VIRTUAL REALITY, ARTIFICIAL INTELLIGENCE AND SPECIALIZED LOGISTICS IN HEALTHCARE

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Virtual Reality, Artificial Intelligence and Specialized Logistics in Healthcare

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FOREWORD

This book focuses on the innovations brought to the healthcare sector by virtual reality, artificial intelligence, and specialized logistics. The book chapters discuss how emerging technologies can advance healthcare research, improve the management of patient records, facilitate human remains logistics, development of innovative applications for vulnerable population groups, and improve health monitoring of different patient groups. Furthermore, several book chapters discuss how new-generation technologies can be used to overcome some of the major challenges caused by the COVID-19 pandemic (*e.g.*, the design of resilient supply chains in the wake of frequent pandemics, anti-pandemic measures to prevent the virus spread across the communities, how to provide a safer environment in the senior citizen homes under the pandemic conditions, micro-business simulation models for healthcare products). We expect that this book will provide a fresh outlook on the latest technologies in the healthcare sector and how they can be effectively used in different settings. Findings, examples, and recommendations presented in the chapters will be helpful to the community and a wide range of stakeholders in the healthcare sector.

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PREFACE

The design of this book aims to enrich policymakers, researchers, students, and industrial practitioners' knowledge and skills of advanced technologies (*e.g.*, virtual reality, artificial intelligence, and macro business simulation) and specialized logistics (*e.g.*, human remains logistics and vaccine logistics) in the healthcare industry. As such, we illustrated various real-life examples to demonstrate across different chapters. In general, this book is divided into nine main book chapters. Chapters 1 and 2 mainly address the state-of-the-art in healthcare research. As such, artificial intelligence, computer information systems, the Internet of Things, and 3D printing are further investigated in the healthcare research in Chapter 1. Digital health with smart Internet of Things technologies is further explored in Chapter 2. The specialized logistics are provided in Chapters 3 and 4. The human remains logistics are comprehensively discussed in Chapter 3 while the vaccine supply chain is thoroughly explained in Chapter 4. Both the aforementioned chapters have been covered in the context of COVID-19. Since the COVID-19 pandemic has created a new page in human history, we illustrate real cases and memorable photos to show how the local community implements various anti-epidemic measures in Chapter 5. Chapters 6, 7, and 8 are relevant to the trending issues of the elderly. Chapter 6 mainly focuses on homes for the aged during the COVID-19 pandemic. Chapter 7 mainly concentrates on the use of advanced mobile apps for the elderly in the 21st century. Chapter 8 mainly provides a narrative review of mobile technology from the older adults' perspectives. Chapter 9 addressed the adoption of macro business simulation on healthcare products *via* the use of hand sanitizers as illustrative examples.

The first author expressed the happiness of forming a new interdisciplinary research team across logistics, health, and engineering disciplines. This groundbreaking research provides a foundation work on future research work. Also, the first author would like to appreciate the unreserved support from his wife, colleagues, students, and friends.

The second author indicated that this book is successful and can enrich the teaching pedagogy and illustrate the real cases in learning materials. The updated knowledge definitely increases the academic and managerial implications.

The third author would like to express special thanks to my lovely wife Poon. She stayed at home with me all the time while I wrote in the evenings, even on Sundays and holidays. My lovely wife sacrificed too much for me.

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CHAPTER 1

The Revolution of Immersive Technologies in Healthcare Research

Abstract: In the digital era, many technologies such as artificial intelligence (AI), computer information systems, Internet of Things (IoT), Industry 4.0, immersive technologies, 3D printing, *etc.* are being adopted to facilitate operations, provide better management, and enhance workflow and working efficiency. As such, digital health technology and management are the key topics that are attracting wide attention, since it is important both in enhancing efficiency and safety. In fact, most of the healthcare and medical care tasks cannot be replaced entirely by computers. The training of healthcare workers and medical practitioners still remains important. Immersive technologies including virtual Reality (VR), augmented reality (AR), and mixed reality (MR) are widely adopted in numerous industrial and training applications. VR provides a fully immersive experience for the trainees, while AR and MR provide interactive stimulation while maintaining attention in the physical world. Despite the types of immersive technologies used for training, healthcare training, and medical simulation are key components of digital health technology. Nevertheless, in many cases, a trainee's acceptance and behavioural training in participating in immersive training are still uncertain. Understanding their acceptance and behaviour is important not only in developing effective simulated training but also in enhancing their autonomy and motivation in participation. To this end, we also introduce some of the research models that are commonly used to support health and medical training and simulation.

Keywords: Augmented reality, Healthcare, Immersive technology, Mixed reality, Research model, Virtual reality.

1. INTRODUCTION

Healthcare and medical care are the most important and essential services for any developing society worldwide. They are not only critical for promoting, maintaining, and managing the health of society, as well as preventing disease, but the item also plays a major role in reducing unnecessary disability and death. In recent years, due to the rapid increases in the size of the elderly population and the aging problem globally, the shortage of healthcare workers continues to be serious in many countries. A direct way to tackle such issues is to increase the number of healthcare workers. However, recruiting and training in healthcare

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are always difficult issues due to the lack of healthcare trainers. Cultivating and training healthcare workers are very important in order to ensure the quality of healthcare services and to ensure the safety of patients so that they can recover as quickly as possible.

In the digital era, much of the workload can be replaced and reduced with the latest technologies such as artificial intelligence (AI) [1], computer information systems [2], Internet of Things (IoT), Industry 4.0 [3], immersive technologies, 3D printing [4], *etc*. Notwithstanding that the technologies can facilitate healthcare operations, improve management, and enhance workflow and efficiency, most of these tasks cannot be replaced entirely by computers, particularly in the training of healthcare workers. Immersive technologies including virtual Reality (VR) [5, 6], augmented reality (AR), and mixed reality (MR) [7] are widely adopted in numerous industrial applications [8]. They have been recently widely adopted in medical and healthcare aspects due to the features of the simulated scenarios and situations that may not be created in traditional real-life training. For instance, VR can be used to mimic sudden changes in virtual environments, external stimulations, display digital cadavers, *etc*.

In this book chapter, we illustrate the latest developments in how immersive technologies can be applied in practical healthcare applications in aspects of medical and health training. On the other hand, regardless of the virtual technologies that have been proven to be effective in many types of research, the practices in healthcare research are not widely documented. Indeed, research that investigates the effectiveness of medical and healthcare training is essential in the design of training programme, as well as in determining the immersive content that can provide better training effectiveness. Here, we first provide an example of how immersive and simulation technologies can be potentially applied in healthcare training. Then, some research background is given to provide insight to readers on how healthcare research can be conducted accordingly. This provides useful insight to the readers that can be further extended to healthcare, medical care, or other related applications.

This chapter is organized as follows. A brief introduction to the importance and the latest technologies in medicine and health is given in section 1. Then, the current applications of immersive technologies in virtual training are given in section 2. Section 3 elaborates on the keys to conducting healthcare research and the theoretical model that is commonly used in technology-based user acceptance research.

2. APPLICATIONS FOR IMMERSIVE TECHNOLOGIES

In the last two decades, VR has been increasingly used for entertainment, education, healthcare, manufacturing, design, aviation simulation, *etc.* VR has proven successful in healthcare and medical simulation due to the difficulty and cost of creating physical and real models for conventional training. VR offers a lot of advantages in terms of cost efficiency and outcome effectiveness in many aspects. Particularly, VR enables the creation of digital content and mimics random simulation to provide more effective and immersive training to participants. Thus, VR training in health and medical care is mainly derived from virtual training and simulation-based training which are elaborated in the following.

2.1. Virtual Training

Foronda *et al.* [9] noted that advanced virtual simulation technologies can be utilized in surgical nurse training. For instance, CliniSpace gives a three-dimensional computer simulation of a healthcare setting. The "world" is a clinical environment, such as an intensive care unit, an office, a clinic, or a patient's home. It is a web-based, multiuser system, so several students can log in from any location using their own laptops. Students choose a character, or "avatar," such as a nurse. The use of a headset with a microphone allows them to be heard by others in the clinical setting and engage in real-time conversation while working with a patient and accompanying equipment. Verbal interaction between distantly logged-in people creates a sensation of immersion and physical presence. Digital Clinical Experience (DCE), developed by Shadow Health as a consequence of academic research conducted by nursing, medical, and allied health schools, is another example. The DCE is a collection of Web-based, asynchronous virtual patient simulations for the development and evaluation of clinical reasoning abilities in nursing. Autonomous, three-dimensional, virtual patients with realistic speech and motion inhabit the DCE's virtual environments, each being able to identify and reply to more than one hundred thousand inquiries. This technology enables students to generate their own patient interview questions, find opportunities for empathy and patient education, and arrange their virtual patient's physical examination. The DCE is extremely useful for teaching physical assessment, communication, clinical reasoning, and nursing processes. Another is vSim, which is primarily intended for nursing instruction. vSim for nursing was created in partnership with Laerdal, Wolters Kluwer Health, and the National League for Nursing. This Internet-based, single-user software allows students to practice cognitive nursing skills in a virtual environment. Learners will be capable of assessing a patient, reviewing instructions, administering drugs, and performing nursing interventions. When the patient responds to therapies, students

CHAPTER 2

Digital Health with Smart Internet of Things (IoT) Technologies

Abstract: Hospitals, nursing homes, and other healthcare facilities will face considerable problems in the next decades due to the aging population's increasing healthcare demands, the complexity of modern healthcare delivery, and the rising expectations of healthcare consumers. Future healthcare development must continue to face problems, which call for more digital innovation. One of the goals for the ensuing decades will be to craft a clever plan to advance digital health. The smart Internet of Things (IoT) technologies are crucial elements to integrate digital health for enabling practical utilization in the field, given the large range of information technologies available. The smart IoT supports medical practitioners in their working process and facilitates the management of the patient's health records. In this chapter, we explore some of the key smart IoT technologies in digital health and management including data acquisition, data transmission, and positioning. Each technology is briefly introduced to provide insights that will allow readers to adopt the essential technologies for potential future practical applications.

Keywords: Artificial intelligence, Big data, Cloud computing, Cyber-physical system, Internet of Things, Information system, Smart devices, 5G.

1. INTRODUCTION

With the wider adoption of a new generation of information technologies such as big data, cloud computing, industry 4.0, artificial intelligence, smart healthcare, and related concepts have gradually come to the fore. Digital health or digital healthcare is a broad and multidisciplinary concept that illustrates the integration of various latest digital technologies into healthcare applications. Although there are no unique definitions of smart healthcare, it usually refers to the adoption of the latest computer and information technologies to transform the traditional healthcare system and medical practices in an all-round way, in order to make healthcare service more efficient and effective, as well as enhancing the safety, reliability, and transparency of medical treatment and therapy processes. Digital health is essential and the adoption of the latest technologies is important to provide quality service to the community. The latest technologies include virtual reality (VR), the Internet of Things (IoT), artificial intelligence (AI), blockchain,

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smart devices, *etc.* These technologies can support digital health in various aspects. For instance, VR is widely used for training healthcare practitioners, as well as patients [1, 2], while AI can be used for supporting the segmentation of the CT or MRI for medical doctors to support the diagnosis, as well as the forecasting purposes [3 - 5]. Blockchain technology can be used to enhance traceability and trackability to enhance management in aviation and other industries [6]. Among all of these technologies, smart devices and IoT in contrast provide the essential infrastructure for sensing, communication, and identification to facilitate the logistics process. These fundamental technologies are essential for enhancing the efficiency, effectiveness, and smoothness of the logistics processes, as well as for improving management. The technologies are primarily used to serve the logistics industries, in fact, it has also been extended to a wide range of applications in the health and medical industries. The smart IoT supports medical practitioners in their working processes and facilitates the management of a patient's health records. The wide range of applications of smart IoTs is useful in digital healthcare and management.

We first review the key data acquisition technologies that are commonly used in smart and digital healthcare. Then, we also explore the key technologies for data transfer, as well as positioning. Data acquisition, transfer, and positioning technologies are essential in many practical applications and enable the practical implementation of smart healthcare and management applications. The data acquisition techniques can be used to obtain data, patients' behavior, and other information, and data transmission technology can be used to send data by wire or wireless means to the management platform. The monitoring management can use various algorithms such as AI and big data analytics to serve in several core fields of smart applications such as diagnosis, treatment, health management, preventive and risk management. The last section gives a brief conclusion to this chapter.

2. DATA ACQUISITION TECHNOLOGIES

Data acquisition is a method that typically employs smart devices, sensors, and Internet of Things (IoT) technologies to collect data from humans, machines, equipment, *etc.*, which is then used as input by an organization or internal systems. For instance, cameras and microphones are examples of common data-collecting instruments used in everyday life. The acquired data are typically physical quantities such as temperature, water level, wind speed, and pressure that are transformed into electrical signals. The data may be analog or digital, and the acquisition technology is often a sampling technique that repeatedly receives the data at the same spot at a predetermined sampling interval. The majority of the acquired data include immediate values, as well as values representative of a specific period. The state of the measured object and the measuring environment

must be considered in order to guarantee the accuracy of the acquired data. Sensors are often contact-based data-collecting devices, whereas vision and radar are non-contact data-gathering technologies that are widely utilized nowadays. In the sections that follow, the specifics of the various data-collecting methods and how the technologies can be applied to digital health and management, such as human behavior recognition, are described.

2.1. Vision Approach

In recent years, with the widespread usage of video perception devices, including 2D and depth cameras, as well as the increasing performance of computing equipment and storage capacity, research, and applications based on computer vision technology have been steadily promoted [7]. On implementation of video sensors, such as human body motion detection, failure detection, surveillance, *etc*, vision data can be utilized to identify the body's action perception and behavior, while computer vision technology can be applied in the field of pattern recognition in digital healthcare for intelligent video surveillance, human-computer interaction, medical diagnosis, health monitoring, *etc.*

Numerous real-world applications that use an image-based method for subsequent processing depend on the application of visual technology for data collecting. Unlike other sensing devices, the video image acquisition device can be utilized in any area and under any circumstance. Nevertheless, the utilization of visual technology requires the creation of additional software systems and digital algorithms for data processing. For example, when a camera captures the movement of humans, the original image or image sequence will invariably include the surrounding environment. In this instance, the visual images or videos will depict the human body in the foreground and the surrounding environment in the backdrop. To distinguish the human body from the surrounding environment, image segmentation algorithms and other methods are necessary. Based on the image's dynamic properties, the vision-based image segmentation method can be separated into static segmentation and motion segmentation. Static segmentation has a pretty extensive history of research. There are representative approaches and methods that can be used, such as the edge detection-based segmentation method, the threshold-based segmentation method, the region-based segmentation method, and the wavelet transforms segmentation method. Since the fundamental characteristic of a moving image is the change in gray level, the dynamic image is segmented differently than the static image. Existing approaches can be categorized based on two factors: the characteristic of the moving image itself and the degree of artificial engagement.

CHAPTER 3

Human Remains Logistics

Abstract: Life and death are unique phenomena. Death is inevitable; thus, people will eventually become consumers of end-of-life products and services. The death care industry is currently facing radical challenges. The death-denying attitude can severely undermine the examination of the death care industry. Personal care and tailored informative services for the ultimate care of deceased loved ones must be given by a professional logistics service provider. The transport of human remains, bones and ashes requires professional knowledge of local regulations and laws, carrier rules and restrictions, rates and market demand, and shipment safety and protection, and communication between the carriers, customers and end-user (family members). On the side of the logistics service providers, they must overcome their fear of facing a dead body and address the funeral atmosphere of the workplace to improve their psychological well-being. This chapter includes five sections on the nature of human remains, specifications, human remains logistics operation, business ethics, and emerging market challenges of green burials.

Keywords: Business ethics, Death care industry, Human remains, Green burial, Logistics service provider.

1. INTRODUCTION

1.1. Funeral Logistics during the COVID-19 Pandemic in Hong Kong

The key issue of human remains logistics concerns sanitation and safety. Funeral workers were required to wear full-body protection suits during the COVID-19 pandemic (Fig. **1**). Since the outbreak of the new coronavirus at the start of 2020 and political issues and social movements in 2019, a large number of Hong Kong citizens have migrated to the United Kingdom, which increased the demand for human remains and related services between Hong Kong and the United Kingdom. During the pandemic, flight schedules decreased by nearly 3% to 5%, which created a high demand but low supply of cargo space. Thus, prices for cargo space increased by 500%–800% or more.

Families were unable to book flights to return to Hong Kong for the 21-day funeral arrangements because of not only the supply and demand problem but also the hotel quarantine policy. Thus, the bodies of deceased individuals remained in

mortuaries. For example, the author handled a case involving a body that was in mortuary storage for 180 days. In this case, the family members were very sad and anxious about the condition of the body of their loved one. Fig. (**2**) shows a simple funeral being held outside a public mortuary.

Fig. (1). Protection suit of funeral workers during covid-19 pandemic.

In case of migration, the process of relocating ancestors will follow, which can create business opportunities for the transport of ashes, remains, and bones. Finding a professional funeral transport service company in Hong Kong is difficult; thus, such services are generally entrusted to funeral undertakers. In addition, customers may encounter difficulties in overseas communication, because English is not commonly spoken by workers in the funeral industry. Hence, finding a company that specialises in funeral arrangements and transportation is difficult. A professional funeral logistics company must be able to provide 100% error-free service. The author has been working in the funeral logistics industry in Hong Kong and dealing with the global market such as the United States, Canada, China, the Philippines, Nepal, Australia, Ghana, and the Pacific Islands for more than 20 years. The author's company has handled more

than 1,500 cases; thus, the author has valuable experience in the field. The problem particularly affects Muslims, because according to Islam, the burial of remains should be within 3 to 4 days after death. During the COVID-19 pandemic, in many cities under lockdown, waiting for flight schedules for more than one month was common. Such a situation is unacceptable and disrespectful to grieving families.

Fig. (2). Simple funeral held outside public mortuary.

2. AIR CARGO TRANSPORT OF HUMAN REMAINS

Being a professional means having a job that is respected, because it involves a high level of education and training. An individual with no training and skills to handle various types of problems cannot be called a ‘professional’. Not everyone will be able to work in the funeral industry because of the gloomy atmosphere of the workplace. The work involves seeing sad and crying faces daily. Death typically does not induce feelings of happiness and relaxation. Coffins, urns, incense candles, shrouds, and corpse beds surround the funeral workplace. Moreover, funeral workers may be required to directly face, touch, and handle corpses to varying degrees. Some corpses are indistinguishable from living people in their sleep. However, some corpses are swollen, moldy, blackened, and seeping blood. In some cases, corpses may have maggots squirming on their faces or broken limbs. Such working conditions have frightened many ‘ordinary people’ from working in the funeral industry.

CHAPTER 4

Building Resilient Vaccine Supply Chain during COVID-19 Crisis

Abstract: The COVID-19 pandemic occurred in the world in January 2020. Without specific vaccines and antiviral treatments, the virus easily spreads across different parts of the world. Accordance to the World Health Organization (WHO), COVID-19 has widely spread to nearly all countries across six geographical regions (*i.e*., Western Pacific, Africa, Eastern Mediterranean, South-East Asia, Europe, and Americas). In doing so, different countries implemented various preventive measures like hand washing, lockdowns, social distancing, and mask-wearing to minimize the transmission of the virus. However, such preventive measures are short-term, ineffective, and may not be sustainable. The introduction of common vaccination campaigns is viewed as a vital effective way to against COVID-19. Over 60 vaccines for COVID-19 are either previously endorsed or going through clinical experiments. As expected, there will be an increasing need for people to accept vaccine injections. The vaccine is a highly vulnerable, high-value, and rare product in the world. As such, resilient vaccine supply chain management is urgently needed. Otherwise, the inferior quality of vaccines poses global health risks and causes the problem of wasting useful medical supplies. Nevertheless, some logistics firms encountered unfolded logistics challenges of the COVID-19 vaccine due to a lack of professionals, capacity, data integrity, inventory management, fluctuating demand, and geographic risk (*e.g*., vibration, location, shock, and temperature. In particular, most logistics firms and health specialists encounter severe challenges in managing the vaccine supply chain in remote areas or developing countries. Although the vaccine is a global and hot issue for researchers, industrial practitioners, local communities, and policymakers, there is scanty attention to investigating the establishment of a resilience vaccine supply chain management in the context of COVID-19. At present, only a few research groups have discussed the role of blockchain in vaccine supply chain management, however, the information is not enough to reveal the impact on how vaccine supply chain management of blockchain can mitigate the COVID-19 crisis. Therefore, this chapter will mainly focus on the overview of the influenza pandemic around the globe, the existing situation of the COVID-19 pandemic in the world and Hong Kong, the current development of vaccines during the COVID-19 pandemic, the adoption of blockchain in the vaccine supply chain, and the vaccine logistics in COVID-19.

Keywords: Blockchain, The COVID-19 pandemic, Vaccines, Vaccine Logistics.

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1. INTRODUCTION

1.1. The Overview of the Influenza Pandemic in the World

The first case of the 1918 influenza pandemic occurred in Spain, and it is also known as the mother of all pandemics. The reason is that the bacteria of the 1918 influenza virus were found in all subsequent influenza viruses. According to WHO data, the H1N1 flu in 1918-1920 years killed nearly 50 million people worldwide and infected one-third of the global population. Many viruses have the power of global infection. In particular, the influenza virus will spread and cause different species, including humans, islands, and pigs, which is characterized by the continuous spread in many countries.

Until now, the diseases related to H1N1 will combine with other influenza viruses and mutate, resulting in a new epidemic virus. In the 1990s, many severe influenza viruses were caused by human death and domestic avian influenza, including the Influenza A virus subtype H5N1 first discovered in 1997, and H7N9 and H10N8 viruses first reported in 2013. In typical years of seasonal outbreaks in the northern and southern hemispheres, there are as many as 5 million serious human diseases and nearly 500,000 deaths caused by influenza viruses [1].

The most influential epidemic in Hong Kong after the war was the first outbreak of new influenza H3N2 in July 1968, commonly known as the Hong Kong Flu. It is a kind of influenza A together with H5N1. Meanwhile, this virus is one of the epidemics with the highest death toll in history [2].

On February 22nd, 2003, the first case of Severe Acute Respiratory Syndrome (SARS) appeared in Hong Kong [3]. The virus is highly contagious, and there have been cases of infection and death in many Asian countries such as the Chinese, Taiwan, Hong Kong, and even Canada. The World Health Organization once declared Hong Kong as one of the “epidemic areas”. It took four months to achieve zero infections and zero death.

From 2014 to 2016, the epidemic of Ebola Virus Disease (EVD) broke out in West Africa, and the whole world paid attention to it [4]. It was originally a fever virus discovered in 1976. Infected animals can spread their virus to others or animals and then spread it in the community by the human-to-human method. But the death rate of this outbreak is 50-90% higher and the side effects are higher. The worldwide popular viruses are summarized in Table **1**.

2. THE REVIEW OF THE COVID-19 PANDEMIC

On December 1, 2019, the first new case of human pneumonia appeared in Wuhan, China. COVID-19 was caused by (SARS-CoV-2) and the symptoms of patients generally included fever, general weakness, cough, sore throat, *etc*. However, a small number of confirmed cases had no symptoms at first [13]. On December 31, 2019, the Municipal Health Commission of Wuhan informed the public and the World Health Organization of a new pneumonia epidemic.

Table 1. Worldwide popular viruses.

Name	Transmission Route	Pandemic in History	Therapeutic Method
Yersinia pestis	Spread in the main rat population. After human infection, droplets produced through the respiratory tract spread through the air among people.	Causing the great plague of Justinian, the Black Death, and the third plague pandemic.	Up to now, there are very few cases, which can be cured with antibiotics.
Smallpox	The virus is transmitted through the nose, saliva, and fluid in the acne of the carrier.	At the height of the epidemic, 3 out of every 10 patients died, and smallpox claimed at least 350 million lives in history.	In 1796, a British medical scientist (Edward Jenner) developed the first smallpox vaccine.
Cholera	Acute diarrhea is caused by some pathogenic strains of Vibrio cholerae infecting the small intestine.	In the 19th century, there were seven global pandemics.	In 1893, Waldemar Mordechai Wolff Haffkine developed the first cholera vaccine. The oral cholera vaccine can have immunity for about half a year.
HIV/AIDS (human immunodeficiency virus)	Through body fluid transmission, attack the human immune system.	In 2016, WHO estimated that there were about 36.7 million HIV-infected people in the world.	Since 1981, there is still no cure.
Monkeypox	Direct infection through bites or scratches and spread by respiratory droplets.	The first was discovered in 1958 in monkeys kept for research. Mainly found in West Africa.	Jynneos Vaccine protects against monkeypox. The smallpox vaccine has proven effective against monkeypox.
Hong Kong Flu	Viruses are usually spread by droplets produced by coughing, sneezing, and talking.	About 1-4 million people around the world have died of influenza in Hong Kong.	In 1968, developed a vaccine against Hong Kong flu.

CHAPTER 5

Anti-epidemic Measures of a Community

Abstract: In this chapter, the authors mainly highlight the key anti-epidemic measures adopted by a community. A total of 14 illustrative examples are discussed to demonstrate the different measures adopted in response to the COVID-19 pandemic. Details of the measures are provided, including photos, such as in a gym, hospitals, swimming pools, catering premises, a cinema, theme parks (*i.e*. Ocean Park and Disneyland), the Hong Kong Airport, schools, public markets, an elderly home, a church, museums, the Hong Kong Coliseum and public transportation. The anti-epidemic measures were effective in controlling the spread of COVID-19 during the different waves in the past 3 years. The anti-epidemic measures may provide valuable insights into the practices and preparation of other countries for the post-COVID-19-pandemic future.

Keywords: Anti-epidemic measures, Community.

1. INRODUCTION

During the COVID-19 pandemic, numerous public facilities and venues implement stringent anti-epidemic measures so as to minimize the transmission of the virus in the community. In this chapter, we have highlighted the common areas including gym room, hospital, swimming pool, catering premises, cinema, theme park (*i.e.*, Ocean Park and Disneyland), Hong Kong airport, school, public market, elderly home, church, museum, Hong Kong Coliseum, and public transportation to demonstrate the different anti-epidemic measures via the photos and key regulations. The details are provided in different sections.

2. GYM

2.1. For Users

1. Must bring their own equipment, such as yoga mats and/or boxing gloves.

2. Must maintain a social distance from others at all times whilst in the fitness centre; must not remove their face mask.

3. Must maintain a distance of at least 1.5 m from others, such as when taking a shower or eating in the designated places.

4. Must check their temperature before visiting; in case of a fever or respiratory tract infection symptoms or sudden loss of taste/smell, they must cancel their visit and seek medical assistance when feeling ill.

5. Must mask up and seek medical assistance as soon as possible when feeling ill.

6. Must properly clean and disinfect lockers before and after use.

2.2. Physical Setting

1. Set up a temperature monitoring station with a heat detector at the entrance; employees took visitors' temperature at the entrance and refused entry to those with a fever.

2. Provided adequate hand-cleaning facilities at the entrance, fitness stations, near the equipment, and around the facility, such as hand rubbing liquid containing 70%–80% alcohol.

3. Provided surgical masks to users in need.

4. Properly cleaned and disinfected equipment before use.

5. Installed additional air fresheners.

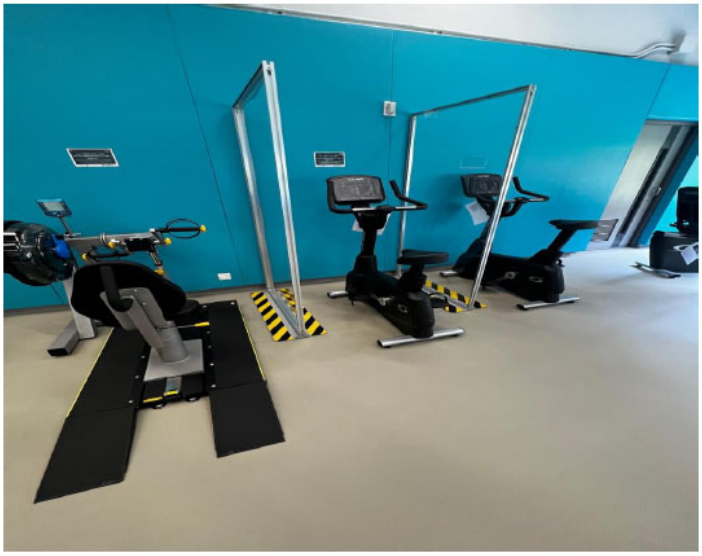
6. Required users to follow the face mask regulations; asked a registered specialist contractor to assess and report the air change rate six times or more per hour or install air purification equipment based on the specifications provided by the Food and Environmental Hygiene Department (FEHD); listed the air purification equipment brand and model.

7. Added water dispensers in the facility.

During the COVID-19 pandemic in 2019, to prevent cross-infection (from a water bottle or nozzle accidentally touching the nozzle of the water dispenser and its protective device), the gym prohibited users from using the jet water dispenser and encouraged them to bring their own container (*e.g.* cup or water bottle) to hold the water from the water dispenser. Gym users were also advised to refrain from washing their hands or cleaning their personal belongings with the water dispenser. The water dispensers were properly cleaned and maintained regularly. The key COVID-19 information related to the gym room can be accessed [1] and the relevant photos are provided in Figs. (**1 - 4**).

Source: Authors

Fig. (1). Gym room during the covid-19 pandemic.



Source: Authors

Fig. (2). Gym room during the covid-19 pandemic.

CHAPTER 6

Homes for the Aged in the COVID-19 Pandemic

Abstract: In the context of the COVID-19 pandemic, homes for the aged have seriously suffered from the fifth wave of COVID-19. Although the problem of an ageing population emerges as a global issue, the relevant studies related to homes for the aged are under-researched. In this chapter, we explored the weaknesses of homes for the aged and weak government policies that have posed threats to homes for the aged to deal with numerous confirmed cases of COVID-19. In response, we propose possible ways for homes for the aged to deal with the challenges arising from the COVID-19 pandemic. It may give useful guidelines for the policymakers, researchers, homes for the aged, and the local community to design and implement anti-epidemic measures in the forthcoming years.

Keywords: Ageing population, Homes for the aged, The fifth wave of the COVID-19 pandemic.

1. INTRODUCTION

In recent years, the problem of the ageing population has become a global issue. According to the research, in 2019, the global population aged 65 years or over was around 703 million. In 2050, it is estimated that the population will increase to 1.5 billion [1]. It is unavoidable that Hong Kong is also facing the same challenge. Starting in 1963, the birth rate in Hong Kong has been decreasing. From 1963 to 2020, the birth rate decreased by around 62% [2]. While the birth rate is dropping, life expectancy in Hong Kong keeps on increasing. In 1981, the life expectancy of men and women was 72.3 and 78.5, respectively. In 2020, it increased to 83.4 and 87.7, respectively [3]. Since life expectancy has increased, it shows the death rate in Hong Kong has become lower. Owing to the decreasing birth rate and increasing life expectancy, the ageing population problem has become more serious in Hong Kong. It causes a common problem: the shortage of subsidized residential care places for the elderly.

From the data of the World Bank, we can find that the number of populations aged 65 and above increased 15.7 times from 1960 to 2020 [4]. The great number of elderly leads to a greater demand for elderly homes. According to the Labour and Welfare Bureau, starting from 2017 to 2018, the supply of subsidized residen-

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tial care places for the elderly increased by 584. However, at the same time, the demand for the places increased by 7681 [5]. It means that even though the supply of subsidized residential care places increased, it still cannot cover the increase in demand. Although the Hong Kong government tried to increase the supply of the places, the result is that the waiting time only decreased from 25-37 months (in 2013) to 19 months (2021) [6]. It shows that the shortage problem is still serious today.

2. THE PROBLEMS ARISING FROM HOMES FOR THE AGED DURING COVID-19 PANDEMIC

First, as mentioned before, there is a serious shortage of subsidized residential care places. Therefore, most of the elderly would choose to live in private residential care places. Facing the great demand, most private residential care places face a problem of labour shortage. According to a document from the Social Welfare Advisory Committee, in the high-care level residential care homes (RCH), the ratio of care workers and the elderly is 1:20 during the daytime; for the nighttime, the ratio becomes 1:40. For the medium care level RCH, the ratio is 1:30 while the ratio of Registered Nurse (RN) and the elderly is 1:60 [7]. The data shows that the manpower of private RCH has a significant shortage. The shortage means it is impossible for the care workers to take care of every elderly carefully and attentively and keep the workplace clear at any time. Therefore, under COVID-19, the shortage of manpower become one of the main reasons for the spread of the virus quickly.

Second, there is a shortage of protective equipment. At the beginning of the fifth wave, most of the private RCHs did not prepare enough equipment for their care workers. Care workers belong to high-exposure work. Therefore, if the workers do not have good Personal Protective Equipment (PPE) to protect themselves, they easily get the pandemic from others. And then, since the incubation period range of COVID-19 is 1 to 14 days, during the incubation, the workers can spread the virus to the elderly [3]. Besides, most of the care workers in RCH do not have a high educational level. As such, it is possible that they do not have enough knowledge on how to prevent the spread of the epidemic or use PPE correctly. These can cause the breakout of COVID-19 in the RCHs.

Third, the space of RCH is too small which is advantageous for the spread of COVID-19. According to the Labour and Welfare Bureau, the minimum area of floor space for each resident in RCH is 6.5 $m^{2.}$ [8]. Living in a crowded area, it is easier to spread the epidemic. Besides, because of the limited space, it is hard for the RCH to separate the patient and the others with a suitable distance and space. Therefore, as an airborne disease, COVID-19 can spread in this tiny area.

3. THE POSSIBLE WAYS FOR HOMES FOR THE AGED DURING THE COVID-19 PANDEMIC

To solve the aforementioned problems, some solutions are recommended.

First, of the lack of care workers problem, it is encouraged that the salary should be enhanced. For the subsidized RCH, the average starting salary point is $12,349 and the average maximum salary point is $14,703 [9]. The average salary in Hong Kong is over $17,000 [10]. It can be found that the salary for working as a care worker for subsidized RCH has already been low. For the private RCH, since they do not get a subsidy from the government, the salary could be lower. The workload of care workers is very high, especially for the medium/low care level RCH. As such, low salary is hard to attract people to enter this industry. Thus, the vacancy rate remains high. Besides, the government can set some programmes to attract mainland care workers to work for Hong Kong RCH. To attract them, the Hong Kong government can offer some benefits on taxes and housing. Since the rent in Hong Kong is very high, facing the high rent, most non-local workers are not willing to work in Hong Kong. Under low salaries and high rent, the existing programme is hard to attract mainland care workers to work in Hong Kong. Therefore, if the government want to enhance the manpower in the care worker market, it should improve the working condition.

Second, for the shortage of equipment, whether RCH is subsidized or not, they should prepare enough PPE for the unforeseeable situation. Besides, the government can offer some short-term courses to the RCH workers to teach them how to use the equipment correctly, what they should do during the outbreak and how to prevent the outbreak.

Third, the government should improve the relative law. For example, the minimum area of floor space for each resident is significantly not enough. The government should increase the floor space and stipulate the space of the common area. Further, the government can also set up a standard for the air ventilation assessment register so that it can reduce the possibility of airborne transmission when there is a pandemic.

CONCLUSION

In this section, we mainly propose possible ways for homes for the aged during the COVID-19 pandemic. To solve the aforementioned problems, some solutions are recommended.

CHAPTER 7

The Adoption of Mobile App for the Elderly in the 21st Century

Abstract: In general, the elderly mainly face two kinds of problems, namely physical and mental. Such kinds of problems lead to the unfolded challenges for the elderly in the community. Also, it may increase the burden on the healthcare system in the long term. To this end, this chapter introduces the adoption of mobile apps for the elderly to increase the elderly social mobility and mitigate the overloaded public healthcare system in the future.

Keywords: Healthcare system, Mental problem, Physical problem, Social mobility, The elderly.

1. INTRODUCTION

1.1. The Challenges for the Elderly in Society

In recent years, the problem of the ageing population hits the headlines. According to the survey, in 2038, the elderly population (65 years old and above) will increase to 2.44 million [1]. Because of the ageing population, more and more people are concerned about the life quality of the elderly. When people become elderly, it is unavoidable that they will face different problems and difficulties in their daily lives. These can be separated into 2 main aspects: physical problems and mental problems.

1.1.1. Physical Problems of the Elderly

First, for physical problems, when a human becomes older, their somatic function would be worse than before. For example, the elderly always face visual challenges, verbal challenges, aural challenges and mental challenges. According to the report from Hong Kong Blind Union, in 2021, there are 199,600 people with visual impairment. The majority of the people (73.5%) are aged 60 or above [2]. In 2018, over 150 000 people were suffering from verbal challenges and more than 80% of them are elderly [3]. In 2017, there were around 100,000 people which is one-tenth of the elderly population suffering from dementia [4]. These challenges can affect the daily life of the elderly and their quality of life becomes

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lower. For instance, the elderly cannot see things clearly, so it is hard for them to read newspapers or some traditional entertainment. Also, verbal challenge means the elderly cannot hear clearly. Besides, the elderly suffering from dementia would be forgetful and their behaviour change to be more aggressive [5]. In fact, in recent years, many accidents are happening to the elderly because of dementia. There are research works that show that over 30% of the respondents said their family members who suffer from dementia have experienced getting lost [6]. Having bad memory not only causes the elderly to get lost easily but also make them prone to home accidents. For example, when the elderly are cooking, they may forget to turn off the fire and go away to do another thing. If the elderly keeps forgetting to turn off the fire, it can be on fire. Thus, we can find that when people become older, their physical ability become weaker. It can bring a great negative influence on their quality of life.

1.1.2. Mental Problems of the Elderly

Second, mental problems, because of weaker physical ability, can make the elderly to suffer from some mood disorders. Mood disorder is "a disorder in which you experience long periods of extreme happiness, extreme sadness, or both. Certain mood disorders involve other persistent emotions, such as anger and irritability." [7]. In fact, in Hong Kong, one out of 10 elderly experience depressive symptoms and 4.7% of people aged 66-75 suffer from depression. Besides, for the suicide cases in 2015, 30% of the cases were aged 65 or above [8]. The data shows that there are a number of elderly who have mental problems. The main reason for the elderly is mental illness. According to the World Health Organization (WHO), facing health problems (*e.g.*, reduced mobility, chronic pain, frailty) or serious illness (*e.g.*, heart disease) is one of the main factors for mental health problems in the elderly [9].

2. MOBILE APP FOR THE ELDERLY

To improve the quality of life for the elderly, it is suggested that we make use of a new mobile app to help the elderly face the problems mentioned above.

In a Digital City, how to make use of technology to improve the life quality of life has become a significant topic of interest. According to the survey, in 2019, the penetration rate of smartphones was 91.5% and 2 out of 3 people aged 65 or above owned smartphones [10]. Based on the data, it shows the possibility that we can design a new app for the elderly to improve their quality of life by solving the problems mentioned above.

The functions of the app can be separated into 3 main aspects.

First, the elderly can communicate with doctors and social workers using the app. Telemedicine is useful to the elderly, especially disabled persons. It is because it is hard for the elderly to walk a long way to see a doctor. Besides, it can minimize the possibility that the elderly have some accidents when they go to the hospital/clinic. Although telemedicine is developed in many countries, in Hong Kong, during COVID-19, people just find the importance of telemedicine and start to develop it. However, since this industry is developing during COVID-19, most of the apps or websites that offer the function of telemedicine are only for people suffering from COVID-19. It means in Hong Kong, the service coverage of telemedicine is not big enough. One of the examples is HA Go. It was launched by the Hospital Authority. Although the user can make a booking for telemedicine by using the app, the user must be a COVID-19 user [11]. The new app can cooperate with some private clinics, especially with some clinics which can use the elderly health care voucher to pay the fee. Several elderlies are not willing to see doctors when they get ill because they do not know which clinic can use the voucher and so they think that seeing a doctor is wasting money. By using the app, the elderly can directly find the clinic which can use the voucher and reduce the time spent on going hospital/clinic. The app can make the elderly see the doctor more conveniently. Thus, it can enhance the willingness of the elderly to find a doctor when they feel sick. In other words, if the elderly get some serious illness, it can help the elderly do some early detection and prevention. For the social worker, the elderly can find social workers by using the app. For the disabled elderly, it is hard for them to visit the workers' office frequently. To a certain extent, it is also impossible for the workers to visit the elderly every day. It means it is quite inconvenient for the elderly when they want to get help from the workers or even just want to talk with the workers. To improve the efficiency of the visiting of social workers, it is better to get meetings online. By using the app, the elderly and the social workers can communicate when they want. It can help to reduce the possibility of suicide since it can help the worker to notice mental problems in the elderly on time.

Second, the app can check the heart rate of the elderly and when necessary, it can help to call the police. Because of the development of technology, when there is a smartphone, there is no need to use a smartwatch or other equipment to check the heart rate. Through making use of photoplethysmography, the elderly only need to put their finger on the built-in camera of the phone and then the app will "measure your heart rate by detecting changes in blood volume below the skin's surface" [12]. Since not all the elderly own a sphygmomanometer at home, this function can help the elderly get a record of their heart rate frequently. Thus, if the elderly

CHAPTER 8

Narrative Review of Mobile Technology: Evidence from Older Adults

Abstract: In the 21st century, many developed countries have become aging societies. Although network speed, the improvement of smartphones, and 5G foster the growth of mobile technology, the employment of mobile technology exhibited a significant gap in the design and application of mobile technology that can be applied for older adults. This study analyses the design and implementation of mobile technologies to investigate novel mobile applications that support older adults in aged homes, by conducting a comprehensive discussion. As such, this study selects an expert narrative overview of a literature search from Google Scholar and archives. Analysis results reveal that designing new mobile apps, strengthening the interaction through VR technologies, and developing smartwatches for nursing homes. We need to consult older adults to ascertain if they are willing to use the technology. Mobile technology provides better support for older adults and monitors their health condition.

Keywords: Aging societies, Mobile technology, Mobile application, Older adults.

1. INTRODUCTION

Mobile technologies have played a significant role in our daily lives in recent years. The network speed, 5G, and the enhancement of smartphones stimulate the growth of mobile technology [1, 2]. The adoption of mobile technology has been widely used in both professional and personal activities [3]. With the use of technology, many tasks are simplified and become more efficient while lacking manpower. "Mobile devices are increasingly being used to extend the human mind's limited capacity to recall and process large numbers of relevant variables to support information management, general administration, and clinical practice" [4]. Some activities are performed through a mobile platform and eliminate geographical constraints. In other words, mobile technology fosters free living, communication, and social participation anywhere and anytime [5]. Mobile phone usage in Asia is growing as shown by more than 50% of the Asian population employing smartphones [6].

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The operational issues faced by aged homes are becoming more serious in Hong Kong. Three key issues are being identified, including the lack of mobile apps designed for older adults, social isolation of older adults, and the demand exceeding the supply of elderly nursing services [2]. Lee *et al.* [7] defined older adults commonly described as those aged 65 or above. In general, older adults are identified as less knowledgeable compared with younger generations. They are unfamiliar with software and operating systems and have weak operational skills, such as clicking and scrolling [8]. Some older adults recognized themselves as being 'too old' to understand how to adopt the technology. This indicates a higher degree of technological uneasiness and suffering from frustrations associated with the use of communication technology [10, 11]. As such, designing and implementing mobile technologies to improve the situation is not being paid enough attention and is poorly addressed. With the advancement of mobile technology, there exists a significant gap in the design and application of mobile technology that can be used for older adults, especially in Hong Kong.

The newly developed mobile technology is common among general patients but is not recognized by older adults. Nevertheless, older adults are presently digitally conscious because of their demand to keep in contact with family or friends, search for information, and have good communication [12]. Mobile technology is crucial to fulfilling the demand for active aging. Lee *et al.* [7] highlighted that "older adults were found to be more mobile today than in the past". Thus, mobile devices have come to be increasingly significant in daily life, even if highly complicated for older adult users. The user interface and the approaches to designing the mobile for this group must be distinct from the young generation [1]. Mobile technology is a technology designed to increase, maintain, or improve the functional capabilities of people with disabilities, older adults, or people with chronic health conditions [8, 2].

This provides a viewpoint and produces a technical paper for healthcare specialists, researchers, aged homes, clinicians, industry practitioners, and technology developers. A comprehensive search for the related scientific literature was conducted by adopting different scientific databases, such as SpringerLink, Google Scholar, EBSCO Host, and Science Direct. The scope of the publication of the literature review is the use of mobile technology for older adults. We focus on homes for the aged in Hong Kong since Hong Kong is now facing a serious aging problem. To the best of the authors' knowledge, there is a serious lack of research studies relevant to older adults, notably the application of mobile technology for older adults. Further, the social context of Hong Kong's homes for the aged industry is booming. Some key issues of older adults are still not yet solved.

The rest of this paper is structured as follows. Section 2 presents operational issues of homes for the aged. The recommendations and solutions to the issues are represented and discussed in Section 3. Section 4 provides a conclusion and direction for future research.

2. KEY OPERATIONAL ISSUES

Mobile technology is one of the assistive technologies [8, 9, 13]. With the emergence of 5G, smartphone improvement, and the advancement of mobile technology, the design and application of mobile technology for older adults have exhibited a significant research gap. Thus, this study addresses how design principles and device features of mobile technology reduce the gap between the demands of older adults and their needs. To what extent are older adults considered in the mobile App design process? How does the design and implementation of mobile technology foster older adults to access smart cities?

2.1. Lack of Mobile Apps Focused on Older Adult Needs

In 2019, the global population reached 703 million. The higher living standard, advanced medical treatment, and availability of nutrient-rich foods further extended the global average life expectancy. In this sense, the number of older adults is estimated to double to 1.5 million before 2050 [7]. Many developed countries have come to be aging societies [12]. The aging population in Hong Kong is growing at a substantial rate. Hong Kong is concerned that the older adult population rate will be growing from 17.9% to 31.9% between 2018 and 2038 (Fig. **1**). In 2038, almost one in three people will be older [14].

Given the aging population structure in modern society, mobile phone users are not limited to only young and middle-aged people but also older adults. According to the Hong Kong Census and Statistics Department [15], there was a certainly noticeable increase in the usage of smartphones among older adults. The coverage rate of owning smartphones increased from 6.9% in 2012 to 57.2% in 2019 (Table **1**). This proves that the demand for older adults for mobile phones has increased.

Smartphones are smart devices with many functions and applications, such as logging in to social media, making phone calls, and setting alarm clocks. However, complicated functions may be difficult for older adults. This is because many older people have no experience using computers, related software, and applications. Therefore, there is a significant gap in knowledge and expertise among this group, creating obstacles to adopting electronic equipment. Some older adults lack confidence in learning and operating smartphones. Older adults

CHAPTER 9

The Application of Macro Business Simulation on Healthcare Product: Hand Sanitizer

Abstract: This book chapter mainly discusses how Macro Business Simulation applies to healthcare products. Due to the COVID-19 pandemic, hand sanitizer is a necessity to minimize the spread of the COVID-19 virus to the public. To the best of the authors' knowledge, the International Association of Business Management Simulation launched macro business simulations over the past few years across academic institutions, firms, and training bodies. Macro business simulation games become emerging educational tools due to the growth of online learning pedagogy and the emergence of innovative educational concepts. This book chapter mainly identifies the key elements of macro business simulation, expected students' learning outcomes, and the key structures of macro business simulation. Hand sanitizer is also used as an illustrative example to investigate how healthcare products integrate into the macro business simulation platform.

Keywords: Macro business simulation, Healthcare products, Hand sanitizer, International Association of Business Management Simulation.

1. INTRODUCTION

1.1. What Do Students Learn About?

● Budgeting –Why do the students need to allocate appropriate numbers to their budget plans by making sound decisions? The educators may conduct a comparison of their accounting with their budgeting to understand their deviations.

● Decision Making – The main role of an executive is to make wise decisions. The students may make numerous decisions, for instance, whether to buy or rent their production lines.

● Product Calculations – What volume of products should students produce, given the costs and the market demand? What prices should they accept when selling in the market?

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● Investment Analysis – Would we allocate the research funding to decrease production costs? Would we finance the new factory? Which new product line do we provide capital for?

● Risk Assessment – If all goes smoothly, can we still fulfill the commitments in our investments?

● Dividend Strategy – How will paying dividends affect how the market values your company?

● Cash flow management – The students will be required to closely monitor their cash flow. They may apply for loans or retain profits. Otherwise, they will bear expensive credit in case of using up money.

● Accounting – The simulation game can systematically establish cash flow statements, balance sheets, and profit and loss statements. Alternatively, you may let the students take the bookkeeping exercises themselves.

● Strategy – link the points between various academic disciplines including finance, operations, strategy, operations, and accounting. In what way are the finances of a cost leader strategy compared to a skimming-the-market strategy?

2. BASIC GAME SCENARIO

Macro Business Simulation (MBS) is a single product, one-to-four markets business game. Product demand is seasonal and affected by individual market prices, product image and quality, and other economic factors. Each round of the game can be considered a quarter of the calendar time.

MBS has four models of the game with a number of decisions see Table **1**. The game can accommodate up to 20 groups of players, up to 6 players with different management roles in a group. The CEO is a "super player" and can take on any extra roles if needed. All players save their decisions temporarily and only the CEO can submit the decisions for the company. Once decisions are submitted, no change will be allowed.

Model 1 and 2 games are suitable for practice purposes because they have only one market and fewer decisions. These games will introduce all players to familiarize the structure of the game, available reports and analysis, and decision-making logic.

Table 1. Level of decision making.

Model	Raw Materials Purchasing	Production Qty Allocation	Retail (Prices and Markets)	Marketing Expenses	Equipment I Maintenance	R&D Expenses	Dividend	Loan	Number of Decisions
1	√	√	√	√	-	-	-	-	4
2	√	√	√	√	√ I √	√	√	-	8
3	√	√	√√√√	√√√√	√ I √	√	√	-	14
4	√	√√√√	√√√√	√√√√	√ I √	√	√	√	18
-	Purchasing Manager	Production Manager	Sales Manager	Planning Manager	Production Manager	Planning Manager	Financial Manager	Financial Manager	-

Model 3 and 4 games extend the business scenarios with four individual markets with different pricing and marketing investment decisions. The production mode also allows up to three shifts a day to expand the capacity needed to meet the potential demand [1].

3. MANAGEMENT DASHBOARD

Once you log in to the system, the management dashboard will be displayed with key performance indicators (KPIs) and related information (Fig. **1**).

Fig. (1). Management dashboard.

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