code service, effectively enhancing the level of convenience in

customs clearance for personnel from both places. [2]

(2) Registration volume

According to experts at the Shenzhen Data Center, the results of the seventh census of China show that the resident population of Shenzhen is 17.56 million [3]. After using the Chinese national standards GB/T 38962–2020 Personal health information code–Data format and GB/T 38963–2020 Personal health information code–Application interface, individuals upload their own health data information through the health information declaration interface, providing users with a convenient and unified registration portal and promoting the use and application of health code. As of September 2021, the number of users registered in the Shenzhen Health Code Application System has reached 33.16 million, inclusive of the migrant population, almost achieving citywide population coverage.

(3) number of uses

After the implementation of the Chinese national standard GB/T 38963–2020 Personal Health Information Code Application Interface, the Shenzhen Health Code Application System provides users with a health code call application interface, which facilitates individual users to initiate health code status inquiry and apply for remote service support. According to experts from the Shenzhen Data Center, as of September 2021, the cumulative number of lighted code in the Shenzhen health code application system was 1.713 billion, and the cumulative number of code swept was 23.662 million. Before using the standards, it took about 5 minutes to register and display personal health information on paper, and the authenticity of the data could not be effectively guaranteed. After using the standard, individuals can quickly display their health status and other information within as little as 15 seconds through

the "Code-Showing End", which saves more than 285 seconds and increases efficiency by 19 times. In terms of personal-time saved through the Health Code Application System Code Showing (from February 2020 to September 2021), it saved Shenzhen approximately RMB 8.2 billion in manpower and time cost, which is equivalent to approximately 0.3% of Shenzhen's GDP for 2020, a detailed calculation is shown in Appendix A.

From 21 May 2021 to 13 July 2021, two rounds of Delta virus outbreak occurred in Shenzhen (the "521" outbreak occurred at the Shenzhen Yantian Port and the "614" outbreak occurred at Shenzhen Bao"an International Airport), Shenzhen quickly rolled out multiple destination screening and health verification for those entering and leaving public areas and on public transports[3]. According to experts from Shenzhen Big Data Center, during the period from the two outbreaks to the complete control of the pandemic, the number of code showing times on the Shenzhen health code application reached 837.534 million (about 48.8% of the cumulative number of code showing times on the application), and the number of code scanning times was 978,000, strongly supporting the emergency prevention and control in Shenzhen during the pandemic in scenarios such as nucleic acid testing, traveling, and access to public places.

(4) Appropriate for the elderly and the young

China has stepped into the mobile Internet era, and mobile phone-based bright code and sweeping operations have been integrated into the public's daily activities of food, clothing, housing and

[3] The "521" outbreak at Yantian Port in Shenzhen refers to a round of outbreak caused by an international cargo ship at Yantian Port in Shenzhen on 21 May 2021; the "614" outbreak at Baoan Airport in Shenzhen refers to a round of outbreak caused by an inbound international flight on 14 June 2021.

transportation. Since the spread of the pandemic, the health code application system has been providing users with convenient operations such as health status declaration, code showing and scanning, and queries with the help of mainstream applications such as WeChat, Alipay and DingTalk. Before using the standards, there were difficulties for elderly and adolescent users who did not have mobile terminals or could not use them to make health information declarations on their own. With the use of Chinese national standard GB/T 38961–2020 Personal Health Information Code—Reference Model, health information can be filled in and health code can be claimed by community grid members or family members on behalf of the elderly and children, and paper health code within the validity range are allowed to be printed for daily travel, greatly facilitating the use needs of the elderly and young users.

8.3 Impact of Standards on the Shenzhen Jianyan Digital Management Center

In this pilot project study, Shenzhen Health Research Data Management Center was selected to conduct the research. After rounds of communication with experts and analysis of data released by Shenzhen, we learned that the health code has played a significant role in Shenzhen's epidemic prevention, as well as targeted prevention and control, and efficiency improvement and cost reduction in Shenzhen. The specific analysis is as follows.

(1) Precise prevention and control

Prior to the use of the standards, individuals traveling would be exposed to many uncertainties about potential exposure to transmission risks due to the inability to distinguish the health status of different persons at risk. Without precise prevention and

control of persons at risk, the restoration of normalcy to society as a whole will be extremely difficult. After using the Chinese national standard GB/T 38961–2020 "Personal health information code–Reference model" standard, the "red, yellow and green" code assignment system is implemented in various parts of China through certain rules, which can quickly and efficiently identify high–risk individuals and take targeted measures to carry out precise prevention and control, making personal "green code" travel safer.

In June 2021, Guangdong Province implemented the scheme of "yellow code + nucleic acid testing" for individuals at risk in key areas and places, and Shenzhen conducted precise management on individuals with yellow codes in accordance with the unified requirements of Guangdong Province. According to public data, during the "614" outbreak at Baoan Airport, Southern University of Science and Technology Hospital was designated as the nucleic acid sampling site for the "yellow code" users in a certain area in Nanshan District. From 14:30 pm on June 20 to 8:30 am on June 21, the hospital took samples from over 3,000 "yellow code" users, and the testing results were uploaded to the "COVID–19 Nucleic Acid Testing Information System of Guangdong Province"[4]. At present, Shenzhen has asked hospitals above the second level in the city and district (including public hospitals and socially run hospitals) to set up a "special channel" for "yellow–coded" persons and provide quick nucleic acid sampling and testing. If the result is negative and uploaded to the system, the yellow code is automatically lifted to a green code. This measure reduces the risk of contact transmission between "yellow code" users and "green code" users, and demonstrates the value of socially accurate governance.

(2) Efficiency gains and cost reductions

In terms of nucleic acid sampling, the Chinese national standard GB/T 38963–2020 Personal Health Information Code—Application Interface provides users with a unified health code calling application interface, so that individual users can display their personal information on the "Code–Showing End". Through the nucleic acid testing system, samplers scan the health code on the "Code–Showing End" to quickly register the user for sampling and link to testing information, which greatly improves the efficiency of sampling registration. According to the nucleic acid testing samplers, without the health code, it could take about 5 minutes for a medical worker to register an individual for nucleic acid testing sampling, and a sampler could only sample up to 12 people in an hour; with the health code, time for sampling registration was reduced to less than 15 seconds, and a sampler can sample up to 240 people in an hour, increasing the efficiency by 19 times, as shown in Figure 7.

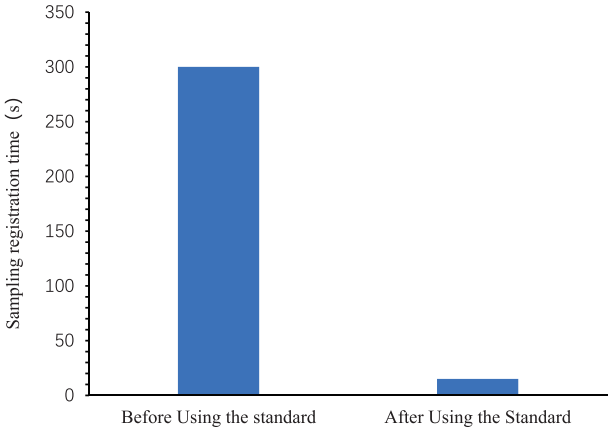


Figure 7 Comparison of the time taken to register nucleic acid sampling before and after using the standard

In terms of nucleic acid testing, on August 17, 2020, the State Council Joint Prevention and Control Mechanism Medical Treatment Group issued the Notice on the Issuance of Technical Specifications for 10-in-1 Mixed Testing of New Coronavirus Nucleic Acid (Joint Prevention and Control Mechanism Medical Issue [2020] No. 352), which formulated the technical specifications for 10-in-1 mixed testing of new coronavirus nucleic acid (10-in-1 test), effectively guiding the work of mixed testing of new coronavirus around the country and further enhancing the capability and efficiency of nucleic acid testing[4]. Public data from the Shenzhen government show that, at present, the daily nucleic acid testing capacity in Shenzhen is 550,000 tubes, and when the 10-in-1 test method is adopted in large-scale screening, the total capacity can reach 4 million tubes[5], as shown in Figure 8. This method improves the testing efficiency by 6.3 times and costs fewer nucleic acid testing kits, greatly reducing the social cost of nucleic acid testing. Based on Shenzhen's current testing capacity combining single-tube and mixed-tube sampling, it is estimated that the city can complete a round of mass nucleic acid testing in 5 days, which would take about 36 days with the single-tube testing only (the testing time is reduced by 86.1% with the use of standards), as shown in Figure 9. Thus, the economic losses caused by the epidemic prevention and control blockade can be significantly reduced.

[4] A method in which 10 swabs collected from 10 individuals are pooled in 1 collection tube for nucleic acid testing.

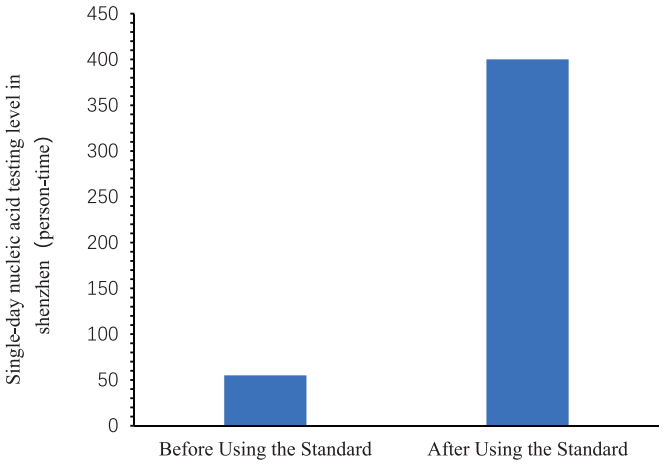


Figure 8 Comparison of single-day nucleic acid testing capacity in Shenzhen before and after using the standard

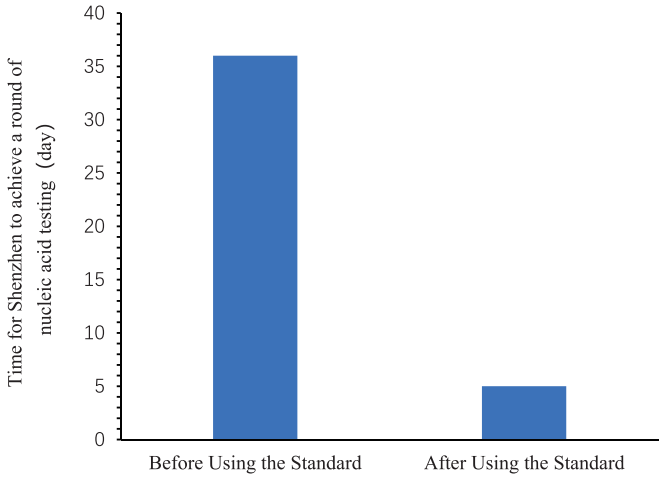


Figure 9 Comparison of the time taken to achieve one round of nucleic acid testing for the whole staff in Shenzhen before and after using the standard

9 Summary of the Evaluation

9.1 Summary of the Benefits Assessment of the Standards

Using the ISO Methodology 2.0, the paper concludes from the quantification of the impact of the standards on each of the operational indicators in Chapter 8 that the standards contribute significantly to the business activities of participants in the health code application.

The use of the standards has increased the R&D integration efficiency of Tencent as a technology provider by about 4.25 times.

For data management organizations represented by Shenzhen Big Data Center, in terms of direct economic benefits, the use of standards increases the number of code showing. The efficiency improvement resulted from code showing alone (from February 2020 to September 2021) has saved Shenzhen RMB 8.2 billion in labor and time costs, accounting for about 0.3% of Shenzhen's GDP in 2020. In terms of social benefits, after using the standards, the Shenzhen health code application system has provided citizens with a convenient and unified registration entry, which has basically covered the permanent population in Shenzhen, providing a convenient tool for the public's traveling. In addition, the standards have promoted data interoperability of the application system of the health code between Shenzhen and other cities across China, which plays a significant role in residents' mobility, work and production resumption, and returning to school and business.

For competent health departments represented by SHDRDC, in

terms of social benefits, the yellow code scheme stipulated by the standards reduces the contact risk of individuals at risk in nucleic acid testing, and enables safer traveling for individuals with "green code"; in the case of large-scale screening, after using the standards, the efficiency of nucleic acid sampling registration is increased by 19 times and the testing efficiency by 6.3 times with a daily testing capacity of 4 million tubes when using the 10-in-1 test method; in terms of indirect economic benefits, the 10-in-1 test method has shortened the time for a round of mass nucleic acid testing in Shenzhen by 86.1% (from 36 days to 5 days), creating indirect economic value in shortening the time of pandemic lockdown and restoring normal production and life order.

9.2 Summary and Suggestions for the Application of ISO Methodology 2.0

This project study was conducted based on ISO methodology 2.0, with reference to previous cases of economic and non-economic benefit analysis, and the evaluation practice showed that the overall analysis idea and route of traditional ISO methodology 2.0 is feasible, but the digital economy standard benefit assessment has significant differences compared to the traditional manufacturing standard benefit assessment, summarized as follows.

In previous case studies in the traditional economy, ISO Methodology 2.0 takes individual organizations as the evaluation object. But for industries such as the digital economy, where the upstream and downstream links of the industry chain are closely linked or involve the flow of data across organizations and links, the contribution of the standards is more reflected in

multiple connected participants, and it is more difficult to analyze the effect on one single group. If the previous evaluation idea is continued, the comprehensive, systematic, and synergistic characteristics of the case itself across organizations may be neglected due to the limitation within the organization, and the benefit value of the standard to the whole application scenario or region may not be accurately reflected. Therefore, it is suggested that in further development of the benefit evaluation of standards for the digital economy, an attempt can be made to take the whole standard application scenario or region of the case as the evaluation object and update the use of the ISO methodology to further improve its applicability in the field of digital economy.

Because of the cross-organizational nature of the value chain of the digital economy, the regulations and announcements of some management departments have in fact formed the agreed rules accepted by all organizations and individuals in the value chain, making the regulations normative documents with "consensus" characteristics, and thus they can be treated as standards and included in the evaluation of standards.

In the early stages of the study, it is necessary to adequately communicate with the senior management of the evaluation objects. Training materials can be produced on the key steps of ISO Methodology 2.0, evaluation methods, and early research examples to explain in detail the goals and objectives of the project study, which will help them to better organize information and collect data.

In addition to questionnaire research and field interviews, on-site meetings and video conferences can also be used for communication.

10 Conclusion

Using ISO Methodology 2.0, this study investigated a number of key participants in the Shenzhen health code application system through research and interviews, analyzed the benefits of health code–related standards on the key business activities of the key participants, and came to the following conclusions: The health code is a typical case of promoting the widespread application of scientific and technological achievements with standards, and the application of the series of health code–related standards has produced significant benefits in Shenzhen. For technology providers represented by Tencent, the standards has a significant effect on the improvement of R&D efficiency, with a single R&D efficiency increase of about 4.25 times; for data management organization represented by Shenzhen Big Data Center, the standards increase the number of code showing, and the efficiency improvement resulted from code showing alone (from February 2020 to September 2021) has saved Shenzhen RMB 8.2 billion in labor and time costs (about 0.3% of Shenzhen's GDP in 2020). The standards have promoted data interoperability of the health code data, playing a significant role in residents' mobility, work and production resumption, and returning to school and business. For competent health departments represented by SHDRDC, the yellow code scheme stipulated by the standards reduces the contact risk of individuals at risk in nucleic acid testing, and enables safer traveling for individuals with "green code". During mass population screening, the efficiency of nucleic acid sampling registration using health code has increased by 19 times, and with the 10–in–1 test method, the daily testing volume can reach 4 million, which has increased the testing efficiency by 6.3 times, enabling Shenzhen to shorten the time used for a round of mass

nucleic acid test by 86.1%. These methods have created indirect economic value by shortening the time of lockdown for epidemic prevention and control, and resuming normal production and life order.

Appendix A Data Calculation Methodology

Bright Code Time Savings Costing.

Time costs for individual users saved by showing the health code (each time) = paper registration time – time for showing the code = 300s – 15s = 285s;

To date, the total number of times individual users have lit the code is about 1,713 million, so the total time saved = total number of times lit the code × time saved by individual users for a single lit code = 1,717 million times × 285s/time ≈ 136 million hours.

According to statistics, the average monthly wage level of in-service workers in Shenzhen is about RMB 10,646 yuan, and based on working 22 days a month and eight hours a day, the average hourly wage of in-service workers is about RMB 60.5 yuan.

Total social cost savings of Bright Code = average hourly wage of employees on the job x total time saved ≈ RMB 8.2 billion.

Shenzhen 2020 city-wide GDP 27670.24 billion yuan, then the proportion of social cost savings by virtue of bright code = total social cost savings by bright code / Shenzhen 2020 city-wide GDP ≈ 0.3%.

Appendix B Presentation on the International Application of Health Code

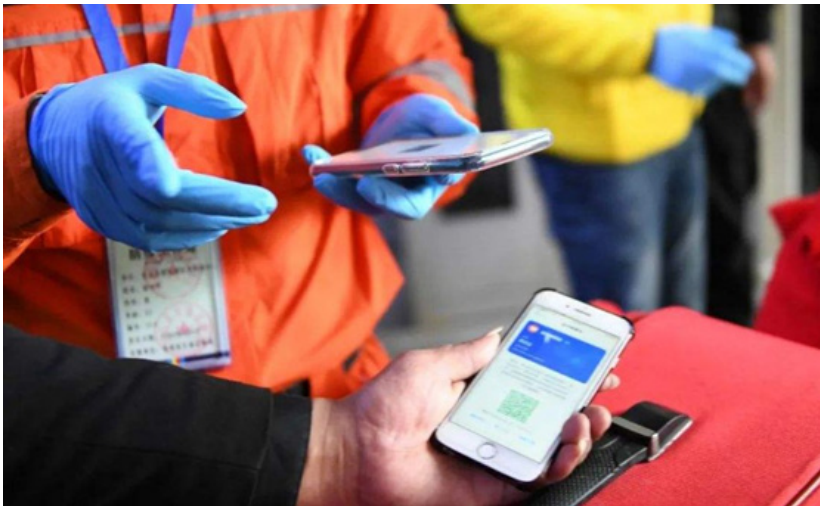
The specificity of the COVID-19 pandemic imposes many challenges to the global fight against the pandemic, and several countries around the world have already proposed or implemented preventive measures in the form of health code. Health code have been introduced in each country to quickly identify potential risks of the spread of the pandemic and respond in a timely manner, but there are differences in the specific ways they adopt. Both health code in China and the Republic of Korea (ROK) are technically innovated by leading enterprises in science and technology, organized and guided by the governments, and used under the support of the public. The two countries have many data collection methods. Health code in countries such as Singapore, France, the UK and the UAE are developed by the governments' public health departments or technology companies, and the public can choose whether to use them or not at will. In terms of data transmission methods, China and the ROK use mobile networks, while other countries use Bluetooth for data exchange.

Table B.1 Comparison of health code models across countries

Nation	Name (of a thing)	Connection method	Promoting the subject
Bank of China	health code	mobile network	Government + Business
R. O. Korea	—	mobile network	Government + Business
Singapore	Trace Together	bluetooth	Government
United States (US)	Contact tracing	bluetooth	Enterprises
United Kingdom (UK)	NHS	bluetooth	Government
Germany	CoronApp	bluetooth	Enterprises
France	Stop Covid	bluetooth	Government
UAE	AlHosn	bluetooth	Government

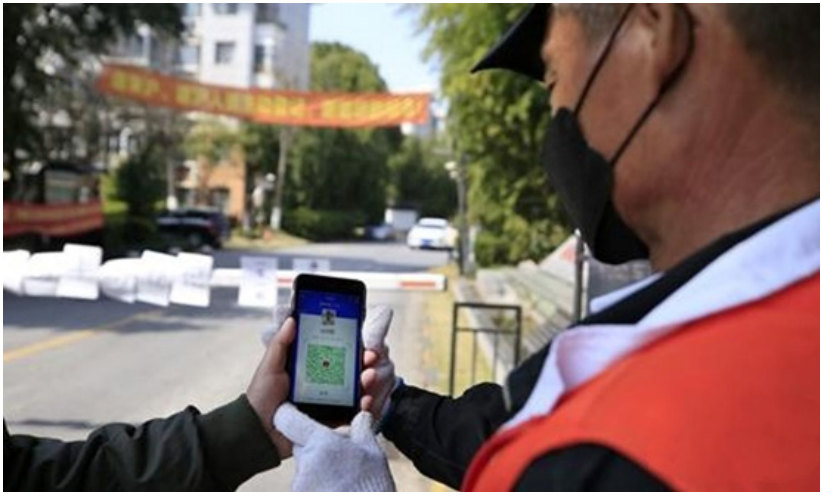
Appendix C Health Code Application Scenario Example Pictures

1、Voucher Code Verification



2、Sweeping Code through the Gate

3、Bright code pass



4、Nucleic acid detection quick scan

5. Scan code to enter the passenger terminal

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http://www.gd.gov.cn/gdywdt/bmdt/content/post_3023843.html

[3] 《深圳市第七次全国人口普查公报》

[4] 深圳为“黄码”人员设检测专用通道 http://sztqb.sznews.com/MB/content/202106/22/content_1049569.html

[5] 2021 年 6 月 24 日，深圳市政府新闻办举行疫情防控新闻发布会