Exploring Urban Facilities Management Approaches to Increase Connectivity in Smart Cities

Abstract

Purpose: The aim is to explore how the discipline Facilities Management (FM) can be developed in a smart city perspective through considering the current and new FM services under the role of Urban FM as well as governance structures that limit and enable it.
Design/methodology/approach: The approach is primarily theoretical by examining current literature around the ideas of Urban FM and Smart Cities linking them to observations in one city aiming to be a Smart City. This specific paper focuses on maintenance management, workspace management, and energy management services in a Smart City perspective.
Findings: The results outline how Urban FM can fill the gaps that are apparent in city planning through connectivity to communities and neighbourhoods using the Smart City approaches of optimising data but also considers prominent governance structures of FM, Urban FM, City Planning and Smart Cities. The study addresses the limitations of what can be done when cities are not organisations, which make identifying the "core business" obscure and intangible but attempts to overcome this limitation by considering social value in communities and wider linkages to the city environment.
Research implications/limitation: The paper sets out the potential of Urban FM in Smart Cities, but the findings are limited to primarily theoretical research and need further empirical examination.
Practical implications: The results indicate how facilities management can improve services in cities through the digitalization of cities and the role of Urban FM. The study will be useful for municipalities in examining how to improve facilities, particularly in cities that aspire to be a Smart City and it is also important for policy makers in considering governance structures to meet Sustainable Development Goals.

Keywords: Smart Cities, Urban Facilities Management, Governance, Social Value

1. Introduction

There is a necessity to consider Facilities Management (FM) within a larger lens coming from a shift of focus in policy from building to city. The FM discipline is established at the singular organizational level and it is far from obvious how skills of maintaining and delivering services to individual organisations are transferable to the city scale (Bröchner et. al, 2019). Core business is often referred to when developing hard and soft services for an organisation, this is how facilities managers develop a strategy to support the core business of an organisation (Atkins and Brooks, 2015). A city is not an organisation, so FM thinking needs to consider what is core in a city or if it possible to develop a perspective of a city in this way. Cities are characterised by a complexity of variables and stakeholder interests (Dixon *et al.*, 2014; Salvia *et al.*, 2015). Smart cities, depending on disciplinary area, considers this complexity both within the integration of data systems and governance approaches (Albion *et al.*, 2015). Communities and neighbourhoods make up the public space of cities where people are key. Similarly, within the FM context, services support the activities of the core business and needs of users (ISO 41011:2017), i.e. people are key. FM plays a crucial role to meet strategic operational objectives for realisation at an operational level, which means FM practitioners must understand organisational core business and that of the needs of the users in order to optimise resources leading to a better work environment for all. Taking this approach to a bigger scale of cities, requires understanding community level needs in order to provide hard and soft services and provide support services to communities.
Urban FM provides a platform for agencies and the private sector for new and innovative settings to benefit local communities. Temeljotov Salaj *et al.* (2018a) view Urban FM role as becoming an active and valuable partner for facilitating liveable cities, with the focus on health and well-being, which strongly includes focus on Sustainable Development Goals. Understanding connectivity between communities and services on a city scale has become more important as carbon emissions are on the rise and more effort among nations is required to meet the 2-degree Celsius goal (UN Report, 2018).

Currently initiatives are fragmented and there is an increasing need for non-state and subnational actors such as cities, states, regions, companies, investors, foundations, civil society and cooperative initiatives to work together (UN Report 2018). The main idea of Urban FM is to improve the quality of the physical environment; create employment opportunities and ensure inclusivity of communities in design and management of services in the urban environment (Alexander and Brown, 2006). It is possible to consider core within communities and districts through shared values (Temeljotov Salaj *et al.*, 2018a) as space is not just about the physical area. Planning urban spaces, one should not just consider the specific area but also the connectivity to its wider environment, which is often lacking in city planning and development (Dixon *et al.*, 2014). This is a connectivity that can be provided through Urban FM, which is currently not considered in many studies. It is this area which the paper explores through a first research question on how FM, specifically Urban FM, is understood within a Smart City context? The second research question is how governing structures in Urban FM and Smart Cities have the potential to increase connectivity of community/neighbourhood services in cities. This is followed and explained by observations of how the city of Trondheim in Norway links Urban FM in its development as a Smart City.

2. Method

The article theoretically explores the extant literature on Urban FM and Smart Cities. This literature review is primarily cumulative in terms that all authors are active in FM research and 3 authors have knowledge on Urban FM and Smart Cities, therefore literature related to this topic has been gathered over many years but with a clear direction since 2017. Urban FM was chosen as a focus as it is already a concept within FM that links to the city scale, though has emphasis on communities, as well as public and private sectors. The literature review was conducted on what FM services are managed in cities that effect urban communities and how approaches of Smart Cities impact and develop these services further. FM is not specifically considered in Smart Cities approaches so it was necessary to conduct observations of an aspiring Smart City to understand the impact of Urban FM in this context. Observations of the Norwegian city of Trondheim, an aspiring Smart City, were done with students of a refurbishment course taught at the Norwegian University of Science and Technology (NTNU), as well as observations of the city linking to the EU funded Smart City project +CityxChange (Positive City Exchange https://cityxchange.eu/). Further data was collected through examining real estate groups of PropTech as well through discussions and workshops with participants at CIRRE (Conference of Interdisciplinary Research on Real Estate) conference in Netherlands 2018 and EuroFM Conference, Dublin 2019. In addition, notes from meetings and seminars organised by NTNU Smart Sustainable Cities group and meetings with FM colleagues around the concept of Urban FM and Smart Cities (2018-2019) also aid in the formulation of this work. As the work is developed, at a city scale governance theoretical lens is applied in order to explore how cities are organized within the context of service management and planning. Cities are not organisations and therefore, there are different institutional bodies necessarily requiring consideration within this context. The data is unstructured based on different literary sources, notes from meetings and conferences as well as observations, the analysis is based on tying all these sources together in a working paper that has had 9 rounds of major iterations through writing, analysis and discussion with all authors. The article will first explore how the extant literature is a way of understanding FM, specifically Urban FM, within the Smart City context and the role of governance and this is followed with observations of how the city of Trondheim in Norway links Urban FM in its development as a Smart City.

3. Urban Facilities Management Connectivity to Smart Cities

Buildings are a major part of cities and people are active participants with behavioural patterns impacting on sustainability, therefore both buildings and people are necessary to work with to meet the SDG (United Nations Sustainable Development Goals). SDG's "provides a shared blueprint for peace and prosperity for *people and the planet*, now and into the future" with a diverse set of goals ranging from eliminating poverty, climate action to building sustainable cities and communities (UN, 2020). SDGs cannot be ignored in any discussion on cities or evolving disciplinary outlook. The ISO 41011:2017 definition of FM states it is an ". . .organisational function which integrates people, place and process within the built environment with the purpose of improving the quality of life of people

and the productivity of the core business offers a starting point". The integration of people within its wider environment in order to improve quality links SDGs directly to FM. Sustainability is fundamental to the FM discipline for good service management. Currently, Facilities managers play a key role in buildings, as the main custodian of buildings ensuring their longevity (Atkins and Brooks, 2015). In other words, FM ensures buildings are resilient and sustainable while also meeting the core needs of those who use them. Taking facilities management thinking on a broader city scale will further increase sustainability of cities by meeting the needs of citizens and in making cities more resilient.

Services within FM are increasingly digitalized (Dansk Facilities Management Netværk, 2018) and services which link to Smart City approaches could optimize data relationships with the physical environment as well as citizens use of the environment. Urban FM primarily focuses on the community level in urban space where shared values aid in the identification on what are the core facilities needed in communities and what core services are required to meet these facilities (Temeljotov Salaj *et al.,* 2018a). Urban FM is "simply a logical extension of the need to reinvest in community facilities and systems and provide a flexible "platform" on which agencies and the private sector can come together in new and innovative settings for the benefit of the community" (Roberts, 2004). It encompasses solutions which include social enterprise for social and/or environmental improvement (Uzairiah *et al.,* 2013, Almahmoud and Doloi, 2020, Grum and Kobal, 2020) and the regeneration of communities through strategic considerations of place design and corporate social responsibility within FM (Larsen *et al.,* 2011). The underlying need for Urban FM is that cities are increasing becoming like corporations in their strategic planning while urban quality is impacting on corporations with the necessity to think about the life between the buildings (Larsen *et al.,* 2011). Urban FM has the potential to implement knowledge in a broader urban context by expanding the concept of FM to fill the gaps that is not being filled by the competencies of urban planners. The planning of the regeneration of a neighbourhood in a city environment is not just about the specific location of that space, it is also about the connectivity to its wider environment. This connectivity is often lacking in the planning of city and built environment dimensions (Dixon *et al.,* 2014). The potential areas of exceeding current knowledge of FM (ISO 41011:2017) to Urban FM lies within urban planning, data modelling, public private people partnerships, financial and multi-criterion optimization models, social infrastructure in dynamic development, forecasting methods, demographic models, communication methods, spatial statistical methods, and visualisation methods (Xue *et al.,* 2019). Data and connectivity between systems is essential within this context. Smart solutions in combination with Urban FM can integrate an iterative approach to the design of the urban space by developing/using digital services platforms and harness the power of digital technologies to help citizens in applying design methodology in the specific urban context. The experiences can be used for better management of spaces to support citizens' health and wellbeing. Norwegian local authorities tend to own and manage their own buildings (Klungseth and Haugen, 2015) and in 2010 85% having a centralized structure for facilities management (Hopland, 2014). However, political fragmentation does influence expenditures on facilities services in cities. Maintenance expenditures are lower and building conditions worse in local governments with a high degree of political fragmentation (Hopland and Kvamsdal, 2018). Political systems are influential on directions set within municipalities (Gohari, 2020a) and the integration and coordination between policies are not easy because temporal, spatial and institutional aspects of policies are often mismatching (Gohari *et al.,* 2020b). Therefore, having consistency on how facilities services are managed within municipalities and secure resources in terms of budgets, would enable long term planning and investment when it comes to investing in Smart Cities such as connectivity across data bases.

The idea of Smart Cities in terms of its relationship with technology and governance gains ground in putting people centre to improve the liveability of cities. The smart city concept is "distinguished from other similar ideas such as the digital city or intelligent city in that it focuses on factors such as human capital and education as drivers of urban growth, rather than singling out the role of ICT infrastructure" (Lee *et al.,* 2013: 287). Some researchers view Smart Cities as being routed in the integration of city's systems such as systems related to transportation, energy, education, health case, buildings, physical infrastructures, food, water, and public safety with no system operating in isolation (Albino *et al.,* 2015). These systems primarily fall under the management of municipal or city services. The application of interoperable databases enables the possibility for town planners and administration bodies to use information sharing platforms for actions with the objective to improve citizens lives (Dobre and Xhafa,

2014). There is scope through the development of smart buildings and digital twins to have data relationships across other buildings, who do not form part of the same organisation but could inform on the quality of facilities within their district. This too needs consideration if it is to become a reality in terms of new value chains for public and private cooperation.

The use of digital data on FM services on a city scale increases the scope of Urban FM scaling up services traditionally linked to the singular organisational/building scale to the city scale. For example, with the EU +CityxChange project (https://cityxchange.eu/) the energy management of Plus Energy Building crosses over different buildings requiring flexibility to cater for peak and off-peak periods of different individual organisations. Currently, there is little consideration of how the management of facilities is done when buildings share resources amongst disconnected organisations as well as impact on the resources within the surrounding areas. The potential to optimize on information is facilitated through a growth in size of data bases which has been facilitated through Web 1.0 (associated with search engines) and Web 2.0 systems where large volume of information from a diverse customer population can be used for different types of businesses (Chen *et al.,* 2012). Big Data is highly visible within the public domain with internet resources of Google, Wikipedia, Facebook and Myspace leading the way in developments in web analytics, cloud computing, and social media platforms within the systems of Web 1.0 and Web 2.0 (Chen *et al.,* 2012, Boyd and Crawford, 2011, Pospiech and Felden, 2013). Smart City Systems are driven by Big data from a variety of data sources which are pervasive and include media, consumer sites, search engines, smart phone apps, smart utility meters, credit card transactions, CCTV, etc. (Viitanen and Kingston, 2013). Complexity is associated with one of the main benefits of big data which is the provision to relate and explore other data sets and seek patterns in parallel to continuously evolving data (Boyd and Crawford, 2011, Wu *et al.*, 2014). However, such a benefit runs parallel to the complexities of analytics involved in optimizing the variety, velocity and volume of big data as Big data, in a city scale, is not regulated or standardized in anyway. Different information collectors have their own preferences of recording data which results in diverse representation and complex data relationships which combined makes it difficult to discover useful patterns (Boyd and Crawford, 2011, Wu *et al.,* 2014). The outsourcing of services within cities therefore requires agreements to ensure the usability of connecting databases and their reliability for decision-making. Governance comes to the fore if such databases are to be connected in the management of services within the vision of Smart Cities in terms of how the data can be used; who owns the data and how it fits with legislation and regulatory frameworks.

4. Governance of Urban FM in Smart Cities

Creating connectivity amongst communities in cities has the potential to have a positive impact on the liveability of cities by ensuring cities can be managed in a smart way. Smart City is often treated by government and public agencies to distinguish their policies and programs for targeting sustainable development, economic growth, better quality of life for their citizens, and creating happiness (Albino, et al., 2015). The "Quadruple Helix" through which government, academia, industry, and civil society are key actors promote a democratic approach with socially accountable decision-making is becoming characteristic of Smart Cities that links to open innovation 2.0 (Ahlers *et al.,* 2019; Curley, and Salmelin, 2018; Cossetta A. and Palumbo M. 2014). Open Innovation 2.0 is based on the principles of "integrated multidisciplinary collaboration, co-created shared value, cultivated innovation ecosystems, unleashed exponential technologies, and focus on innovation adoption" (Curley, 2015, p.10). The approach of quadruple helix and open innovation 2.0 are in someways codependent acknowledging that one knowledge base is not enough for innovation approaches within smart cities. Within Norway, governance of Smart Cities has been criticised in being adhoc and needing more collaboration and coordination across the different sectors (Gohari *et al.,* 2020). However, the Quadruple Helix is a collaborative governance approach that is aspired to in Smart Cities in Norway.

Bottom up initiatives such as Community Vitality are important for the Smart City vision as it involves active responsible citizens who are empowered and work with other members of the community through collaborative action and shared values for social well-being of the population (Sinkienė *et al.,* 2017). Community vitality in cities encompasses all social groups (residents, private, public and non-governmental organisations, visitors, all levels of government) interested in wellbeing of the city they reside in (Sinkienė *et al.* 2017). It aims to solve complex problems for their members which are not being resolved at a state, regional or municipal level. They do this by using own internal or external

resources to target necessary action in time and where they are most needed with reduced involvement of higher government levels (Sinkienė *et al.,* 2017). However, linking to higher government and city initiatives is important for long term change and not just change that will impact on one area.

Organisations give FM the remit to provide services to meet their needs, which is not the case in cities. Cities are made up of a complex set of organisations and stakeholders who are the decision makers of cities, but they are often obscure and the distinction of who the stakeholders are is less obvious (du Plessis and Cole, 2011). The approach appears much more divided amongst city departments responsible for waste and cleaning, infrastructure, etc. The goals set at the strategic level within municipal goals and political agendas seem diluted amongst the operational departmental responsibility for the city's operation and maintenance (Hopland, 2014; Hopland and Kvamsdal, 2018). Indeed, cities reflect a complexity change which is co-evolutionary and non-linear incorporating a range of actors and networks operating over long time-scales (Dixon *et al.,* 2014). There is a critical challenge for contemporary urbanism is to understand how to develop the knowledge, capacity and capability for public agencies, the private sector and multiple users in city regions systemically to re-engineer their built environment and urban infrastructure in response to climate change and resource constraints (Eames *et al.,* 2014). In this context, there is a necessity to monitor approaches that are both top down and bottom up in order to create solutions to meet the desired outcomes of the different interest groups who impact on the management of the city (Lindkvist *et al.,* 2018). It is important to ensure communities provide input on how their community is developed and maintained, but the uniqueness of their requirements can be many and difficult to measure for monitoring purposes as well as compare on regional and national levels (Reed *et al.,* 2006).

The design of the built environment requires facilitation and the common denominator of such arrangement in the current situation is that it often provides commercial interest, and in many cases, do not get the community to take part in the value added. The value added is asymmetric and prevents desirable development when the community's incentives to facilitation is limited by resource shortages (Bogataj *et al.,* 2015). One study found that the deterioration of physical place relates to the absence of self-organisation of neighbourhood residents, leading to tensions between societal groups (among citizens), but also between citizens and government or citizens and other institutions (Kuijlenburg, 2020). In Norway, a recent survey (Hopland and Kvamsdal, 2018), indicated that the lack of resources over the increasing maintenance needs in public buildings is a concern for facilities management who view there is insufficient priority to maintenance challenges for maintenance work amongst politicians. There were also constraints on maintenance spending in municipalities as maintenance activities were often sacrificed for investment in new buildings. In addition, maintenance and daily operations share the same budget for the investment into new buildings. The impact of not maintaining these buildings will more than likely have negative consequences on the users as well as the economic value of neighbouring buildings (Hopland and Kvamsdal, 2018). Findings from the above study indicates that the value chain actors lack the overview of the impact of decision-making on society and local communities. Urban FM perspective has the potential to go between the different value chain actors to ensure the holistic picture is provided. As seen in the above section, Facilities Managers view the provision of social welfare services, particularly under maintenance, as insufficient due to the political boundaries in which it is established in. It is local citizens who are at the forefront of these services and who experience the negative effects of lapses in services. Urban FM aims to connect with communities through a multisector participation approach of informing, consulting, involving, collaborating and empowering (Xue *et al.,* 2020). He potential of this connectivity has the potential to create an effective, collaborative and interactive governance structure for co-creation, co-finance and co-ownership of urban public spaces to improve citizens' sense of attachment, commitment, trust, inclusion and integration (Temeljotov-Salaj *et al.,* 2020, Xue *et al.,* 2020).

Current governance structures are unable to cope with the need to respond to climate change challenges. There is a need to consider "Governance" in terms of structures and processes by which people in societies make decisions and share power, creating the conditions for ordered rule and collective action, or institutions of social coordination (Schultz *et al.,* 2015, Gohari *et al.,* 2020b). Developing a system of governance that enables coordination, negotiation, and collaboration across communities, neighbourhoods and districts in cities as well as across sectors and institutional levels, allowing issues to be addressed in a holistic manner (Schultz *et al.,* 2015). Disconnected governance structures currently limit the potential on how Urban FM can contribute to service management in smart cities. Little is

known how integrated local community values and understandings of sustainability is integrated into plans (Turcu, 2013) where final decisions are with politicians. There is often a danger that local needs get lost in the noise of different agendas. De Rosa (2018) identifies different categories of stakeholder groups when considering land use and land use change in Life Cycle Assessment with three categories relevant for a governance structure for Urban FM in Smart Cities:

i. *local community:* access to material resources, access to immaterial resources, delocalization and migration, cultural heritage, safe and healthy living conditions, respect of indigenous rights, community engagement, local employment, secure living conditions;
ii. *society*: public commitments in sustainability issues, contribution to economic development, prevention and mitigation of conflicts, technology development; corruption and
iii. *value chain actors:* fair competition, promoting social responsibility, supplier relationships, respect of intellectual property rights.

(Temeljotov Salaj *et al.*, 2018b)

An open governance approach requires new models for urban development and design of urban settlements that generate shared value creation for community, users and commercial actors over time. The vision of this type of open governance aims to connect a happy, healthy, regenerative city which underpins the principles to maximize economic, social, cultural and environmental opportunities laid out in SDGs (Temeljotov Salaj *et al.*, 2018c). The value and serviceable orientation of FM shows the potential to act as an active partner in the design process for new buildings or the refurbishment of existing buildings as well as additional facilities (e.g. public services such as schools, elderly homes and medical centres), and organising new services extending FM to the broader settlement area, thus taking more social responsibility in areas (Temeljotov Salaj, *et al.*, 2018c). The recognition is a clear correlation between the design of the built environment, individuals' quality of life, the community's social structure, and business development. Taking a sustainability perspective leads to questions on how one benefit for one side of a community impacts on the other communities in the surrounding areas. In this way, developing a more organised approach within an Urban FM perspective assists in the connection for both top down and bottom up approaches to services in cities.

5. Evolution of Urban FM in the development of a Smart City

Trondheim is a city in central Norway which is a major public transport and logistic hub in Central Norway and Mid-Scandinavia. Trondheim has a population of about 190,500 people, with the wider region exceeding 280,000 inhabitants. The core of the city has a total urban area of just over 340 km^2, with a population density of 557 per km^2. Trondheim is a growing city, with a low unemployment rate (2.5%). It is part of a smart city project called *+CityxChange (Positive City ExChange)*, that is funded from the European Union's Horizon 2020 research and innovation programme in the call for 'Smart cities and communities. The main aim of this project is "enabling the co-creation of the future we want to live in by developing a framework and supporting tools to enable a common energy market supported by a connected community" (Accessed February 2020 https://cityxchange.eu/objectives/). In the context of being a 'connected community' the role of Urban FM is appropriate when considering the various value chains at play in the development of a Smart City. The following only focuses on one demonstration of *+CityxChange* project in Trondheim which includes a Plus Energy Building, simply put, it is a building that produces more energy than it needs. Further discussion of observations of Urban FM in Trondheim is based on the adaptability of the city to different communities needs by linking to smart and flexible approaches to work, specifically the approaches of WeWork taking in the influences of new ways of working within the city scape. Finally, we consider one study by students of refurbishment who observed the deterioration of buildings within the city. We discuss how the use of sensors could potentially be used to address maintenance requirements in Trondheim.

5.1 FM managing relationship between buildings

Communication between physical space and work activities is becoming increasingly exemplified in Smart Buildings. The relationship and sharing of information between buildings is increasing in importance as individual buildings become energy sources in the form of Powerhouses – buildings which produce more energy than they require and can provide energy to neighbouring buildings. Energy management comes under the remit of FM within individual organisations; however, this remit becomes

more complex when one building becomes the source of energy to other buildings. Powerhouse Brattørkaia in Trondheim is set to power two other buildings – an educational facility and an office building which is part of Trondheim Positive Energy District (PED)[1]. This has clear implications for energy companies, and the energy management done within Facilities Management. While there is only one owner for these building, there are 3 tenants all with a different core business meaning the usage of energy will be different. This leads to questions on how agreements are developed for energy usage and the diverse design of each of the buildings as the green certification schemes for each building is not the same. In this way the challenges for a facilities manager is not just understanding how the usage of energy is impacted by core business of one organisation but diverse core organisational functions. However, the benefit of being able to monitor energy usage in one district has the potential to enable city planners to monitor the diverse ways in which buildings are being used according to functionality and create data trends on expectation for similar buildings as well as have information on how location may also impact energy usage.

Figure 1 Powerhouse Brattørkaia and neighbouring buildings in Trondheim.

5.2 Workspace management on a city scale

The development of Facilities Management within an organisational context is very much tied to where workspace it is based. However, over the last fifteen years the concept and idea of workspace has changed and evolved focusing more on the activity of the work being done rather than the physical space available to do that work. Today there is flexibility of being able to do work anytime and anywhere through development of wireless technology and mobile technological devices. However, we are also seeing a growing flexibility of the type of agreements and locations developed for physical workspace. 'WeWork' is a well-known example of a company who re-conceptualize the physical workspace to be 'anywhere work takes you'. The mission of 'WeWork' reflects a Community vitality narrative viewing their clients as part of a 'community' and the spaces as a 'home' for start-up companies (https://www.wework.com/mission). In this way, it is a bottom up initiative, where a need was identified for start-up companies who could not invest in large physical spaces for long term but have the flexibility of that space in several locations around the world.

An extension of this type of workspace can be viewed by opportunities within a smart city framework. Observations in Trondheim, (Norway) illustrate that space functionality is no longer fixed but optional. Rents of buildings can be expensive in Trondheim and one business used the initiative to share space where during the day the space was used as a café and during the evening, with small alteration, it became a bar. This diverse functionality of space has also been extended to some cafés in Trondheim where they are under used during office work hours. Such cafés rent space to organisations for seminars and work meetings during the day to change to a social functional area in the evening. In this way, space is not fixed to one organisational functional need but adaptable to multiple and diverse functional needs of many organisations. One entrepreneur viewed the lack of used space in cafés during work hours as an opportunity to develop an app for potential users to find cafés, bars and restaurants to work in. However, such diversification of cafés is not widely done in Trondheim. Figure 2 is an illustration of a café in an industrial built up area with residential areas are nearby. It is the only café in this area; however, the café is primarily used for takeaway of beverages or food outside of lunch times. In this way the space is under-utilized most of the time in which the café is open. However, the space has potential for collaborative or individual work activities. Developing such spaces from a workspace perspective and identifying the different work types will benefit the wider community who seek unconventional office space on a temporary basis as well as the business owner of the café. The challenge is the organisation of such needs through knowing when café spaces are free to occupy for work which could link to digitalization of managing city space for diverse service use.

[1] Positive Energy District is an urban neighborhood with annual net zero energy import and net zero CO_2 emissions working towards a surplus production of renewable energy, integrated in an urban and regional energy system https://jpi-urbaneurope.eu/ped/

Figure 2 Example of empty café in urban area.

5.3 Improved Maintenance for healthy cities

The majority of the European building stock that will exist in 2050 has already been built and most of which suffers from poor energy performance (Meijer *et al.*, 2009). Earlier it was mentioned that politicians do not view maintenance of existing building in high priority as the more visible decisions have more impact during their political term. However, a lack of maintenance of existing building reduces their sustainable qualities and impact the environment by reducing them to be desirable to live in as well as not addressing energy efficiencies which exist in building that are not properly maintained. Figure 3 is an illustration of a building in Trondheim was noted to require maintenance by refurbishment students, but this is done by observation – walking to the area and visually seeing buildings. Developing sensor technologies to monitor existing buildings to understand how they are used in terms of energy, functionality and numbers of people using them will aid in developing maintenance plans that can alert when maintenance is needed and track what types of maintenance is required. Sensors on buildings could potentially aid municipalities in allocating resources in a planned rather than a reactive way or reducing the need to invest in areas that have not benefitted from ongoing maintenance. Such data is also a potential source for informed decision-making amongst politicians, which could also improve the liveability of the area by buildings being secure and safe as well as facilitating healthy conditions in the area.

Within Urban FM, a Facility manager is more proactive in their role which is seen in the circle of the urban value ecosystem, to facilitate a long term citizens involvement into sustainable refurbishment actions, to develop desirable incentives to encourage creation potential of stakeholders, and to create better model for sustainable refurbishing, reusing, and reprogramming of existing buildings, open spaces and infrastructures. The ideal model is to be focused in social creative economy, which includes public authorities, business stakeholders, civil society actors and citizens, to develop better balance between the business and shareholder value with the public interest (Temeljotov Salaj *et al.*, 2018b).

Figure 1 Old building in Trondheim. Photos

8. Discussion

Understanding the relationships between FM, Smart Cities, Urban FM and City planning is no easy feat, but table XX illustrates where the linkages are based on the work of this current research. Urban FM in Smart Cities is not given a remit by an organisation. Bröchner et. al, (2019) question if it is possible to transfer the skills of FM to a city scale. This article indicates Urban FM can extend on services from FM by addressing gaps not being addressed in the physical planning of the city and build on opportunities provided within Smart Cities. What is clear is that Urban FM is reliant on initiatives of people coming together to address a problem, finding and building on opportunities by actively engaging with municipalities and private sectors to aid in creating solutions for that problem. In this way it requires a multi-sector participation approach (Xue *et al.*, 2020). Urban FM is primarily at local community level, while the quadruple helix approach is increasingly tied to Smart Cities to lead to open innovation 2.0 (Ahlers *et al.*, 2019; Curley and Salmelin, 2018; Curley, 2015; Cossetta and Palumbo, 2014). Cities are more complicated than individual organisations where the decision makers are often obscure and difficult to identify (du Plessis and Cole, 2011) often a negotiation between municipalities recommendations and political agendas (Gohari *et al.*, 2020b). There are political challenges in prioritising FM areas as evidence by FM in municipals who struggle with politicians in decision making on maintenance in cities who do not see it as a priority (Hopland and Kvamsdal, 2018). In this way, while municipalities can influence the decision of politicians, this influence is limited to depending on the political outlook. The different governance approaches within FM, Smart Cities, Urban FM and City Planning at the strategic, tactical and operational are necessary to co-exist as they target different levels of space and service, (though there is sometimes overlap). FM, Smart Cities and City planning

are established areas, where as Urban FM develops skills from FM through a multi-sector response to social value of neighbourhoods and cities that are not being met within City planning and has the potential to create connectivity and build on opportunities within a Smart City approach.

Table 1 Approaches from FM, Smart Cities, Urban FM and City Planning/Urbanism

the starting point of social values making up a community or neighbourhood to identify a core of individual communities, requires connectivity to the wider environment in order to have a real impact on meeting SDGs. City planning often focus on specific local context of areas (Eames *et al.*, 2014), but identifying social values in a larger connected way within cities, not just within communities but also across communities, empowers cities to respond and be proactive in meeting communities needs. Thus, enabling communities to provide input into what they view as important to their area(s) development and how their areas are maintained for the long term, within the larger focus of city planning. In order to get to this ideal, there is a requirement of building up of knowledge, capacity and capability for public agencies, the private sector and multiple users in city regions which should also lead to an organised response to climate change and resource constraints (Eames *et al.*, 2014; Dixon *et al.*, 2014). There is a potential to compare and monitor developments across similar communities based on their social values and needs at city level as well as at regional and national levels (Reed *et al.*, 2006). In FM, this is referred to as benchmarking, and being able to benchmark services across communities could empower municipalities and communities on how to improve their services.

Technological developments in terms of sustainability create linkages between buildings and districts as illustrated in the use of Plus Energy Building included in the *+CityxChange* project, but the governance on how to manage energy across buildings is not clear and whether they will impact the energy behaviour of users. Currently FM manage energy in individual buildings, so developing FM knowledge based on experiences energy use in buildings and including FM in the dialogue between municipalities and private industry may create new insights on how energy management agreement across buildings and organisations should be developed. Within this context, city planning may have to consider new value chains between public and private sectors. In addition, there is potential of the use of sensor technology to ensure healthier and better maintained buildings in cities. The deterioration of physical place has been reliant on self-organisation of neighbourhood residents, which leads to tensions between citizen and other governing institutions (Kuijlenburg, 2019) as well as being exasperated when community's incentives to facilitation is limited by resource shortages (Bogataj *et al.*, 2015). However, creating links between FM, Smart Cities and City planning enables Urban FM to identify how to address local community challenges and potentially provide evidence-based data to argue for improvements within neighbourhood and community areas, and create opportunities through public private people partnerships involvement for addressing resource shortages.

Transferability of FM skills in the Smart City approach through initiatives like WeWork where space is multi-functional for office work and available for different activities, where the workers are not coming under one organisational outlook but are coming together out of the need for a service creating opportunities for the city area. Such potential links to the need to consider a broad perspective for multifunctional use of empty spaces in cities such as cafes and restaurants that are busy at only certain points of the day in order to encompass many community practices. This also links to the need to consider adaptability of buildings within the development of cities for the long-term use of buildings rather than meeting the needs of current citizens. The management of workspace, linking service to function and multi-functions and adaptability of building fall under facilities management within a singular organisational context but could be further built on within city planning as well as enhanced through linking data bases together in order to manage city space digitally. Understanding how to manage these relationships from an Urban FM perspective is important to ensure local communities can benefit from these developments. In addition the connectivity of databases leaves many questions unanswerd. While Norwegian local authorities tend to own and manage their own buildings (Klungseth and Haugen, 2015, Hopland, 2014), political inconsistencies from one government to another (Gohari *et al.*, 2020a) does present challenges in long term public investment in FM for city services (Hopland, 2014; Hopland and Kvamsdal, 2018). These inconsistencies is currently in city services requires new collaboration and cooperation which can be facilitated through Urban FM by engagement with public private people partnerships which can facilitate connectivity across databases on a city level that can

benefit communities and neighbourhoods. Such use of interoperable databases requires consideration of General Data Protection Regulation (GDPR) on the citizens who's data would be used.
The paper has implications for municipalities role as a negotiator between communities needs and politicians in order to stimulate the role of Urban FM to facility a more holistic approach to operating services on a city level. Facilities Managers within municipalities also need to engage in the developing solutions for Smart Cities in how it can be used to produce more proactive service approaches and linked services through connected communities. Finally, governance structures do not suit the current idea of connectivity espoused within Smart Cites and therefore limit the advantages that can be achieved within the role of Urban FM, such structures need to be reviewed at a policy and regulatory level. On an educational level, the paper lays ground on the future of FM and how it is being influenced by Smart Cities and the growing need to respond to communities within the urban environment.

9. Conclusion

Understanding the relationships between FM, Smart Cities, Urban FM and City planning is no easy feat, but is important to consider in developing Urban FM and building on the opportunities of Smart Cities. The first research question guiding this paper was on how FM, specifically Urban FM, is understood within a Smart City context. Urban FM is not clearly understood in a Smart City context and is rarely referred to in studies related to this context, yet they both have a lot of commonalities in emphasising multisector, engaging collaboration and tackling the sustainability goals in cities. These two areas diversify where Smart City is built more on Open Innovation 2.0, while Urban FM examines how public private and people partnerships aiming at communities and neighbourhoods. The focus on social values in Urban FM can fill the gap in the lack of wider connectivity to the environment in city planning in terms of understanding what defines neighbourhoods and communities within cities i.e. what is their core. This connectivity could be further facilitated within Smart Cities in being able to monitor and link databases of services within cities. Such approaches address challenges in the fragmentation of initiates between non-state and subnational actors identified in the UN Report (2018), in order to see what activities are working well and building a bigger picture to meet the 2-degree Celsius goal. Such developments are reliant on governing structures which is why the second research question focused on how governing structures in Urban FM and Smart Cities have the potential to increase connectivity of community/neighbourhood services in cities. Smart Cities in Norway focus on a quadruple helix and is open to multiple organizations. Urban FM complements this approach focusing on multi-sector participation. The scales are different as Urban FM focuses neighbourhood and communities whereas Smart Cities is city focuses, but to meet SDGs it is important to work with large and small scales that link to each other through digital and governance approaches. This connectivity within public services is reliant on investment, which is challenging as political governance that leads city planning changes every 4 years (in Norway). If cities are truly to become smart, the focus needs to be for the long sustainability of cities which means engaging with facilities management and Urban FM. Facilities managers and Urban FM work with existing buildings, infrastructures, urban spaces and communities/neighbourhoods so have the know-how to manage existing problems and can build on opportunities to engage in new developments in cities.
The paper is limited by with the intentional emphasizes on facilities management in Smart Cities and City Planning. It introduces, but does not thoroughly investigate, many diverse areas that are important for developing Urban FM within the changing concept of cities. In this way further work is needed. Continuous engagement with Smart Cities and City Planning is important to develop new insights and opportunities that can be met using Urban FM approaches. Further work on the connectivity which is potentially enabled through Smart Cities that can be facilitated by Urban FM using new smart solutions, visualization approaches, digital information platforms and digital tools for better service management in cities and people/citizen inclusiveness. Research on new business models and new value chains in cities needs consideration in terms participation of different sectors as key and the connectivity to the wider environment of cities. In addition, closer examination on how to formalize citizen feedback in community projects and ensure interested stakeholders further up organizational management know how to better use these new forms of information.

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Table

Table 2 Approaches from FM, Smart Cities, Urban FM and City Planning/Urbanism

	FM	Smart Cities (-	Urban FM	City planning/Urbanism
Services	Soft/ Hard (Maintenances, workspace management, energy management)	Optimizing databases across hard/soft services	Led by social values	Primarily centralized (in Norwegian context)
Strategic	Owner (s)/ Client	Quadruple Helix: government, academia, industry, and civil society	Multi - sector participation approach	Led by governing authority
Tactical	Supports client core business, responds to user needs, benchmarking	Open innovation 2.0	Engaging public/private agencies to address and invest in local problem resolution	Planning of one specific area but lack connectivity to wider environment
Operational	Inhouse/ outsource	Open multiple organizations	Public, Private, People, Partnership	Inconsistent due to changing political authorities which can limit resources for operation
Space	Building(s)/ Infrastructure	Cities and Digital Cities	Urban Spaces/ Neighborhoods	Neighborhood, Districts, City

Figures

Figure 2 Example of empty café in urban area.

Figure 1 Powerhouse Bratørakaia and neigboring buildings in Trondheim.

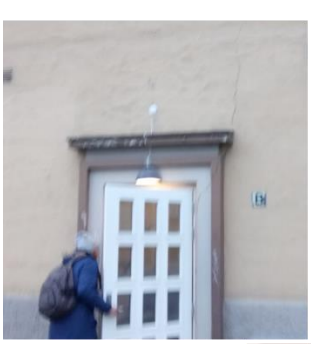

Figure 2 Old building in Trondheim. Photos