Defining a niche for Facilities Management in Smart Cities

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Defining a niche for Facilities Management in Smart Cities

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Abstract. A wide variety of disciplines engage in Smart Cities as the scope and breadth of it is broad. Within the built environment, there is much discussion on how planning and construction phases influence Smart Cities. There is little discussion on the role of Facilities Management (FM). However, there has been much work on the influence FM has on design phases to ensure functional and usable buildings. Neglecting to scale up the influence of FM from individual buildings to city scale may have long term consequences on sustainability of cities. Taking a mindset of including an FM perspective early in the development of a Smart City is considered here in terms of social aspects of required services. The work draws on ideas of Urban FM to operationalize local needs which also responds to the need to link to broader city sustainable strategies. The starting point is from the development of two districts in Trondheim, Norway. In a three-day workshop, students interpret the needs of the area based on their own knowledge-based perspective, guidance from tutors of Urban FM and through engagement with local users of the area. The work highlights the potential of including an FM perspective in the development of cities.

1. Introduction

Facilities management (FM) perspective of Smart Cities is necessary to consider as buildings become more and more connected to wider districts. Smart Cities and ZEN mentality argues away from the individualistic approach of how buildings are used and focuses more on relationships between buildings, this introduces further complexity on how to maintain and manage FM services in buildings, neighbourhoods and city scales. To date, most work in these areas are based on planning and design. There is very little understanding on how buildings are managed from a use stage which is where FM takes on the responsibility. This knowledge gap highlights the contradiction within sustainability angle of ZEN and Smart Cities as sustainability is for the long term, FM manages the long-term realities that come from ideas in planning and design stages and ignoring the role of FM may have long term consequences on how realities live up to ideas.

Facility managers as the custodians of buildings are in a prime position to ensure buildings can be adapted to meet owners and user's needs as well as societal requirements. The connectivity of buildings within a district is apparent particularly within the idea of Plus Energy Buildings (PEB). These buildings produce more energy than they consume and therefore supply energy back to the grid or to surrounding buildings. In this way, these building create a community of energy users. Energy users are not easy to predict as their behavior is linked to function and use – two core concepts of FM. Lifecycle Assessment (LCA) tools often do not reflect the impact of user's behavior on energy load, indeed the electricity consumption by the office equipment is generally excluded from the plus-energy calculations (Fouquet et al., 2014; ISO/FDIS 52000-1:2016 Energy performance of buildings). A study in Vienna on a so-called 'plus plus' energy buildings found that appliances and powerful scientific desktop work stations which were not included in the original plans for the building combined with unintuitive lighting user

interface resulting directly in excessive internal energy loads which both increased energy needs for cooling, but also the heating energy needs due to opened windows (David et al., 2017). In this study the goal of energy consumption in usage was not reached which impacted the ability for the building to provide plus energy to the surrounding area. However, while this study considered the impact of user behavior in the singular PEB, it did not consider the co-dependence of user behavior within the surrounding buildings. It is this co-dependence on buildings with disconnected organizations increases the complication in understanding how buildings are being used within and in the surrounding areas and how this impact on the district as a community. The implications of this is that in order to develop areas that will be developed in sustainable ways, it is important to understand their function and use or how users wish to use the area. This paper aims to build this understanding from a bottom up approach in first identifying what are the function and use of an area.

2. FM within urban development

FM is regarded as a relative newcomer to the real estate and construction sectors being formalized in the late 1970s. It is a profession that encompasses multiple disciplines, which include architects, economists and engineers, to ensure functionality of the built environment by integrating people, place, process and technology managing both soft services such as catering and hard services such as building maintenance (Atkin and Brooks, 2015). The broad nature of the profession makes it challenging to define, but what it ultimate seeks to do is to support non-core needs of an organization that are defined at the strategical level of management, planned at the tactical level and realized at the operational level. In the planning of cities, processes are in place to design cities to meet citizens future needs. However, the future is uncertain and therefore it is necessary to consider how cities that are developed are adaptable for changing citizen demands as well as regional and national goals. The challenges of linking strategic goals at the city level to operational at the local and district level is made clear within the planning literature. There are many diverse service needs within a city as neighborhoods are made up of different people who assign different degrees of importance to an area and it is unclear how these local agendas become integrated at the policy level (Turcu, 2013). In this way, there is no clear connection between the strategic level of political and municipal goals and local operational level of the citizens working and living in the neighborhood.

Urban FM is a concept which connects the knowledge of facilities management to that of urban planning providing a platform for public and private sectors to come together for the benefit of the community (Roberts, 2004). Alexander and Brown (2006:255) state three key areas of how FM can develop corporate social responsibility within communities:

- ensuring that the physical environment does not deteriorate
- creating a platform for skilled employment opportunities
- the opportunity for genuine involvement of the communities in the design and management of services and the urban environment

Clearly even in buildings that aspire to exemplary performance, if the basic functioning of building systems are not correct, fine-tuning individual component efficiencies and other details within the design will not result in desired performance outcomes (David et. al., 2017; Fedoruk et al., 2015). The main barriers, in practice, to achieving ambitious design goals regarding energy performance are not economic or technical, but institutional (Lindkvist, 2018; Fedoruk et al., 2015). Institutional in the sense the various stages of the building life cycle are specified, contracted and implemented without room for the necessary overlap of practices within these stages. There are key attributes of green building performance typically included in most assessment tools are shown resource use, emissions/ waste, and health and comfort issues (Cole, 2012). Comfort provisioning dominates in user expectation for energy services (Dalamagkidis et al., 2007). In this way to ensure energy targets are met being able to understand use and comfort from a user perspective key. There are various studies within the building context where users are excluded from the rationality of sustainable technical implementation resulting in unintended consequences that may run counter to the sustainable goals. One example is where users manipulate the sustainable aspects for their own comfort needs (Petersen

et al., 2017). The exclusion of users on a city scale indicates that such an affect can result in a counter effect on sustainable goals. On the other hand, districts acting individually will also be detrimental to sustainable goals as sustainable success calls for holistic approaches and partnerships. In this way, the inclusion of the top down approach within the district level is important. As Turcu (2013, pp.711) states *"…a community goal may not always be to reach a defined (policy) target/indicator), but to respond to local condition(s) which impact or influence that certain target/indicator".* Cities can become "sustainable heroes" by focusing on sustainable integration from both top down and bottom up approaches, accounting for both the strategic and operational outlooks of the city. Cities reflect a complexity of a "co-evolutionary and non-linear nature of change which incorporates a range of actors and networks operating over long time-scales" (Dixon, Eames et al. 2014). The context of cities and the multiple dimensional aspects of sustainability necessarily means that the a cross disciplinary approach is necessary in order to account for organizational and structural conditions as well as the broad range of stakeholders with vested interests (Schweber and Leiringer, 2012). The planning of the regeneration of a neighborhood in a city environment is not just about the specific location of that space. It is also about the connectivity to it's wider environment and this is often lacking in the planning of city and built environment dimensions (Dixon, Eames et al. 2014). However, we see taking an urban FM perspective will facilitate connectivity.

The 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, Marvin et al. 2014). In terms of a neighborhood scale – the end-user is not just one user with diverse demands but a number of diverse end-users with diverse demands and therefore present challenges to combine diverse understandings on the same dwelling. Stakeholders view a building with different lenses depending on their role in the neighborhood (Karlsson, Lindkvist et al., 2013). There are not just diverse agendas making development of a holistic social perspective of a neighborhood challenging, there are also practical problems of developing sustainable neighborhoods. As neighborhoods are made up of diverse groups of people with different interests and the focus of sustainable neighborhoods is to make them more livable. We examine services in terms of what services are required to make the neighborhood livable. With the increased use of terms such as 'smart' and 'intelligent' to describe infrastructure, it is important to remember that the true 'intelligence' of a facility comes from its designed ability to serve specific functions in a useful and convenient way (Chen, 2010). Engaging users to understand future function and use of space creates increased opportunity of developing districts that will enable sustainable behavior.

3. Method

In February and March 2019, three-day workshops were held with students of a refurbishment, technology and management course. The workshops occurred over a week period where the student worked inbetween each one. The objective of the workshops was to gain student perspectives of further development and transformation of real case areas in two districts, Sluppen and Brattøra in Trondheim. The two area aim to be Positive Energy Blocks. The two districts are quite different as Brattøra has undergone a more recent transformation than Sluppen which is still being developed. In the course, students examined the concept of Urban FM in early lectures and were also given a presentation on FM in a Smart City vision. They were divided into two groups, given a practical exercise to draw on some Urban FM ideas and apply them to the two districts. Prior to the workshops, a survey was conducted by the workshop coordinators with a residents or citizens living or working in the districts in order to gain an understanding of what services were needed to develop these areas. The survey was conducted over one week and the response rate was small. The survey was given to one housing association in one neighborhood (known as "Borettslag" in Norwegian) and residents living close to the area known by the researchers. The survey was also given to a business to be disseminated to employees working in the area. The students were given survey results – 19 survey respondents in Sluppen and 5 survey respondents in Brattøra. It is not known what was the entire number of the population sample was given the survey in the end, but a response rate of 24 was considered low given it's close location to the city of Trondheim. Students also did on-site visits to Brattøra and Sluppen where they conducted

observations of the area and spoke to people who were in the area on the day of 26 February between the hours of 1400-1700. The students in the Brattøra area did not use the survey in their presentation because of the low response rate. The weakness of the methods used here is that the survey was disseminated within a short amount of time and only to a limited number of citizen living or working close or in the areas. Having more time to work with more housing associations in the areas as well as linking in with businesses to disseminate results may have increased the number of respondents. The methods were also a learning process for the students as part of a wider course on refurbishment. The objective of the class was to enable students to increase their understanding of the impact services as well as use participatory process of engaging in observation and talking to people who live and work in an area under transformation. The students were successful in the learning goal, but it did impact on the quality of data received during site visits and adhoc interviews with peope they spoke to. The two student groups had very different districts in terms of development, there was some commonalities, where they focused on mobility and demography in the area, seeing that as core to creating connectivity to the Trondheim city culture. Below is an outline of key findings from these workshops.

4. Findings for Sluppen

Sluppen is 4km from Trondheim city center and has primarily office buildings. It is located near a large road, the E6 which leads directly to the city center. It has poor public transport links with the need to cross the E6 to access the majority of buses from the core Sluppen business area. It is currently being developed and the population of this area is expected to increase.

Service and comfort needs were assessed in responses of 9 people who participated in the survey and who either worked or lived within a range of 3km distance of Sluppen. It was primarily residents with some workers included in results. The age range was primarily between 36 and 55 years – indicating a wide demographic who have an interest in the area. The focus of the survey focused on what respondents would like from the area and what they do not like. Table 1 illustrate the results.

Table 1 Results of respondents likes and dislikes of Sluppen

Likes	**Dislikes**
Quiet areas	Lack of green areas
To live close to the city center	Noise
Live close to school	Poor public transport Poor
Live close to work	maintenance of the area
Live close to the river	
Feeling of a nice neighborhood with good communication with each other	

The above indicates that people either living or/and working in the area seek good public transport connecting where they work and live. They seem to like the quietness and nature of the area and want a community atmosphere. While they wish to live close to the city, they do not want noise in the area. The likes that the respondents chose from primarily link to comfort issues while the dislikes link to aesthetic issues in the area.

The students identify services that they deemed would improve the area. The students linked to health through identifying the need to develop hiking areas and improving the area for pedestrians and cyclists. This may have been linked to Sluppen being near a nature area but also identifies how respondents wish to reduce their usage of car and the current public transport not being efficient to do so. From the strategic perspective in the city, the students believed they may have to decide whether there were short term solutions to respond to the current needs in the area that would impact on the sustainable aspects by meeting people need's for comfort and healthy areas as well as develop long-term planning of the area.

4.1 Student observations

The students in their observations focused on the attractiveness and access to social facilities of the area. They referred to the area as a 'Car city' and linked to this evidence of there being a lot of car parks in the area as well as a petrol station referring. There is a lack of green infrastructure in the area and existing activities could be improved in terms of their visibility. They considered the demographic of the area in terms of families – "is there enough schools? Kindergartens?" and students "Can students go out and be social?". They believed the E6 impact decreased the attractiveness of the area as it was a source of pollution and noise from traffic.

While the students were quite critical of the area – they saw potential in the area. They focused on increasing the residents in Sluppen but being inclusive referring to a "Sluppen for all ages". They believed there is a need to go from a commercial area to a recreational area – which deflects away from an image of being a 'car city' and more toward the identified need of healthy living. The students also saw a need for green and blue areas. Also, as they viewed some of the buildings as empty – they saw a need to consider multipurpose buildings. The concluding thoughts were to stop Sluppen from being a "ghost city" after working hours and weekends and create better connectivity to the town center. Overall, the students believed in order to increase and optimize on the area, they believed the area to be more adaptable for not just the core functions in which buildings were developed, but view buildings through diverse functionality, to reduce it being empty when all the workers have gone home for the evening.

5. Findings for Brattøra

The students described Brattøra as an area in Trondheim which is an artificial island. While it is part of Trondheim – it was quiet and was not a busy area during their observation which was on a Tuesday between 1500-1700. The municipality's objective that this area should be known as Trondheim's most technological developed area obscures the socializing aspects of the area. They see PowerHouse Brattørakaia as a statement building for the water front. The students found that people only go to the area if they have business or a need to come to the area. They do not tend to come to the area to be social or to enjoy the views of the fjord. The current buildings being built are very architectural attractive but are quite functional to cater for the needs of their occupants who are primarily office workers or students – but if an area is to impact on a district level – there needs to be consideration for outside the walls of buildings. In this area, while the needs of the primary users seemed to be met, the potential for the wider public use of the area were unclear to the students other than enjoying the views that the existing nature from the fjord provides.

5.1 Student interviews with pedestrians in Brattøra

In order to find out more beyond their observations and document search, the students asked people on the street what they thought of the area. The table here presents a general perspective of people they spoke to in terms of their likes and dislikes.

Table 2 Likes and dislikes based on student observations and interviews they met on the street

Likes	Dislikes
Nice architecture	Barriers is the railway – walking over the bridge at the train station may be problematic for people who bike
Not many cars as construction area	
Bike and walking paths good	
Good waste management in the area	Most people who work there seem to use the car
	The bus transport is not great for parents who use it for young children*
	They thought there was a lot of asphalt in the area – "asphalt jungle"
	The area is very quiet after working hours and this is reflected by the food store which closes at 8pm

	People would like more cafés and nice places to stay there in the evening There is no community life The coast is not taken advantage of in terms of social activities and accessing views of the fjord

*The public transport has radically changed since the study was conducted

The like focus on very technical aspects of the area in that is has good architecture, good bike and walking paths as well as good waste management, however, the social aspects appear to be lacking where there are limitations of possibilities beyond buildings functionalities in the area. This is alludes to how the building cater for the individual need of their occupants, but lack social connectivity which may lead to the perception of no community life.

5.2 Student observations

The students believe the areas could become more social rather than an area that is functional to the workers of the businesses. They wish Brattøra to be a place to socialize and increase in it being more welcoming place for Trondheim. They did not observe housing in the current situation which they viewed as a problem as Brattøra appears "deserted at night". They believe housing could make it more lively and they compared it to another part of Trondheim which had a waterfront with residential house as well as bars and restaurants. In terms of development – they believed both increased housing and development of bars and restaurants need to happen at the same time. While Brattøra can be reached by bus or car, people feel the area is too far from city center and it is not easy to reach by public transport. They proposed to keep the area free from bus and use self-driving automobiles which fits with the theme of it being a technological area. They propose these self-driving cars to service the whole area as well as roof top buses that can move around north of the area. They also propose E-scooters (electric scooters) which are currently being used in other cities and provide different stations for electric-scooters in and outside the area. Further potential is to motivate people to come to Brattøra and enjoy the beautiful views of the fjord through boat trips rather than go for just working or studying. Thought to improve the area by having a swimming area in the sea as well as increasing the number of food places by or on the sea through use of floating restaurants and a park for kids to play. The students believed Brattøra is an attractive area but is very quiet in the evening, they believed that it needs more integration with the city center. While there is a lot already in the area with innovative buildings, hotel, swimming pool and offices, the main task in Brattøra is to attract people to come to the area and to invite people to spend more time in the area, particularly after working hours. The students acknowledge the area was quite successful in economic and environmental aspect but lacked social aspect and they questioned the sustainability of the area with social aspects not being clearly obvious based on their observations. In considering, this they focused on how different facilities could improve the area, while also considering the wider long-term development.

6. Discussion and conclusion

The students of this workshop had very limited time to develop their ideas, but they were quite good at indicating how the built environment sets limitations on use and functionality of an area. "Smart" is not just about technology, it must link to function by also examining the space between buildings as social arenas that build communities and create connectivity between districts. As Chen (2010) claims true 'intelligence' of a facility comes from its designed ability to serve specific functions in a useful and convenient way (Chen, 2010). Urban FM is an intermediary to examining links to function and use in the development of districts. It has the potential to develop business opportunities where areas lack services, identify ways to build communities and serve needs of areas to be healthy linking cities ability to be 'Smart' in meeting sustainable goals.

One of the three areas identified by Alexander and Brown (2006) on how FM can develop corporate social responsibility within communities was primarily considered by the students which was *the opportunity for genuine involvement of the communities in the design and management of services and the urban environment.* While the students identified that there are diverse service needs within a city

as neighborhoods are made up of different people who assign different degrees of importance to an area, they also indicated that the areas did not reflect how local agendas become integrated at the policy level (Turcu, 2013). While Sluppen is an area planned to go through radical redevelopment, there were a lot of needs and lack of facilities in the area that the students identified. Knowing what these needs are could potentially help decision makers to develop plans to meet needs that require a short-term investment in improving the sustainability of the area and may also fit in with the long-term plan. This could be potentially done on what comfort issues impact on the sustainable use of the area an what will therefore impact on carbon emissions and energy use in these districts. If comfort provisioning dominates in user expectation for energy services and impact on their ability to behave in sustainable ways (Dalamagkidis, Kolokotsa, Kalaitzakis, & Stavrakakis, 2007, Petersen et al., 2017), these expectations should also be considered on current and future uses of an area. The critical challenge is 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, Marvin et al. 2014). One way of doing this, is by considering the development of services from an Urban FM perspective by considering how services can impact on user behavior as well as meet the use, functionality and comfort provisioning of an area for citizens.

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