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What Smart Campuses Can Teach Us about Smart Cities: User Experiences and Open Data

Roza Vasileva [1,*], Lucelia Rodrigues [1], Nancy Hughes [2], Chris Greenhalgh [3], Murray Goulden [4] and Jeni Tennison [5]

1 Department of Architecture and Built Environment, Faculty of Engineering, The University of Nottingham, Nottingham NG7 2RD, UK; Lucelia.Rodrigues@nottingham.ac.uk
2 Human Factors Research Group, Faculty of Engineering, The University of Nottingham, Nottingham NG7 2RD, UK; Nancy.Hughes@nottingham.ac.uk
3 School of Computer Science, The University of Nottingham, Nottingham NG8 1BB, UK; Chris.Greenhalgh@nottingham.ac.uk
4 School of Sociology and Social Policy, The University of Nottingham, Nottingham NG7 2RD, UK; Murray.Goulden@nottingham.ac.uk
5 The Open Data Institute, 65 Clifton Street, London EC2A 4JE, UK; jeni@theodi.org
* Correspondence: Roza.Vasileva@nottingham.ac.uk; Tel.: +44-7491-872276

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Abstract: Universities, like cities, have embraced novel technologies and data-based solutions to improve their campuses with 'smart' becoming a welcomed concept. Campuses in many ways are small-scale cities. They increasingly seek to address similar challenges and to deliver improved experiences to their users. How can data be used in making this vision a reality? What can we learn from smart campuses that can be scaled up to smart cities? A short research study was conducted over a three-month period at a public university in the United Kingdom, employing stakeholder interviews and user surveys, which aimed to gain insight into these questions. Based on the study, the authors suggest that making data publicly available could bring many benefits to different groups of stakeholders and campus users. These benefits come with risks and challenges, such as data privacy and protection and infrastructure hurdles. However, if these challenges can be overcome, then open data could contribute significantly to improving campuses and user experiences, and potentially set an example for smart cities.

Keywords: smart city; smart campus; open data

1. Introduction

In recent years, our daily life has become extensively penetrated by a wide range of 'smart' things: smart meters for electricity, smart homes equipped with sensors for heating and light controls, smart phones to bring these applications together coupled with smart watches for everything else. Now, we increasingly live in smart cities, which have been rising in all parts of the world in response to two modern phenomena: dramatic growth of the world's urban population and the digital revolution [1]. Many cities around the world have announced and started implementing a smart city vision in the last few years, and the United Kingdom has seen the same trend [2,3].

University campuses have similar facilities to small cities (multi-use buildings, retail outlets, sports and medical centers, transport networks, security systems, waste and energy generation/distribution systems) and consequently similar challenges [4]. Recently, universities have also started putting forward 'smart campus' projects [5] and whenever possible publicly releasing data on campuses and university operations. Southampton University [6] and the University of Cambridge [7] provide full

access to energy data for all facilities throughout the campus to the public. Glasgow University plans to deliver a smart campus platform, which, among other things, will be "a place to gather and display open data about the Campus". [8] (p. 36). This poses the question, could these projects set an example for smart cities initiatives? What can be learnt and scaled up to city level? These questions have not been addressed in previous literature, and this paper aims to start filling this gap.

The study presented in this paper served to develop an understanding of the possible role of user experiences and data in making campuses 'smarter'. The project explored the extent to which campus users are willing to share data and the implications of using such data, particularly regarding issues around privacy and security.

The rest of the paper was structured, as follows. Section 2 discusses relevant academic works, expanding on how the current literature covers the concept of a 'smart campus' and relates it to a 'smart city'. In Section 3, the methods of the study are presented. In Section 4, the results of the study were summarized. Section 4 presents a discussion on using and releasing campuses data in an open format, and the benefits, risks, and challenges of this approach, as perceived by the study participants. At the end, the conclusion outlines the need for further research on implementing open data for smart campuses and using these to support smart cities.

2. Smart Cities and Smart Campuses

With the extreme growth in the number of inhabitants, cities are facing a wide range of challenges that local governments around the world strive to address. The overall challenge is to ensure that cities address urban issues taking into account people's needs and to provide essential services as well as the best possible experiences of city living to every resident. These issues concern both optimizing tangible infrastructure such as transportation, energy distribution networks [9], waste management and supporting intangible assets, such as human capital, intellectual capital of companies, and organizational capital in public administration bodies [10].

As digital technology progresses, and cities accumulate digital data on their operations, city governments have realized the value in using city data for increased efficiency and urban innovation [11]. "Sophisticated data analytics for understanding, monitoring, regulating and planning the city" [12] (p. 12) has become almost synonymous to a 'smart city', where "massive, dynamic, varied, detailed, inter-related, low cost datasets that can be connected and utilized in diverse ways" [12] (p. 3) to improve urban living. Open data is data that "anyone can access, use or share", as defined by the Open Data Institute [13] (p. 5) and is often considered one of the key components of 'smart city' projects [14].Opening up city data for public use is believed to have the potential to empower communities to drive sustainable development in cities and "transform the public realm and the way we live and interact in urban areas" [15] (p. 1).

Although the term 'smart city' has been in use for over 20 years [16], it has only recently become a buzzword [2]. Many authors have attempted to define a smart city; however, the area is complex and influenced by many disciplines [17,18]. Gil-Garcia, Pardo, and Nam [19] conducted an extensive review of available definitions of a smart city and identified the following common features between many of them: (1) technology; (2) critical infrastructures; (3) better services for population; (4) integration of systems and infrastructures; and, (5) vision for a better future. The notion of 'forward-looking' underpins many of the definitions, and sustainability and livability are identified as the main outcomes of being 'smart'.

More recent interpretations of a 'smart city' also highly emphasize people's and the community's needs as well as sustainable development [2,10,20]. "Citizens can, and should, play a leading role in conceiving, designing, building, maintaining our cities of the future" [15] (p. 2). 'Citizen participation' has become an important condition for a smart city and considered key to improving quality of life of city dwellers [21].

Whereas, a 'smart city' has gained momentum in the literature due to rapid urbanization, pressing urban challenges and dramatic threats to urban sustainability [16,19], the concept of a

'smart campus' has not been studied as extensively. The term 'smart campus' has been referred to in the literature since the early 2000s [22]. Research is fragmented and largely focused on particular digital technologies. Some authors emphasize video-conferencing systems [22], the use of smart cards [23], cloud computing and the Internet of Things (IoT) [24,25], information platforms, such as the wired/wireless and virtual private networks [26], and ubiquitous sensor technologies [27] as the basis of a 'smart campus'. Huang et al. [28] attempted to conceptualize the term and referred to a 'smart campus' as "the high level of digital campus", which remains quite vague. Abuelyaman [29] defines a 'smart campus' as one that "deploys smart teachers and gives them smart tools and ongoing support to do their jobs while assessing their pedagogical effectiveness using smart evaluation forms" and at the same time "provides its students with reliable services anytime and anywhere access to the Internet is available. The smart use of instructional and supporting technology strengthens the options a smart campus can offer students and faculty" [29] (p. 12). This definition does not bring more clarity.

Similar to smart cities, the private sector attempts to conceptualize a smart campus and offer smart business solutions to university campuses. In its brochure on Modern Education Experience, Avaya, a multinational technology firm, provides the following definition: "A smart campus enables everyone from administrators to faculty to students to engage with the entire educational experience anytime, anywhere", which seems to have a strong focus on educational experience, similar to the definition by Abuelyaman. It actually refers to the application of ubiquitous technologies, which is only one component of 'smart'. To achieve a smart campus, Avaya suggests implementing its critical elements, such as: (1) smart network infrastructure; (2) smart devices like video cameras and door locks; (3) smart mobile devices; and, (4) smart apps. This interpretation of a smart campus is again technocratic and it implies that the implementation of 'smart technology' is what makes the campus 'smart'. Unlike in the definitions of a smart city, 'engagement' here does not assume a role of the users in the creation of a smart campus, but rather it is a function that is enabled by 'smart' technologies.

Xiong (2017) offers a more comprehensive understanding of a smart campus that supports wider school development with a focus on the IoT and integration of systems: "Smart Campus is to use the Internet of Things, data fusion, cloud computing, data mining, and other information technologies, to integrate the independent business systems and resources of schools into an organic whole with highly collaborated capability, perception, as well as service ability to support school development" [30] (p. 919). This understanding of a smart campus emphasizes the integration of systems and various applications of data as the main components.

Overall, the scan of the literature suggests that in describing a 'smart campus' the emphasis remains on digital technology as a key element of the term without attempting to provide a definition or connecting it to the wider objectives of an academic institution. Discussion on the role of opening campus data to the public for a 'smart campus' or how smart campuses can provide testing grounds for smart cities seem to be absent from the literature.

3. Methods

To achieve the objectives of the study, we carried out 23 interviews with key stakeholders, i.e., faculty staff and researchers (10), management and services staff (4), the Estates Office (3), the Student Union (3), management staff of a neighboring university (2), and the City Council (1), including several that are currently involved in shaping a smart campus vision at this University. This had the objective of eliciting their insights, particularly regarding what kind of data is already being collected and shared. Figure 1 presents interview questions in three categories in line with the goals of the interviews.

General awareness about smart city/smart campus concept:

- Are you familiar with a concept of 'Smart City'? What does a 'Smart City' mean to you?
- In your opinion, how can we assess the city's 'smartness'?
- What parallels can be drawn between a 'Smart City' and a 'Smart Campus'? What should the University do to transform into a 'Smart Campus'?
- Similarly, what measures do you think should be used to assess campus' 'smartness'?
- Who should participate in developing a 'Smart Campus' strategy? How should 'Smart Campus' engage with the students and other stakeholders?
- What are the key benefits of a 'Smart Campus'?

Current initiatives on campus:

- Do you know of any initiatives on campus that in your opinion qualify as 'Smart Campus' initiatives? Who is in charge?
- How do you think these initiatives could and should be integrated in a comprehensive 'Smart Campus' strategic plan?
- Are you aware of any public data platforms at the University?
- Are you aware of any online platforms or other feedback mechanisms where the students can report any issues?

University data collection and storage:

- What personal and other data is being collected by the University that you are aware of?
- Do you know specific datasets, who administers them and where are they stored?
- Is it or should it be assessable by public? Where? Who should be responsible for making these data available and updated?
- What other data would you like to see collected and available?
- What are the key challenges in gathering and using the data?
- What are the opportunities to use the data? What are the challenges on campus that you think could be addressed with data?

Figure 1. Questions of a semi-structured interview.

In addition, 205 responses to an online survey from different groups of campus users (students, staff, visitors) were received to understand perceptions of personal data being collected by the University. The online questionnaire was open from 20 February to 21 March 2017 and it was advertised through multiple email distribution lists at the University and via several university social media platforms.

The survey questions were structured around three categories. The first category was related to the areas of the campus that affect user experiences in a positive or negative way. This category aimed to identify what challenges users face on campus in their everyday experience. The participants were asked to rate how each of the areas impacted upon their experience on a scale: 'very positive', 'positive', 'no impact', 'negative', 'very negative', or 'not applicable' if this area does not apply to them. The responses from these multiple-choice questions were analyzed quantitatively. The respondents were also asked to provide written comments for the areas to which they responded 'negative' or 'very negative'. Using a thematic analysis technique, responses from this section were reviewed to identify common trends and new areas ('other'), which people felt were challenging and why.

The second category of questions was related to people's willingness to share data collected on campus with a third party to improve services on campus and their interest to use the data themselves. A list of datasets from 18 different sources was offered (these included card access to buildings, class attendance, access to Wi-Fi, etc.), with the options 'other' and 'none of the above'. Questions in this category were analyzed quantitatively to discover for each data source how people felt about sharing their data and having access to them for their own benefit.

The final category was related to a smart campus concept. People were asked to provide written responses to the following questions on what 'smart' initiatives they were aware of, what could make campuses 'smarter', and what they saw as the key benefits and disadvantages of using technologies to make campus 'smarter'. The responses from this section were analyzed both quantitatively (count of words and 'none'-responses) and qualitatively to identify common themes. Questions in this section were purposefully open-ended to allow the respondents to "think outside the box" and provide their own ideas and perceptions without any more specific directions.

Data collected through interviews and open-ended survey questions were analyzed qualitatively using thematic analysis, the most common qualitative approach used for interview data analysis [31].

Themes were developed using open coding and following an inductive process of analysis as data was being collected and collated. Structured survey data were analyzed quantitively, which are presented in Figures 2 and 3.

4. Results

A short research study was conducted over a three-month period (January to April 2017) at a public university in the United Kingdom, with a total of 32,000 students both in the U.K. and overseas campuses. The University has been actively developing a 'smart' vision for its campuses in the last two years. A key part of this vision is the development of a data platform to make data open, i.e., publicly available and accessible.

4.1. Improving User Experience through Smart Campus

Understanding the challenges campus users face is crucial to improving user experience. The analysis of survey responses provided an overview of these challenges at the University. For each of the areas in Figure 2, we present the percentage of people who rated each area excluding the number of people who replied 'not applicable'. This was done so that the percentage accurately represents people who use particular services or find them relevant to their experiences of the campus.

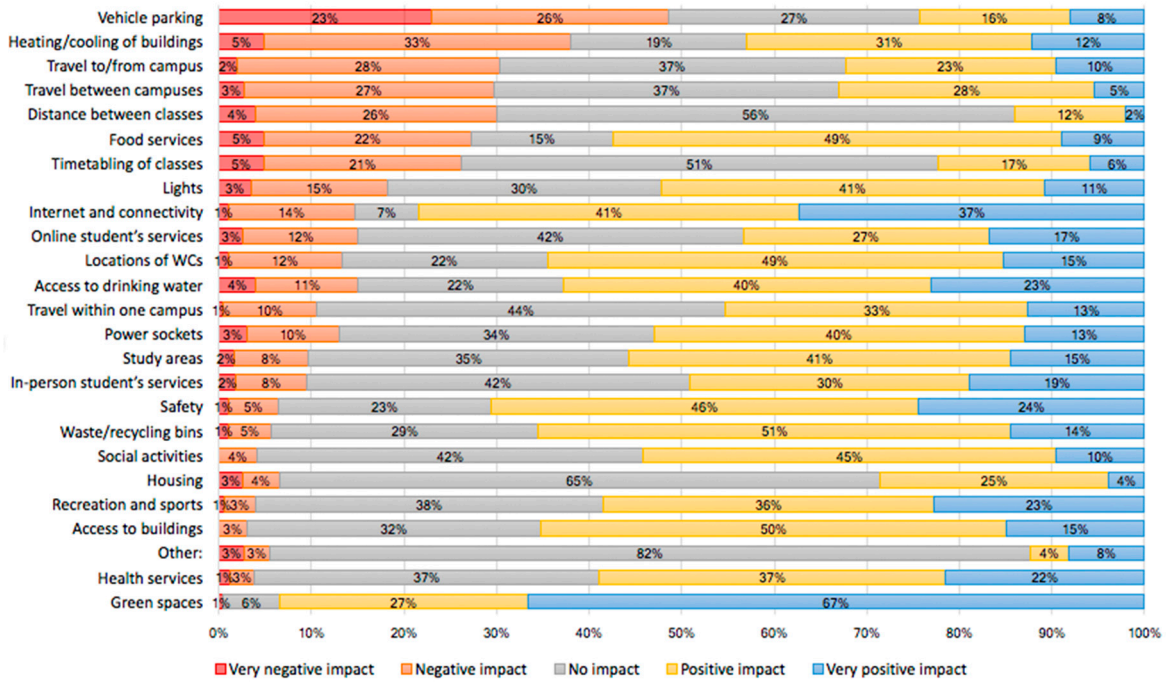

Figure 2. Rating by survey participants on how much each of the listed aspects impacts positively or negatively on their daily experience of the campus (sorted on 'very negative' and 'negative' impacts combined).

126 people provided written comments to elaborate the issues that they were facing as campus users, which is over 60% of the respondents. Much of the feedback included constructive suggestions on how things could be improved and provided alternative scenarios, for example: "Green space is underused—perhaps have football nets/cricket wicket there would be good", or "needs to be a landlord 'approved-list' and a 'black-list' written by the uni and 2/3rd year students so future students don't end up with horrible houses/horrible landlords when living outside of uni".

The area that received the majority of negative ranking was 'Vehicle parking', primarily cost and availability of parking spaces, and the size of parking slots: the response 'parking spaces are too tight' was among the most frequent in this category. Some people felt very strongly about parking

issues: "This is enough to make me reconsider whether I really want to work here—the campus is beautiful and I love working at/for the University but travel—and indeed parking after 8 a.m.—are really off-putting" and " . . . student parking rules meant going to the library at 5 p.m.".

Three travel related areas combined made 30% of people report that mobility related issues had had a negative impact upon their experiences of the campus: travel to/from campus, travel between campuses, and distance between classes. There was a wide range of comments in these areas: inconvenient locations of bus stops or route of public transportation, "single-decker buses at peak times do not meet demand of number of travelers", travel not available between campuses at certain times on certain days of the week, not being able to access campus from the direction of the home (e.g., if coming from Beeston), unclear bike loan scheme, long distances between buildings/long walks. One person put that they felt like the University is "always putting some form of barrier between me and where I want to be".

Second to the first area with the lowest satisfaction rate was 'Heating/cooling of buildings' with building temperature management issued spread across all campuses. The main concern expressed by respondents was not being able to control temperature. Most people who commented in this category said that the buildings were too hot or too cold at different times of the year, in fact the difference could be significant even between different rooms of the same building. People often commented that they have to wear jackets and warmer clothes in their work places, 'migrate' to different offices for certain periods of the year, or work from home because it was impossible to get the temperature in the buildings right.

Comments regarding food services were mostly related to lack of healthy foods and high prices. There were no comments about religious or dietary restrictions but rather poor variety and quality of healthy foods or lack of incentive to buy healthier food options because they were more expensive. In general, a variety of food, especially on smaller campuses, was one of the major concerns. "The food on campus is very expensive . . . and varies a lot across campus—negative if you're only at one location on campus".

A striking number of the issues that were reported by the survey respondents could be improved by providing timely access to information about campus services. Consequently, the majority of 'Smart' solutions proposed by the users largely included ways to share and display real-time information (e.g., occupation of study areas, temperature feedback in the rooms, parking availability, class location and time changes, knowing the peak times at each food outlet, campus news app, etc.), improvement to connectivity (more reliable and consistent eduroam, Wi-Fi outside buildings, better mobile phone access, etc.), better communication (asking what people want/need, more information on smart uses of the campus, better information about services, etc.), and simplifying information technologies (IT) services (interactive IT/conferencing solutions, touch screen information points, more services on phone or tablet, single sign-on for all software, etc.).

We also asked which kinds of personal data should be shared to help improve the university campuses and services, and which kinds of data participants would be interested in using if they could gain access. Percentages of positive responses distributed is shown in Figure 3.

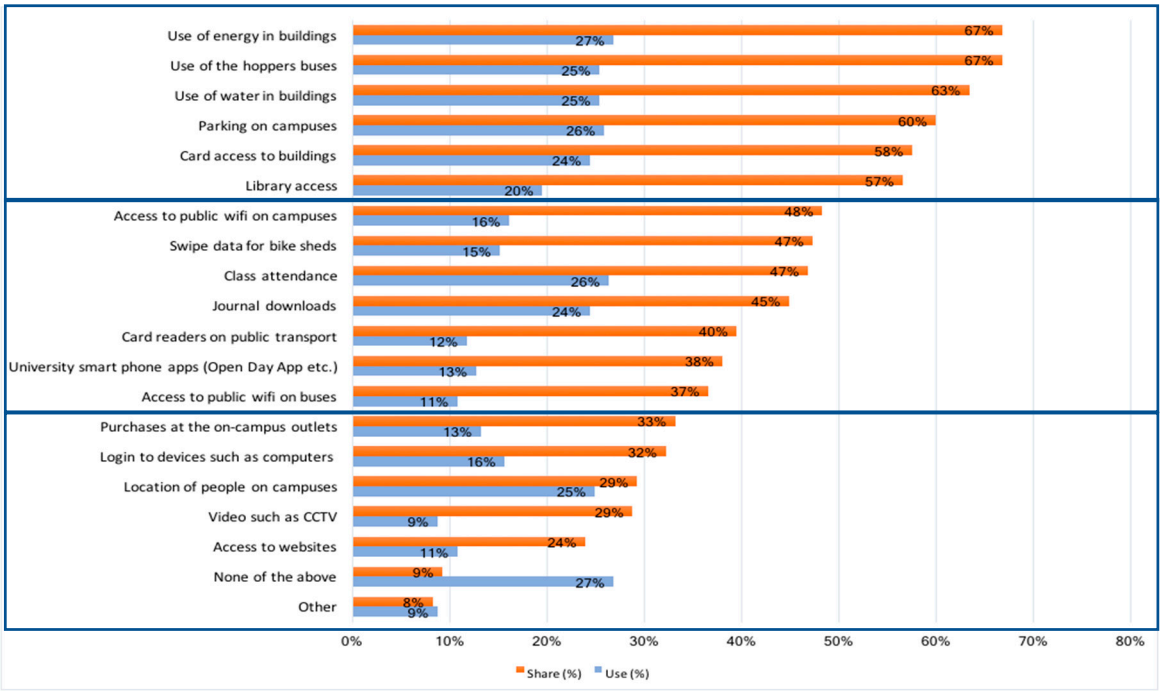

Figure 3. Perceptions of sharing data with third parties to improve services on campus (Share) in comparison to the interest in gaining access to the data (Use).

Almost one-third of the respondents did not find any of the data interesting to them, while over 90% thought that sharing at least some of the data would improve services on the University campuses (only 9% said that they would not share any of the data). If we consider the distribution of percentage of willingness to share the data we will see that the highest percentages (the top section) were related to data on building management and infrastructure that is easily anonymized: use of utilities and access to buildings, transport schedules, and parking availability. The lowest percentages (the bottom section) on the other hand related to data that was highly personal: financial details, login, location, video tracking, and access to websites. Looking at the graph, it appears that people are more willing to share data that is less personal. This demonstrates the degree to which people are willing to share their personal data and perhaps requires better explanation of the benefits and how in particular data would be handled and used (e.g., anonymized), so as to gain user consent to make these data publicly available.

4.2. Benefits of Open Campus Data

Universities generally collect massive amounts of data, but as one study interviewee observed: "smart campus is not about data collection, but about improving environment and creating healthier spaces". Interviewees who represented the university management team felt that using data analysis to understand the user needs and in particular movement data is important in pursuing a 'smarter' campus. It is important for an institution to understand what the data can be used for, but also to unlock the data for others to use to address these issues [32]. Interviewees who represented faculty staff, researchers and the Student Union stressed the need for data to be open and accessible to everyone at the university and to the public. In general, the interviewees had a very positive outlook on making data on university and campuses available. This includes data on building management and operations, safety, academic performance, transport schedules, facilities availability, and other data routinely collected by the University, including real-time data on services on its campuses. Although it does not have to be on the same portal, it must be easily accessible, as suggested by faculty staff and researchers in the interviews.

Interviewees from different stakeholder groups discussed benefits appropriate for their needs and roles at the university, which we allocated into four groups:

- reputation and trust;
- data analysis;
- services and resource utilization; and,
- user engagement.

4.2.1. Reputation and Trust

One of the key benefits to the University as a whole of releasing open data to the public, is sending a message of openness and transparency. Interviewees from the Estates Office reported that they position their campuses as open to the public but felt that the public did not perceive them as such, despite holding regular public events and encouraging use of the campus amenities and services. Sharing data could contribute to creating an environment of openness and fostering trust [33]. For example, some participants felt the University's open data should evidence its achievements as a high-ranking institution in the global UI GreenMetric. One interviewee noted: "Not all will care but those who do care are the most vocal. The university needs to be proactive in providing information". Another interviewee echoed this statement by saying: "There is a big push from public to be green but how can we trust the rankings if we cannot find information supporting it?".

4.2.2. Data Analysis

"It gives a good reputation of being open if you have a good pool of data and can get analysis for free". This quote by one of the faculty staff links to another important benefit of open data, i.e., encouraging data users to analyze the data. At the same time, faculty staff and researchers found that it was somewhat hard to get a hold of the data to perform analysis of different functions of the university. Faculty members expressed strong interest, especially in the School of Computer Science, to engage students with the smart campus initiative and to use data on the university campuses. Student projects are actively seeking 'smart campus' ideas and collect campus data, which is felt to be difficult to acquire through the university for their studies. The student potential appears largely underutilized. Our study revealed a number of student projects, which could use campus data and provide practical smart campus solutions and provide invaluable learning material for students from different disciplines.

4.2.3. Services and Resource Utilization

Many interviewees who represented university management and the Estates Office spoke of a 'smart campus' in terms of resource availability and accessibility noting that the main benefit of a smart campus is the efficient utilization of resources combined with improving student experiences: "improving the actual day-to-day experience of the campus for students and reducing the costs for students as well because the university is running more efficiently". Providing timely information to students and other campus users on availability of different services and hence improving the utilization of resources was described by interviewees who represented the University management as one of the key benefits of a smart campus.

4.2.4. User Engagement

Student engagement was reported as a challenge in the interviews, and at the same time could a critical element of any smart campus. Undergraduate students are the largest user group (over 71%) of the U.K. campuses of the University which was studied. A low response rate from the undergraduate students (8%) to the survey presents a limitation to an understanding of this campus user group's perspective. This also indicated a strong need to find ways to engage with the students. From the Student Union representatives, we also learned that there has been minimal communication and

collaboration on the concept of a 'smart campus' and open data. Despite an absence of significant empirical evidence, in the expert community open data is believed to enhance citizen engagement [34], and this could apply to open data on campuses. By making campus data open and available to students and members of surrounding communities, the University could increase the engagement and public participation in campus activities.

4.3. Risks and Challenges to Releasing Open Data on Campuses

While the interviewees mentioned a host of benefits that could come with open data, one of the primary challenges mentioned was privacy and security of the data, including how data is being released and used. This was echoed in survey responses. Indeed, key disadvantages that respondents raised included 'Big Brother' issues, privacy issues, data security and misuse, cyber security, poor and inconsistent delivery, costs, failure of technology, and less human/student interaction.

Nevertheless, as the discussions progressed, the interviewees mostly agreed that with appropriate data protection and anonymization measures in place, the University should be able to release the data on its operations, possibly subject to a login procedure to know who uses the data. As for the use of personal data, interviewees from university management felt that the University should acknowledge the reputational risk that is involved in how data is being handled and used. They believed that user perceptions of how their data is used imposes a significant risk, which needs to be mitigated by carefully following the data protection regulation and communicating to people what data is being used and how.

Disconnected and outdated information systems and infrastructure for data collection and management can impose another barrier to creating a connected smart system. Technical experts reported that the information systems at most universities and the building management data collection systems need to be updated and linked. Most of the current systems are typically disjointed [35], although some universities have prioritized the upgrade of data systems, which are all linked and interconnected. For example, a neighboring university has implemented a data-based student engagement platform and provides opportunities to supply and use linked data.

5. Discussion

The empirical work related to conceptualizing a 'smart campus' is fragmented, and only touches upon some technology solutions for a campus that are referred to as 'smart' solutions. More work needs to be done to understand what a 'smart campus' is and how it can provide valuable lessons for smart cities and integrate with them.

As demonstrated in our study, challenges, which most users reported on university campuses, correspond to the issues smart cities strive to address (transportation, mobility, energy) and they are closely linked with 'smart' solutions and the concept of 'smart campus'. This echoes with the literature on smart cities and could potentially create opportunities for 'smart' pilots, which could be conducted on campuses and then scaled up to the city level. From the user point of view, providing timely access to information about the campus could improve many of the issues reported by the survey respondents.

Our research suggests that handling and releasing data on campus openly and in an easily accessible way could be central to a 'smart campus' concept. Through interviews with key stakeholders of a 'smart campus' initiative and campus user surveys we were able to identify attitudes towards having an open data initiative on campus including key benefits, challenges and risks. However, the kinds of data that people are willing to share to improve the campus vary. While over 90% agreed that sharing at least some of the data would be beneficial for improving the University campuses, the more private the data is to the users the less they are willing to share.

There is an opportunity for the University to make data on building management and transportation available quickly to enable the potential benefits of data re-use discussed in this paper. Using and releasing open data that potentially is more personal will require additional work, perhaps

including explaining to the users the benefits of using the data and how the procedures of keeping it private and secure are followed. These more sensitive data include individual movement data, which many interviewees felt was important to analyze in achieving a 'smart campus'.

Based on our study, we suggest that a smart campus should be underpinned by open data accessible to anyone. Opening data could bring a number of benefits for various stakeholders, which are based on respondents' comments that we allocated into four groups. A summary table organized by types of benefits and stakeholder groups discussed in the interviews is presented in Table 1.

Table 1. Benefits of open data on campus for different stakeholder groups.

Groups of Benefits	Stakeholder Groups		
	Administrative and Management Staff	**Academic Staff and Students**	**Public Visitors and City**
Reputation and trust	• Credible rankings and performance achievements • Open to public	• Trust in university achievements	• Perception of campuses as open to public
Data analysis	• Free data analysis • New insights for improved decision making and planning	• Using campus data as learning material • Practicing data analysis skills applicable in many disciplines	• Community members can analyze data • Integration with the city open government data portal
Services and resource utilization	• Higher uptake of campus services • Better utilization of resources	• Timely information about services on campuses	• Better participation in campus events and activities
User engagement	• More engaged students and public	• Higher engagement with campuses	• Higher engagement with campuses

While opening data may seem risky from data privacy and security perspectives, our study participants mostly agreed that these risks could be mitigated by following appropriate data protection and anonymization mechanisms. Based on our study participants' perceptions, the first step would be to implement the process of consent to collect the data and to provide full information on how data is being used and an option to opt out.

An interconnected and updated data management system and information technology (IT) infrastructure typically also needs to be in place to support a smart campus in releasing open data. There seems to be a real opportunity for university to invest in improving its wireless networks and data collection and management systems. Any new infrastructure investment should consider how data is being collected and shared and enable the better integration of data systems.

6. Conclusions

As university campuses in many regards could be considered as small cities, parallels, and links between the campus and the city are expected: "[The] campus is a city within a city"—a City Council representative said in the interview for our study. Often being the size of a small town, a smart campus has a potential to serve as a testbed for a smart city. The extent to which this could be true was outside the scope of this study and will need further investigation. The University also has an advantage of having a "young and intelligent cohort who far more prepared to try technology" another interviewee commented. Rolling out smart city projects out across the whole city has additional challenges whereas on campus there is a group of 'early adopters'. However, low engagement from the students, which we have seen in this study might undermine this assumption. But overall there is significant potential to use smart campuses to come up with more ideas and test out the possibilities, which could be scaled up later to the smart city.

Usage of data and making data on campus available freely has several potential benefits. Our study shows that, although people associate 'smart' initiatives with data privacy issues, when presented with the benefits, many users suggested that they would share their data. However,

the benefits of using the data need to be explained and adequate data privacy and protection measures put in place.

Open data for smart campus needs to be further investigated to create the right framework for data release and use, as well as to understand in greater depth how it could provide valuable lessons for open data initiatives in smart cities.

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