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A study of sustainable facility management from a green supply chain perspective in the united arab emirates

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Abstract

The paper investigates how Sustainable Facility Management (SFM) can be integrated with Green Supply Chain Management (GSCM) initiatives and its application in the innovative sustainable business environment of the United Arab Emirates (UAE) in compliance with the UAE National 2030 agenda for sustainable development. To ensure the integration among the three pillars of sustainability: environmental, economic, and social vision, the UAE National Innovation Strategy is intending to brand the UAE as one of the most innovative nations in the world. Considering these initiatives and the concepts of Facility Management (FM), this research first examines the role of GSCM in adopting environmentally friendly approaches, and then explores the role FM plays in the context of GSCM. The study concludes by investigating how both concepts could be further extended in accordance with the UAE's vision of 2030 toward sustainable development using a qualitative benchmarking analysis. The analysis makes use of primarily European and North American best practices from the current literature. From the benchmarking exercise, an extended list of proposed initiatives is recommended with future implications also discussed.

1 Introduction

Over the past few decades, organizations have evolved and business processes have become more complex and integrated. The way managers used to operate has changed dramatically in part due to the way business has become less labor-intensive and more dependent on technology. The old approaches to performing daily tasks manually are becoming more obsolete. On the other hand, personal computers and smart mobile devices have automated more of the work. Moreover, the office walls are increasingly being replaced with open-plan layouts. Layers of management are being removed and managers are becoming their own administrative assistants, scheduling their meetings and planning their agenda themselves using electronic applications. The world is demanding everything faster and employees have remote communication through mobile devices, making their work hours extend past the traditional work day. As a result, businesses are more dynamic as means of communication have become accessible to everyone on all levels. This technology revolution has created a need for smart facilities that host such dynamic activities and provide a safe, secure, and productive environment that contributes to a firm's success. Eventually, as businesses' technological infrastructure has become more of a necessity in order to be competitive, employees are being replaced by machines to further facilitate efficiency, thus reducing operating costs and running more efficient and sustainable properties.

With the advent of the internet of things, there is a greater probability that the infrastructure needs of businesses will be radically redefined, including normal work hours being replaced by always-on as well as the elimination of physical offices for some employees. This leads into virtual offices and cloud hubs redefining the work environment. Furthermore, future office buildings will be greener and run more efficiently by utilizing cleaner energy (wind and solar energy solutions for example) where businesses and communities will collaborate toward advanced sustainable

environment solutions provided by professional suppliers. In addition to this, there is a growing need for Facilities Management (FM) solutions that provide energy plans and cost reductions across business environments. These solutions will make use of new technologies that will drive the development of new models for businesses to outsource their real estate needs. Hence, this development will allow the intelligent aggregation of business solutions, data optimizing and visibility of total operating costs in order to minimize total costs. To assist organizations with such a strategic shift and combining a vast scope of services with innovative IT and consultative FM, various innovate opportunities can be created (EuroFM, 2009).

FM is often an unseen industry that operates in the background to ensure buildings and services operate safely and effectively. This allows employees to do their work without having to worry about how their business facility functions promptly, productively, and in a safe environment. Millions of people work within the facilities management industry to ensure buildings are maintained efficiently. There are some tasks required to be performed, for instance FM managers need to ensure the lights work properly, air-conditioning is comfortable, workspaces are clean, waste is collected, and security keeps the premises safe. However, sometimes the users of these services take the industry for granted and fail to notice how everything is working efficiently and safely. Of course, this process of efficiency requires specific managerial skills, and this is where FM managers play a pivotal role. These managers are responsible for the training of their workers while they also have to maintain tight coordination amongst the subcontractors to facilitate adequate service delivery to their clients.

2 Purpose

The purpose of this research is to relate modern Sustainable Facility Management (SFM) tactics as a sub-discipline of Green Supply Chain Management (GSCM) within the UAE. How these disciplines are implemented determines to what level the UAE government's 2030 agenda is being met, which is primarily based upon the United Nation's 17 goals of sustainable development.

The research explores how SFM & GSCM comply with Dubai Expo 2020, the UAE's government vision of 2021, and the 2030 Agenda that fulfills one of the UN's 17 goals of sustainable development. Consequentially, this research first explores how supply chain management principles can aid in adopting an environmentally friendly approach toward green principles and continues with exploring the role SFM plays in the context of the GSCM. The research concludes by investigating how both of these concepts can be applicable in compliance with the UAE's vision of 2021 and 2030 Agenda goals of building sustainable cities and communities.

The topic for this research was chosen based on the fact that sustainability is one of the major challenges that threatens our modern way of living and contributes to the UN initiative of sustainable development that is intended to make the world a better place. Additionally, the UAE infrastructure and various facility developments are being accelerated to meet the challenge of hosting the Dubai Expo 2020 as well as meeting the UAE vision of 2021 and the 2030 Agenda for building sustainable cities and communities in the region. This research adopts a qualitative approach to build a case study using secondary information from literature on recent developments in the field of study. Since SFM is a relatively recent field of study, and because in particular there is lack of literature in the gulf region, this is an important topic to study.

3 Methodology

Benchmarking was used to critically analyze the UAE's 2030 Agenda and to provide insights into further recommended enhancements to the country's current performance in regards to FSM and GSCM. By benchmarking against current best practices that have been implemented or proposed within other countries, it allows for direct comparisons that can determine how much more the UAE could theoretically achieve in regards to its current agenda. Benchmarking also allows the ability to think beyond these current best practices in order to become a leader in the implementation of new best practices in these fields.

In order to achieve the purpose of the paper, a three-step process was implemented for the qualitative benchmarking study. First, a thorough literature review was conducted in the areas of SFM and GSCM. Next, a review and analysis of the current state of SFM and GSCM practices within the UAE was performed in regards to the country's mission in

accomplishing the UAE 2030 Agenda. Finally, a qualitative benchmarking analysis was conducted based on the best practices of current research findings in various related fields of interest, including design management, green supply chain management, facility management, resource management, and sustainable refurbishment (see Achillas 2019; Atkin & Brooks 2015; International Water Association, 2013; Meng 2014; Samar Ali Kaur, & Marmolejo, 2019; Shah 2012; Wison 2015; Yao 2013). The result is an extensive list of recommendations for future enhancement of SFM and GSCM within the UAE that could be further extended to other GCC countries as well as globally.

4 Literature review

4.1 Green supply chain management

For the purposes of the research, the focus of the literature review is on the last two decades when supply chain management (SCM) was directed towards an environmentally friendly approach in order to reduce the carbon footprint. However, to understand how the literature has evolved, a brief overview of the historical development of operations and supply chain management leading into the current sustainability era is presented.

When humans averted from hunting to agriculture, the settlement of domestic communities and bordered kingdoms, raised the need to develop raw materials into consumable goods. However, the expanding of communities led to increases in demand that could not be satisfied by manual means. The need to have more cost-effective methods of production created a need for machinery, that led to the rise of automation and factories. Accordingly, the first Industrial Revolution started in Europe in the late 1700s and early 1800s. However, in North America, it did not start until the end of the Civil War in 1812. The uniting of the United States of America required sustainability through developing means of transportation, such as the railways, to connect the whole country and to allow the mobility of people and exchange of resources and goods This development was the cornerstone of supply chain management. Supply chain management is essentially the managing and planning of the processes required to source, procure, and transform products and services. The management of the supporting logistics are also included in supply chain management. Additionally, supply chain management involves the collaboration and coordination needed among supply chain partners, which can include customers, service providers, suppliers and other intermediaries. Efficient integration of supply and demand among the supply chain members is another key aspect of successful supply chain management.

The second Industrial Revolution started in the early 20th century when Henry Ford mastered the moving assembly line, accompanied by mass production. The Third Industrial Revolution, digital manufacturing, is currently taking advantage of the rapid development of digital technology, cloud computing and the internet of things. The last decade witnessed a shift from traditional mass production to fully automated manufacturing facilities that employ robots more than humans. Absolute labor costs are being reduced and many industries are returning manufacturing to their home countries due to the cheap labor in developing countries becoming less of a driving cost factor. Raw materials are becoming lighter and stronger such as the carbon fiber that can be easily customized by new digital machine technology such as 3D printing. This technology does not require spacious factories to host large mechanical machines, which reduces the maintenance cost. As a result, firms are planning to make use of new digitalized applications, such as mobile applications and digitally controlled means of transportation such as drones, hyperloops, and self-driving trucks (The Economist 2012).

Jeremy Rifkin, an advisor to the European Union and the president of the Foundation on Economic Trends in Washington, D.C. argued the following:

“Today, Europe is laying the groundwork for the Third Industrial Revolution. The digitalized communication Internet is converging with a digitalized, renewable “Energy Internet” and a digitalized, automated “Transportation and Logistics Internet” to create a super “Internet of Things” infrastructure. In the Internet of Things era, sensors will be embedded into every device and appliance, allowing them to communicate with each other and Internet users, providing up-to-the-moment data on the managing, powering and moving of economic activity in a smart Digital Europe. Currently, billions of sensors are attached to resource flows, warehouses, road systems, factory production lines, the electricity transmission grid, offices, homes, stores and vehicles, continually monitoring their status and performance and feeding big data back to the Communication Internet, Energy Internet and Transportation and Logistics Internet. By 2030, it is estimated there will be more than 100 trillion sensors connecting the human and

natural environment in a global distributed intelligent network. For the first time in history, the entire human race can collaborate directly with one another, democratizing economic life" (Rifkin 2015).

The digital manufacturing revolution that rose in the last decade brought along concerns about the negative effect of the industry on the environment, such as carbon emission and the excessive use of natural resources. As a result, green and sustainable supply chain management practices have been developed by some dedicated academic researchers and industry leaders. This has resulted in a significant growth of knowledge with business applications aiming to incorporate environmental concerns into organizations and reducing the unintentional negative impact of its production on the environment.

GSCM has been described as "the integration of environmental, social, and economic criteria that allow an organization to achieve long- term economic viability to the logistics literature, and positioned sustainability within the broader rubric of SSCM" (Carter & Rogers 2008). This work presented a comprehensive evaluation of the sustainability literature, introduced sustainability to the field of supply chain management, and expanded the conceptualization of sustainability beyond the triple bottom line, "evaluating the firm against social, economic, and environmental criteria" (Rogers 2008). Seuring and Müller (2008) provided a conceptual framework for sustainable supply chain management using 191 papers published from 1994 to 2007 as the basis for contextualizing GSCM. Sarkis, Zhu, & Lai (2011) have further outlined most of the recent significant theories pertaining to GSCM.

The increased attention given to the topic of GSCM drove Chin, Tat, and Sulaiman (2015) to focus on environmental collaboration, which has been seen as a key relational component to facilitate GSCM strategic formulations into action.

Industry has also contributed to GSCM research. For example, Deloitte created a strategic process for green sourcing that complements traditional techniques in order save costs and improve their environmental sustainability numbers. They accomplished this through a six-step process involving critically analyzing their current operations, seeing where unsustainable resources are damaging their bottom line and overall sustainability, and then shift their strategic plan to include transitioning out of these risky areas. For example, Deloitte upgraded to energy-efficient lighting for their offices in order to reduce the need for electricity consumption which resulted in millions of dollars of annual savings. Thus, using these sorts of techniques can result in reducing costs, waste and overall use of common yet essential resources (Jacobs & Chase 2017).

In terms of waste reduction, there are several examples to draw upon. One such example is the redesign of something as simple as a milk jug (Nefedova 2013). By altering the dimensions of a jug, it can make for less water required for cleaning, less waste of spilled milk, and less space needed for packaging, storing, and transportation. These changes can result in reduction in the reduction of various resource requirements while simultaneously reducing costs to supplier and purchaser. These sorts of changes inevitably result in stronger relationships among supply chain partners.

4.2 Facility management

Facility Management is a challenge to define. The literature discusses various definitions as FM plays various functional roles in practice, and its application is significantly broad between the varoious domains. For instance, some suggest that the factors pertaining to the culture of the organization and various business needs form the basis for FM. However, others argue that it is significantly concerned with the services and maintenance activities conducted within the organization. Therefore, FM is largely seen as the operational and functional services that support the core activities of an organization. On the other hand, the literature expresses its link with resource management, suggesting that FM plays a pivotal role in contributing and aligning with the organization's strategic directions (Waheed & Fernie 2009).

Typically, the British Institute of Facilities Management (BIFM) defines FM as follows: "Facilities management is the integration of processes within an organization to maintain and develop the agreed services which support and improve the effectiveness of its primary activities" (BIFM 2010).

Furthermore, some sources have extended the definition of FM by linking it to specific categories. For instance, FM has been concerned mainly as the integration of three main components of organizational activities that include:

(1) Property management
(2) Property operations and maintenance
(3) Offices administration

All these departments have one thing in common; they all support the core activities of the organization. However, they significantly differ with respect to the financial impact they create and the skills that are required to perform such activities. Consequently, these also greatly depend upon the culture and people of the organization itself.

Nevertheless, only recently has FM been recognized as a separate discipline and has emerged mainly due to changing organizational environments in which highly competitive firms are trying to provide the best product to their customers. This has paved the way for FM to offer significant aid in supporting more competitive work environments for organizations in terms of sustainability. Therefore, FM is often associated with managing the infrastructure of firms. Moreover, these organizations tend to have a continuous range of processes and activities operating on a daily basis. Consequently, the need for integrating the processes has been identified by practitioners of FM and the discipline has been successful in making processes more efficient than ever before (Kincaid 1994).

Markets today have become more dynamic and many countries are facing economic downturns. These circumstances create the need for organizations to be more proactive in their approach to enhance the efficiency of their management systems. It is evident from the literature that FM has significantly helped organizations reduce their costs and support the business process via applying coordination between their activities. For this purpose, it has been suggested that a coordinated model could facilitate organizations' processes. Furthermore, outsourcing could be one of the methods that could enhance coordination and provide better integration within the organization as outsourcing has also played a vital role in enabling organizations to reduce costs (Potkány 2015).

It is evident from the discussion above that the scope of FM is quite broad. But no matter in what context it is used, FM eventually leads to enhancing the environment of firms by focusing on improving employees' performance and minimizing the operating costs. For instance, International Facility Management Association (IFMA), a respected representative of the majority of world facility managers, defines FM as "a method whose task in organizations is to mutually harmonize employees, work activities and the work environment that includes principles of business administration, architecture and humanities and technical sciences" (Potkany, Vetrakova, & Babiakova 2015). Furthermore, this contribution of FM and FM management, leads towards sustainability. Sustainability and FM are seen as complementary, and both are relatively new concepts. In addition, their relationship could be substantiated by the fact that both significantly empower three basic domains: environmental, social, and economic sustainability. Moreover, economic and environmental concerns have made it mandatory for FM managers to adopt more sustainable approaches towards managing the businesses processes that could reduce waste and cost simultaneously for firms (ITU 2016).

Some arguments have been made that despite developments towards sustainability, the construction industry has not been able to eradicate wastes and reduce costs. Instead, the industry has been criticized heavily for its slower and more traditional processes, which have further harmed corporate social responsibilities (CSR). However, this is where FM, if combined with sustainability, can play a vital role not only to minimize the costs for the construction industry but also to enhance the environmental value and efficiency of the industry (Meng 2014).

4.3 Sustainable facility management

Before discussing the link of sustainability with FM, one should define sustainable development. One such definition is as follows: "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (The International Institute for Sustainable Development (IISD)).

The reason why there is a need to incorporate FM with sustainability is due to the challenges that the changing environments and climate changes have presented. These challenges have further created the need for sustainable development and energy efficient applications to be adopted by organizations. Furthermore, most figures suggest that buildings contribute about 40 percent of the total energy consumption and one-third of greenhouse gas emissions in Europe while 80% of the impact on climate change is created during the operation phase of the buildings. The operating phase can not only affect energy consumption, but it also requires the use of renewable resources because it may lead to the inefficient use of food consumption, hence giving rise to poverty and disrupting the health of society. Moreover, these factors have forced practitioners to focus on the built environment, making buildings and offices that are

environmentally friendly and sustainable in nature. In relation to the built environment, green buildings have not only enhanced the satisfaction levels of the tenants, but have also significantly improved the productivity of the employees working within such green spaces. Therefore, this has enabled stakeholders such as property owners and building owners to adapt more sustainable practices in the context of the built environment. For instance, stakeholders are not only forced to use sustainable construction and building materials, but the focus has also shifted towards creating sustainable designs of the buildings. This is where sustainable facility management (SFM) can propose solutions for making the operation phase and maintenance of the buildings to be more sustainable and efficient than the traditional methods used previously (Hollander 2004).

Nevertheless, to benefit from both FM and sustainability, it is imperative to develop a system that could digitally automate and integrate the processes for the construction industry. Consequently, some research has suggested that co-creation of digital systems along with FM services would greatly enable on-site monitoring system to aid in minimizing cost and waste (Lavikka, Lehtinen, & Hall 2017).

On the other hand, the evolution of Information and Communication Technologies (ICT) can further benefit SFM to apply automation and integration in the business process. ICT has emerged rapidly over the past few decades while several advancements of the Internet-of-Things (IOT) have enabled ICTs to support and improve the digital economy. Eventually, enabling these technologies will add value to society by building less costly and more environmentally friendly work environments (ITU 2016).

Before applying SFM in the UAE, it is imperative to know the issues the region has been facing regarding sustainability. Therefore, the next section is focused on what role sustainability plays in the GCC and the UAE in particular.

5 Current findings of sustainability within in the UAE and the gulf region

The Gulf Cooperation Council (GCC) consists of six countries. Its member states are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. All the other GCC countries have significant political and economic influence on the UAE. Sustainability has been one of the critical issues in the GCC over the past few decades. Reports suggests that all of the GCC countries are in the top 10 countries that are either less effective in sustainability or they have the highest consumption in the world. The report by the International Energy Agency suggested that these countries are amongst the highest energy consumers per capita in the world. The State of Qatar is at the top while Saudi Arabia and Oman are at the 11th and 15th places respectively. Furthermore, Bahrain holds the fifth position while Kuwait is sixth. The UAE is ranked ninth overall in the world. This means that all the GCC countries have been consuming resources such as water, energy, and food quite extensively compared to the rest of the world (Azar & Abdel Raouf 2017).

The report raised many concerns for the Gulf region and the UAE as well. The UAE has been focusing on reducing the consumption of these resources and in building sustainable cities that could enhance the economic growth and simultaneously reduce the greenhouse gas emissions in the region. The UAE leadership has set some clear goals and vision for the year 2030 that is discussed in the next section.

6 The UAE 2030 vision and sustainability goals

The vision of 2030 for the UAE expresses clear and identifiable goals towards the sustainable development of the region. The UAE leadership aims to reduce poverty and food consumption and to make sure that the educational needs are accessible to every citizen and resident in the country. To create a healthier lifestyle for future generations, the UAE leadership is focusing on developing sustainable architecture and infrastructure. One such example is the development of Masdar City in the Abu Dhabi Emirate. The objective of developing Masdar City is to build a city that can be the first sustainable city that can inspire other countries to follow the same methodology for urban development (Nader 2009). Moreover, the UAE has been focusing on implementing renewable energies, particularly solar power to reduce consumption. However, this has posed a significant challenge to develop architecture to support an eco-friendly city that could pave the way for other countries to adopt new path towards sustainable and urban development (Ibrahim,

2016). Therefore, the Emirate of Dubai has also adopted similar approaches in developing four sustainable cities and communities to further the testing of eco-friendly cities.

The project called Sustainable City has already been started in the community known as Dubailand. The project aims to build a township by planting 10,000 trees and organic house farms. It is expected to operate on solar power energy as the main source of electricity.

Desert Rose City is another sustainable mini city whose construction has been underway in the area of Al Ruwwaya. The city utilizes renewable energy and is required to produce its own energy. Already 10,000 units have been designated for expatriates and 20,000 units for Emiratis.

Dubai South District is the venue of EXPO 2020 which is to be hosted in Dubai. This city is expected to generate half of its energy on-location, while the rest will be generated from other renewable resources.

Dubai Silicon Oasis has been operating for several years, and was expected to reduce energy consumption by 30% according to the Dubai Integrated Energy Strategy 2030. The city has already been successful in surpassing this margin by reducing energy consumption by 31%. This has been primarily achieved by implementing some of the following sustainable technologies:

- Power consumption of lights
- Smart street lights
- Smart building technologies (UAE Goverment 2017)

It is evident from the discussion above that the UAE government understands the importance and the value of having a sustainable development for the sake of country prosperity and the future of the next generation.

Along with the sustainable developments discussed earlier, the government has been making progress in facility management as well. For example, in 2009 the Middle East Facility Management Association (MEFMA) was established as a member of Global FM and supported by the Real Estate Regulatory Authority and the Dubai Real Estate Institute. The association works with industry professionals to implement long-term sustainable development strategies. Imdaad organizes accredited training programs, educational courses, seminars, and conferences. Imdaad further provides extensive FM regional networking and fundraising events tasked with reaching out to members and governments across the Middle East, MEFMA conferences, open days and networking events. Their aim is to help shape a sustainably built environment in order to further socio-economic development now and for future generations. (MEFMA, n.d.)

The Dubai Government-owned global holding company, Dubai World, focuses on the strategic growth areas of urban development, transport & logistics, maritime, and financial services. As it is committed to investing in the long term and generating value in strategic areas, it established Imdaad as a subsidiary company to offer strategic and operations solutions in facilities management, FM consultancy, specialist facilities services, and employee welfare activities. Imdaad clients' portfolios contain most of the prestigious real-estate developers and logistics and operation corporations of the region. For instance, Nakheel, Jafza, DP World, Dubai Customs, and Limitless cover landmark developments such as The Palm Jumeirah, The Gardens, International City, Jumeirah Islands, Burj Khalifa, Al Barari, the Jebel Ali Port and Free Zone and The Dubai Mall, among others (Imdaad 2017). Moreover, it was estimated in 2015 that Dubai FM serves contracts in the UAE in the value of approximately Dh20 billion per annum. This statistic included FM services that ranged from cleaning services, pest control, office services, landscaping, waste management and building management systems with the exclusion of security services. An average of 60 percent of most industries in the UAE are thought to outsource its FM requirements (WAM 2014).

7 Benchmarking, analysis and recommendations

Despite implementing the sustainable approaches discussed, the government of the UAE is still concerned about the sustainability in the region as resource consumption is still relatively high compared to other countries of similar size. Moreover, the research on this topic is quite scarce in this part of the world. To fill this gap, further opportunities within the 17 goals of the United Nations on sustainability need to be explored deeper. If the UAE needs to apply the sustainable approaches, it can follow the standards proposed by the United Nations. However, keeping in view of the

vision of the UAE and the scope of this research, this paper limits its scope to exploring goal number 11 amongst the UN 17 sustainable goals to be implemented in this region. Goal 11 pertains to developing sustainable cities and communities. Although the UAE has already tried to implement the sustainable city in the shape of Masdar City as well as several smaller implementations, it still requires improvements. For instance, the UAE still needs to reduce congestion and also further exploit building designs that are sustainable. This could be achieved by complementary infrastructure, efficient use of resources and creating more jobs that support the economic development of the region (UN 2015). Therefore, it is suggested that the importance of FM and green supply chain management are more emphasized. In particular, both concepts could be used to provide complementary benefits that could further aid the vision of the UAE. As a result, after conducting a comprehensive review of literature, the following is a general list of ways FM and GSCM can greatly influence and foster the UAE vision of 2030:

1. Integrating Green processes in supply chain and facility management
2. Creating healthier work environments
3. Preparing and consolidating for better future and living standards
4. Mainstreaming green business practices
5. Streamlining the business processes
6. Bolstering the growth of economic, social and environmental sustainability.
7. Eventually reinforcing the UAE vision of 2030 towards sustainable development

However, to efficiently implement these suggestions, the UAE could adopt the framework of current studies, particularly from developed regions such as Europe and North America. For example, the UAE can use as a benchmark a study conducted in the UK and Ireland by Meng (2014). The study identified some key roles of FM and GSCM that could foster sustainable development. These key roles were identified in order of importance to those interviewed in the study as: Integrating all sustainability considerations, linking strategic level with operational level, incorporating FM knowledge and experience into design, disseminating sustainable knowledge and educating people, and encouraging sustainability through innovation (Meng 2014). Consequently, it is recommended to use these findings as a benchmark and thus propose this framework to be utilized by both the appropriate practitioners within and leadership of the UAE.

Further to the previous example, Achillas (2019), Atkins and Brooks (2015), the International Water Assocation (2013), Samar, Kaur, and Marmolejo Saucedo (2019), Shah (2012), Willson (2015), and Yao (2013) have recently provided a plethora of case examples and theoretical recommendations that can be applied as best practices for the UAE specifically and the GCC region as a whole to emulate. The following are a list of recommendations specific for the UAE based on the literature:

- Phase-in the sustainable cities implementations already installed in Dubai and Abu Dhabi to the rest of the cities. This can be done in a systematic way through phasing out older areas of the city first and replacing them with newer technology in order to have the greatest impact.
- Take a holistic approach to city planning in order to customize SFM and GSCM implementations that best complement the rest of the city and its supply chain requirements.
- Move from a throw away culture (e.g. plastic bottles, water) to a reuse and refurbish culture. Governmental policies and public campaigns can help in encouraging this initiative. Careful planning on water reuse would especially have a great impact on the region due to the lack of naturally fresh water.
- Redesign parking facilities for more efficient use of resources. With the UAE being a car culture, reducing congestion and creating more efficient parking would create a meaningful impact.
- Designing facilities that are flexible enough for expansion with minimal excess resources required would reduce the carbon footprint in regards to future growth and keep costs down. This would also allow more compact expansion, which is more efficient. This would be in contrast to developing land further and further inland as is the current trend.
- Continue to invest in construction technologies in regards to streamlining the currently inefficient processes that exist in the industry. This field has a lot of room for improvement in regards to sustainability. Since the UAE is fairly new in its development process as a country with much more expansion planned in the future, improvements made in this sector will bring large benefits to the economy.
- Apply more weight in regards to environmental factors when deciding location of new developments. This is in contrast to the traditional practice of profitability.

- Adopt more sustainability education requirements in grade school through university. Creating awareness and interest in the youth would result in more residents getting involved.
- Invest more in both basic and applied research at both the university and industry level. The research should encompass the science, engineering, social, and economic levels in order to provide holistic sustainable solution. This will also position the UAE as a leader in the field and allow the resulting technology to spread to its neighbors.
- Grow coalitions with neighboring countries as well as other countries in regards to sustainability knowledge-sharing in order to increase the speed of state-of-the-art implementations.
- Design new facilities with the perspective of a developing country. In other words, the UAE should not become comfortable in its current infrastructure and operations. They should strive to always be learning, improving and willing to expand its goals rapidly.

If the UAE takes these cues provided by others and puts enough leadership and supporting resources behind the initiatives, they can be the leader in SFM and GSCM for the region and the world.

8 Future implications

SFM and GSCM can support the vision of the UAE, and in order to implement sustainability, focus should be on building techniques such as reducing costs of construction and using sustainable designs for buildings. Moreover, the application of ICT can help ensure integration and coordination between the processes. However, it cannot be done without the support of the citizens and for that, the mindset needs to be changed. The UAE needs to be more educated about the consequences caused by global warming and this could contribute to developing a healthier society for future generations. Only then can SFM and GSCM be effective and compliment the 2030 vision of the UAE.

Moreover, it is evident that this challenge requires an adequate operational strategy that sustains the country's resources for future generations. It is also clear that the UAE government is known for seeking invasive approaches and new tactics to make the best use of its resources. On the contrary, it is also evident from the literature reviewed that there is a dearth of research in this specific region. As a result of this knowledge gap, it is recommended that more research is conducted to complement and further analyze the local initiatives of sustainable development knowledge building in the region.

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