New Trends and Technologies in Facilities Management in China: The Dual Impact of Environmental Protection and Digitalisation

Qi Wu(✉)

University of Malaya, Kuala Lumpur, Malaysia
wuqi7728@gmail.com

Abstract. This article analyses the current state of facilities management in China, highlighting the importance of facilities management while focusing on the challenges it faces. The paper discusses emerging trends and technologies such as sustainability and efficiency, the use of IoT technologies, the shift towards preventive and predictive maintenance, teleworking and distributed teams, and how they are changing our understanding and management of the workplace. Particular attention is paid to two key trends, digital facilities management and sustainable, environmentally friendly facilities management. Finally, we explore the implications of these emerging trends for facilities management practices in China and highlight the importance of how these emerging trends and technologies can be used to optimise the operation of urban infrastructure, improve the quality of life of citizens and drive economic productivity.

Keywords: Facilities Management · Emerging Trends · Technology · Digital Facilities Management · Sustainable Management · Environmental Management

1 Introduction

1.1 The Importance and Current State of Facilities Management in China

Buildings, installations, and other types of facilities are assets that support our social and economic activities [1]. Facilities encompass various forms of physical infrastructure (such as highways, bridges, and stadiums) as well as structures (such as hospitals, retail malls, and homes). The responsibility and significance of management have expanded due to the complexity of contemporary infrastructures. Facilities management (FM) is an organisational function that integrates people, places, and processes into the built environment to enhance the quality of life and commercial efficiency, according to the International Standards Organisation [2].

In China, facilities management is a relatively recent concept that is becoming more significant as the nation continues to urbanise and the middle class expands. Chinese businesses, particularly multinational corporations, a growing number of State-Owned Enterprises (SOEs), and domestic firms have started to implement strategic facilities

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management planning in recent years with the aim of maximising operational efficiency throughout the lifecycle of a building [3].

In the current urban and increasingly digital/informative era, facilities management is critical to the well-being of society in terms of the services provided by cities, and this is well illustrated by its role during the COVID-19 pandemic in China. However, while facilities management is making significant progress in China, it still faces a number of challenges. There is not much enthusiasm for resources and energy efficiency due to the outdated philosophy of property management companies. As a result, the development requirements for facilities management are not being met. Currently, the educational backgrounds and levels of experience in building operations and maintenance of property management and service professionals in China vary. Many members of the service and maintenance crew are unaccustomed to using modern technology [4]. The inability to meet facilities management goals is mostly due to poor property services and out-of-date ecological notions.

1.2 An Overview of Emerging Trends and Technologies

In the field of facilities management, emerging trends and technologies are changing the way we understand and manage the workplace [5–7]:

Trend 1: Efficiency and sustainability: Sustainability is one of the main themes in facility management. A growing number of businesses are searching for strategies to lessen their carbon footprint due to rising environmental concerns. This implies that more emphasis will be placed on sustainable practices in facilities management, such as better environmental management and energy-efficient lighting. Smart facilities management technology is necessary for innovative best practices, professional accreditation, luring visionary investors, and remaining competitive in the modern marketplace.

Trend 2: Shift to preventive and predictive maintenance: Many organisations still rely on reactive maintenance, even though it is more costly and less efficient. Preventive maintenance helps teams predict when assets need maintenance so they can continue to operate at their best by using FM software that is on-site and identifies assets within the facility. Thanks to advances in equipment monitoring technology and data analysis, facility managers will use preventive and predictive advice. These technologies will make it easier for managers to monitor asset performance and anticipate equipment breakdowns, allowing them to take proactive measures before issues arise.

Trend 3: Remote working and distributed teams: As hybrid working, flexible working hours and desk rotation become increasingly popular, FM teams must be prepared to apply them without compromising the quality of their production. This may involve facilitating co-working and controlled workspaces or developing mobile applications that allow teams to work efficiently from anywhere. These platforms allow employees to take control of hybrid work, making collaboration easier and optimising the capacity of the office experience.

Trend 4: The advancement of facilities management in China also involves enhancing the technical skills of property managers and deepening their understanding

of the benefits of energy efficiency. This is essential in fostering a culture of innovation and sustainable development. Many property managers in China are now being trained in the use of advanced facilities management software and digital tools, such as building information modelling systems and energy management software. This training is aimed at enhancing their ability to monitor and optimise building operations, resulting in improved energy efficiency and reduced environmental impact.

2 Emerging Trends in Facilities Management

2.1 Digital Facility Management

Digital Facility Management is the process of using digital technologies (e.g. cloud computing, Internet of Things, big data, artificial intelligence, etc.) for facility management, including operation, maintenance, improvement and adaptation of facilities. This type of management enables real-time monitoring of the status of facilities, improving their efficiency and reliability and preventing facility failures [8].

1. The Internet of Things (IoT) plays a significant role in the facilities management industry. Facilities management focuses on the maintenance, operation and monitoring of buildings, grounds and infrastructure with the goal of keeping the physical environment safe, efficient and conducive to the conduct of work. IoT technologies assist facilities management in achieving these goals by deploying sensors and other IoT devices to monitor and manage all aspects of the facility, automating tasks and processes in facilities management, and using data analytics and machine learning.
2. In terms of comprehensive energy solutions, corporate value, and the highest level of customer satisfaction, big data may provide a multitude of options in every facility. Therefore, the goal is to provide an organised method for gathering, processing, and analysing a collection of data in order to optimise a facility's efficiency and functioning. Big Data applications in facility management Manage building performance and make predictions about potential equipment breakdowns or power outages.
3. Cloud computing: Cloud computing is playing a key role in the facilities management industry. It provides a way to store and process data centrally and with ease, regardless of the volume of data. For facilities managers, this means that they can quickly access and analyse data on the performance of each facility, thus improving the accuracy and timeliness of decisions.
4. Artificial Intelligence: Artificial Intelligence (AI) has become an important technology in the facilities management industry. AI can help facilities managers to improve efficiency and reduce resource waste by predicting and optimising facility performance. The application of AI opens up new possibilities in facilities management, allowing facility managers to manage and optimise facility operations more effectively, thereby creating greater business value.

2.2 Sustainable and Environmentally Friendly Facilities Management

More than 50% of the world's population lives in cities, which also support the majority of a nation's important economic activity. The ecology is impacted by the high concentration of economic activity and population dispersion in urban regions [9]. The amount

of CO^2 emissions as a result of human activity has significantly increased, widening the discrepancy between actual emissions and the target for reducing global warming. Global CO^2 emissions climbed to 35.6 billion tonnes in 2012, with China contributing 28% of the total, the US 16%, the EU 11%, and India 7% [10]. The largest man-made structures are buildings, and they emit a lot of carbon dioxide. Additionally, buildings account for 40% of all worldwide energy use, making them the most energy-intensive asset in cities [11]. Therefore, decreasing environmental, economic, and social consequences and meeting the sustainable development goals depend on reducing lifecycle carbon emissions and energy consumption of buildings. Building emissions are primarily greenhouse gases produced by the use of resources over the course of a building's life cycle and may thus be connected to the daily activities and employment of the building's occupants [2].

Sustainable and environmentally friendly facilities management is an environmentally conscious and sustainable approach to facilities management that focuses on green buildings and energy efficiency [12]. In short, FM sustainability is the process by which organisations change the way their physical environment operates to minimise its harmful effects on the environment and people. This process considers three areas - the environment, people and buildings. The facilities management team, therefore, has the ability to make a significant impact on sustainability efforts in the following five ways. Adopt green cleaning, conduct sustainability analysis of facility management and carry out preventive maintenance. Preventative maintenance helps to keep equipment running properly, uses sustainable materials and resources and renews assets in the building.

3 Impact and Examples of Emerging Trends on Facilities Management Practices in China

3.1 Trends in Sustainable Development

Sustainability trends are increasingly evident in Chinese facilities management practices. Governments and businesses are beginning to focus on energy efficiency and environmentally friendly design of buildings, and facilities management is therefore receiving more attention as an important tool that can achieve these goals. Over the past five years, China's green building certification has increased dramatically. In 2022, the US Green Building Council stated that 1,121 LEED projects with a combined size of more than 180 million square feet (16 million gross square metres) were certified in China [13]. There are presently an estimated 200 structures recognised under China's own certification programme, the 3-star Green Building Certification, which was launched in 2006. Certification creates energy efficiency responsibility, lowers operational costs over time, and significantly contributes to resource conservation.

Facilities managers may make a case for enhanced sustainability measures by measuring progress and integrating the sustainability agenda into building operations. Strategic FM planning is being implemented by businesses, not only multinationals but also more and more private enterprises in China and Chinese SOEs, with the aim of maximising efficiency over the lifetime of the building. This is accomplished by combining project management with FM, working in focused teams to develop innovative solutions and quantifiable objectives.

However, the environment for building projects is dynamic and complicated, and digital transformation is a long-term and sustainable process. The digital transformation process for the construction sector is fraught with challenges due to a lack of core technologies, limited funding options, and inadequate data quantities.

3.2 Example of Trend 1: Smart Lighting in Facilities Management

The application of digital technology to facilities management can be illustrated by the use of smart lighting systems. These systems incorporate IoT technology to improve energy efficiency and reduce the environmental footprint of buildings. Smart lighting systems use a network of sensors and connected devices to regulate the lighting in a building [14]. These systems can adjust the brightness of lights based on natural light levels, occupancy, and specific tasks or activities. This not only enhances the comfort and productivity of occupants but also reduces energy consumption, contributing to sustainability efforts.

For example, in China, some commercial buildings have started implementing smart lighting systems. These systems use sensors to detect natural light levels and adjust the brightness of artificial lights accordingly. If a room is empty, the lights automatically turn off, saving energy. Furthermore, the smart lighting systems collect data about energy usage, which is then analysed to identify further opportunities for energy efficiency improvements. This approach to lighting management not only contributes to sustainability goals but also reduces operational costs.

4 Conclusion

Facilities management is playing a key role in shaping China's infrastructure landscape as urbanisation accelerates and the middle class grows. While significant progress has been made in this area, a number of challenges remain, particularly in terms of resource and energy efficiency and employee acceptance of emerging technologies. These issues also provide opportunities for substantial growth and development in this area. Environmental and digital trends are reshaping facilities management in China. The adoption of digital facilities management is still in its infancy, and the challenges we can meet by upgrading the technical skills of property managers, developing an understanding of the benefits of energy efficiency, and encouraging a culture of innovation and sustainability, also present opportunities to transform the facilities management sector and promote a more sustainable and efficient built environment. China's future must therefore take advantage of these emerging trends and technologies in facilities management to optimise the operation of its urban infrastructure in order to improve the quality of life of its citizens while promoting economic productivity in an environmentally friendly manner.

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