ARE WE LOOKING AT THE SAME THING? MULTIPLE METHODS TO FRAME 'OCCUPANCY' OF A LIBRARY BUILDING

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The user occupancy patterns of a building are an important factor influencing the performance of that building. The occupancy patterns influence the technological performance of a building such as its energy use, indoor air quality and thermal comfort. The occupancy patterns are also linked to the socio-material practices in which a building is embroiled. A range of different research methods can be utilised to study a building's occupancy. However, the influence of different methods in framing the conception of occupancy is under-articulated. This paper draws from a multi-method research on occupancy patterns of the 50-year old University of Reading's library building. Methods used include archival method, ethnographic method and 'sweeping' method. A comparison is also made with the published findings of this building's occupancy pattern using Wi-fi-based indoor positioning method. The data and findings from different methods are analysed using the concepts of 'method assemblage' and 'ontological politics'. The findings reveal that the 'occupancy' of library building is framed differently by each method. Moreover, these framings do not suggest that the conception of occupancy is either singular (i.e. methods framing occupancy from different perspectives) or plural (i.e. methods framing occupancy in a mutually exclusive way). Rather, the framing of occupancy is multiple, such that different versions are linked to one another in a variety of ways. The findings also allude to the ontological politics of choosing one version over the other and what is at stake when making such decisions. The paper concludes that the research methods are not a set of technical procedures. But the methods are performative as they are a process of crafting and enacting the research object.

Keywords: archival research, occupancy, ethnographic research, method assemblage

INTRODUCTION

Improving the performance of buildings, over its life-cycle, has been identified as one of the key objectives for the UK construction Sector (HM Government, 2018). The topic of building performance has been interrogated for many decades but has pertinently struggled to locate itself within the structure of the UK construction industry (Bordass and Leaman, 2015). More recently, the architectural profession made a clarion call to reinvigorate post-occupancy evaluation (POE). POE was identified as integral to the agenda of the Royal Institute of British Architects (RIBA) to promote research culture and continuous learning within the profession (Hay *et al.,* 2016). Despite several efforts, building performance evaluation (BPE) has not succeeded to gain prominence within architectural education, and mainstreaming BPE within the architectural profession remains a challenge (Stevenson, 2019). However, architects have demonstrated frustrations with current POE toolkits that favour

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quantitative measures focusing on technical aspects only (Hay *et al.,* 2017). Architects are interested in POE methodologies which explore how buildings work for their clients and the experiences of users. The definitions of POE and BPE are not definite and many versions co-exist. Mallory-Hill *et al.,* (2012) suggested that BPE emerged out of POE. BPE is a more comprehensive process spanning the life-cycle of a building (from strategic planning to adaptive re-use). POE often focuses on the evaluation of the newly completed buildings for a period up to 3-5 years. Government Soft Landings is one such example where aftercare is stipulated for up to three years (Bateson, 2015). The use and adaptations of a building beyond that time-frame are not being considered by many approaches to POE and BPE. Such notions of BPE and POE do not embrace the ongoing adaptations that occur in everyday practices.

Current debates around BPE argue for adopting a socio-technical or practice-based approach to study performance in order to incorporate technical as well as social factors. The performance of buildings as perceived by the occupants have been studied via occupant questionnaire surveys, building walk-throughs and focus group techniques. Responding to the technical performance of buildings, such studies focus on indoor environmental factors or their effects on work and productivity. Tweed and Zapata-Lancaster (2017) argue that an interdisciplinary approach is required to study building performance as existing POE methodologies provide a limited understanding of user behaviour. Recent studies have explored alternative methodologies for post-occupancy evaluation. Koolhass and AMO's (2006) post-occupancy study of Seattle Central Library analysed social media content and discussions with scholars and critics. The use of Seattle Central Library was further studied through phenomenological approach and computer-eye tracking (Dalton and Holscher, 2017). However, these studies do not explore the potentiality of cross-method analysis to improve the understanding of buildings in use.

Occupancy of a building is an important aspect to understand user behaviour and user practices. It is also a crucial aspect that influences a building's energy demand, indoor air quality and utilization of spaces (Wang and Shao, 2018). As part of the Post-Occupancy Review of Buildings Engineering (PROBE) project, Elizabeth Fry building on the University of East Anglia campus was surveyed in 1998 and achieved excellent energy performance and good comfort levels on Building Use Studies (BUS) survey metrics (Standeven *et al.,* 1998). At the time of a subsequent survey in 2011, the building had undergone various changes in the layout. Overall, the building's occupancy had increased, which had resulted in a decrease of perceived occupant comfort (Bordass and Leaman, 2012). Moreover, occupancy of a building might explore the number of people in a building at a given time, their location and their activities in the building using a range of methods. This paper aims to explore how different methods frame the occupancy of a building using the ideas of method assemblage (Law, 2004) and ontological politics (Mol, 1998). Occupancy of the 50-year old University of Reading's library building is studied through archival method, ethnographic method and 'sweeping' method. A comparison is also made with the published study of this building's occupancy using Wi-Fi-based indoor positioning method. The findings allude to the ontological politics of enacting a research object and imply a reflexive approach towards foregrounding a certain version of reality.

The Problem of Method

Sailer *et al.,* (2013) studied space use in a university building using RFID wearable technology, manual observations and an online survey to ascertain if these methods

generated comparable, complementing or contrasting findings. They found that the data sets differed in terms of how they framed the objects of their study; the manual observation data included all building users, while the sensor-derived data was based on the participants who volunteered to wear the RFID tag. The temporal resolution varied across the datasets as manual observation was based on snapshots, while the sensor-derived data provided a longitudinal view. The authors concluded that manual data gathering methods do not result in the same findings as the automated ones. Building on Sailer *et al.,* (2013), this paper explores the comparison of other methods in addition to sensor-derived data, observations and an online survey. Particularly, this paper investigates the occupancy of an academic library building using archival method, ethnographic method and observational 'sweeping' method in conjunction with the published study using Wi-fi-based indoor positioning method. This study aims to understand how these methods frame the research object 'occupancy'.

The problem of the method is a matter of concern when studying buildings in use and adaptations made to buildings over long periods of time. Many methods to study building performance assume a building as a fixed technical object and fail to take into account the fluid nature of the building. Alternative theoretical and methodological approaches are needed to conceive buildings in flux. For instance, a praxiographic approach to conceive buildings as enacted in socio-material practices opens the possibilities to take into account the heterogenous nature of a building which is always in making (Patel and Tutt, 2018). Such approach also affords to take into account entities other than the physical building as crucial actors in enacted the reality of a building.

Method Assemblage and Ontological Politics

A method enacts the research object it sets out to study. Law (2004) suggested that the research methods are not an innocent set of technical procedures but are actively involved in shaping the realities about which we theorise. He thus suggests that research methods are performative. He did not conceive method as a set of technical procedures. Instead, he proposed the idea of method assemblage, which is "a continuing process of crafting and enacting necessary boundaries between presence, manifest absence and Otherness" (144). The method is a continuous enactment of boundaries that create the reality-in-here (presence), reality-out-there (manifest absence/context) and whatever is absent (Otherness). These three concepts are used to analyse the methods to study occupancy.

If the conception of method as enacting the reality is accepted, there is a need to attend to the politics of method. Law (2004) suggested that as method is the continuous process of crafting boundaries, there is a possibility of shaping the reality in more than one way. However, it does not mean that each method enacts a different version of the research object, which in turn are unconnected (i.e. the research objects are plural). Neither does it mean that each method offers a different perspective on a singular research object. Mol (1998) proposed the idea of ontological politics to address this issue of singularity and plurality. She posited that the different versions of an object are not mutually exclusive but are connected in various manners. de Laet and Mol (2000) observed different ways in which the Zimbabwe bush pump (the research object) is enacted from one region to another. At one site it is a hydraulic pump, at another site it is a community pump. Each of these enactments involves different networks. The practices around the pump as well as the identity of the pump changes in these different networks. Using the example of atherosclerosis disease,

Mol (2002) has further argued against the perspectivism view. She contends that exploring an object from different perspectives does not mean that those perspectives are looking at one single object. Rather, each of those perspectives or research methods in our case generate a version of the object, which are linked to the other versions. The different versions of the object sometimes cohere and sometimes contrast with each other. As Law and Singleton (2005) suggest "difference is no longer a matter of different perspectives on a single object but the enactment of different objects in the different sets of relations and contexts of practice" (342). Law and Mol (2008) through the example of Cumbrian sheep, explain how different versions of the sheep do not suggest plurality. Rather these different versions are intricately linked and suggest a multiplicity of the object, which was the sheep in their case. Relating to the research object 'occupancy', this paper explores how different versions of 'occupancy' relate to each other.

Given that there is a possibility to enact 'occupancy' in multiple ways, it demands reflexivity on part of the researcher to attend the crafting of boundaries between presence, manifest absence and Otherness (Law, 2004). Mol (1998) articulated four questions to attend the ontological politics. Firstly, she suggested to explore the sites of the different versions of the object to understand the decision-making process of which version to foreground. In terms of occupancy, this question helps to explore how a particular method is chosen over the other. Secondly, she pointed towards the concept of 'interference' to explore the effect of a certain crafting of an object on other realities. It is not just the crafting of occupancy that is at the stake. The enactment of occupancy implies how other entities such as the building and the users are enacted as well. Thirdly, she questioned whether the different versions of an object are in fact discrete options. She suggested it not to be the case as different versions of an object are not mutually exclusive but depend on each other in different ways. This raises the question of whether different versions of occupancy are linked in any manner. Fourthly, she attended to the problem of how to choose between the different versions of the object. In case of occupancy, the question becomes which method gives a 'good' understanding of the occupancy and who should have a say in discerning that. Through the analysis of the findings from the different methods to study the occupancy of a library building, an attempt is made to address these four questions.

Methods to Study Occupancy of a Building

The University of Reading Library building is centrally located on the University's Whiteknights Campus. The library opened in 1963 and has been undergoing phased refurbishments since 2012. Four methods are proposed to study the occupancy of the library building are discussed below: Wi-Fi-based indoor positioning method, ethnographic method, 'sweeping' method and archival method. The Wi-Fi-based method is discussed on the basis of a published study by Wang and Shao (2018).

Wi-Fi-based technology

Wang and Shao (2018) investigated the occupancy of the Knowledge Exchange room on the ground floor of the library building using Wi-Fi-based indoor positioning method. The data was collected for 30 days - from 27th May 2016 to 26th June 2016. Six Wi-Fi sensors were installed in the room to trace the movement of Wi-Fi -enabled devices. The data collected included latitudinal and longitudinal values of Wi-Fi devices, their truncated MAC addresses (to protect the privacy of the users), and the test time. The occupancy of Knowledge Exchange room was measured by analysing the duration for which a a Wi-Fi enabled device was present in the room.

Ethnographic method

I 'shadowed' library users to understand their practices of using the library building during 2013-14. Czarniawska (2012) suggested that "…shadowing consists of watching over people's shoulders as they work and receiving explanations" (132). I shadowed and interviewed four library users: two undergraduate students, one postgraduate taught student and one postgraduate research student. The data amounted to observations for 8 hours and 30 minutes and 6 hours of interview recordings. None of the users were shadowed in the Knowledge Exchange room which was the room studied in Wi-Fi-based method. The users were shadowed in following locations of the library building: the second-floor study spaces, the first floor PC lab, the book-stack areas and fifth-floor study spaces.

Observational 'sweeping' method

In my ethnographic study of the library building, conducted during 2013-14, I observed that the library staff members often did a headcount of library users at certain times of the day. A member of staff would walk around the library areas, punching a counter and writing the numbers on a sheet of paper. This practice of library staff to measure occupancy was based on the number of people in the building. However, I was interested in a more detailed survey to understand user practices in various study spaces. Given and Leckie (2003) described the sweeping method to study social activities in a public library. They collected information on the users' profile, possessions and activities. However, they did not link that data to physical space i.e. where those activities happened. Inspired from Whyte's (1980) use of sighting maps to study outdoor plazas, I firstly populated the building's floor plans with all the study furniture. I then carried out observations at regular intervals from 17th - 23rd January 2014 and plotted dots on these furniture plans, each one representing an occupied seat. The areas studied by me were those to which I had access as a student. Hence, I could not study staff areas or other restricted areas. The data analysed in this paper relates to Knowledge Exchange room on the ground floor (the room studied in Wi-Fi-based method) as well as study spaces on the second and fifth floor of the building (the areas studied in shadowing method).

Archival method

In order to understand the changes in practices and adaptations of the library building over time, I undertook archival analysis of various documents pertaining to the library. The University Records Centre holds archives pertaining to the operations of the library as an organisation as well as records of the building. A data-set of 307 student responses from a survey titled 'Survey of University Library use of Undergraduates' dated 8th May 1969 was found in the archives[2]. The responses were filled by University of Reading's undergraduate students who visited the library on that day. The proforma of the survey was created by the Library Management Research Unit, Cambridge. The key purpose of the survey appeared to be understanding the use of the books in the library by undergraduate students. The respondents were also asked to fill in the time of entry and exit from the building as well as the year of their study. This data could be inferred to understand the duration of occupancy in 1969 and offer a possibility for comparison to the findings from the Wi-Fi-based method. For the purposes of this study, 47 responses were deemed invalid as the data regarding the entry or exit timing were missing. Also, three responses did not have data regarding

[2] The dataset can be found in Box 9, University of Reading Records Centre.

the year of the study. In addition to this dataset, I analysed other archival records from the University Records Centre to understand the issues around occupancy in the library building. All the archival sources are referenced in the footnotes.

Multiple framings of occupancy

Occupancy - availability of seats

In 1958, the Reading University Library's initial building design stipulated 500 reader seats. This figure was based on a 1 seat per 4 students, with an expected student population of 2,000 in 1963.[3] The ratio was deemed appropriate in comparison with the seating provisions made for other university libraries constructed at that time.[4] When the library building opened in 1963, total seating provision was 583 seats.[5] In the following years, as the University's student population increased, the number of seats in the library were increased as well. In 1968, the number of seats in the library was 751 seats, which included all chairs, stools on the ground floor main hall and lecture room seats. However, by this time the student population had increased to 4000[6], and thus the ratio of seats to student population was no longer 1:4. The gap has been widening ever since. In 2014, there were 1436 library seats[7] for a student population of over 17,000[8]. However, the 2013-14 library refurbishments did not attempt to re-establish the original seating accommodation ratio of 1:4. Rather, the focus was to provide a variety of study spaces to suit different user needs. The number of seats was maintained in 1455, only slightly higher than the pre-refurbishment total.

Over time, the University's student population has increased from 5000 in 1969 to over 17000 in 2014. Students often complain that seats are not available in the library. The situation is exacerbated during exam period which is generally spans from May to early-June. However, not all seats in the library are occupied at all times. The findings from the sweeping method demonstrate that at no time during the survey all the seats in the library were occupied. Wang and Shao's (2018) discussion of representative days suggest that number of users at any given time on those days was less than 18. The number of seats in Knowledge Exchange room were 38.

The Wi-Fi-based method revealed that the peak time for occupancy in the Knowledge Exchange Room was between 15:00-22:00 pm. This finding complements the findings from the sweeping survey for the Knowledge Exchange Room which demonstrate higher occupancy of seats from 12:30pm onwards. However, the sweeping method, which surveyed other areas of the building as well, revealed that

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[3] Minutes of the Curators of the Library dated 17th November 1958. University of Reading Records Centre Box 256.

[4] A note dated September 1958 lists the new library buildings from four universities and the ratio of reading places to the students. The ratios ranged from 1:3.1 to 1:5. University of Reading Records Centre Box 256.

[5] University of Reading (1964) New Library. University of Reading Library.

[6] Paper 'Future development of the Library: a report for submission to the Committee of Deans' prepared by the Library, approved by the Curators of the library. Dated 16th October 1968. Box 595, University of Reading Records Centre.

[7] Annual Review 2013-14, University of Reading Library.

[8] Financial Statements 2013-14, University of Reading. Accessed at https://www.reading.ac.uk/web/FILES/finance/Accounts_UoR_13-14.pdf, on 23rd December 2015.

occupancy in other study areas is much higher during this period. The occupancy demand in the Knowledge Exchange Room might be related to the availability of other spaces in the building. Thus, the demand for space in a building or part of it might be related to the availability of space in or beyond a building. This observation demonstrates the different craftings of the reality-in-here (Law, 2004). For the sweeping method the occupancy related to the spaces in different areas of the library building. On the other hand, the Wi-Fi-based method focused on one of the areas, the Knowledge Exchange room. Wang and Shao (2018) noted that future study could focus on monitoring which involves larger number and more types of spaces. This note might acknowledge the 'reality-out-there' (Law, 2004), which is manifested absence in the enactment of Wi-Fi-based method by Wang and Shao (2018). Moreover, the duration of presence was not investigated in the sweeping method. It could be considered as the 'Otherness' (Law, 2004) in the framing of occupancy based on this method. Similarly, the number of seats could be considered as the 'Otherness' of the Wi-Fi-based method. Rather than the occupancy in terms of occupied seats, the occupancy in Wi-Fi-based method was based on the number of Wi-Fi-enabled devices present and the duration of the presence.

Occupancy - duration of presence

They identified four patterns based on the duration of occupancy: observers (0.5-1 minute), intensive learners (0.5-1 hour), inspectors (those who returned once or several times for occupancy duration of 0.5-1 minute following an absence duration of 2-8 hours) and normal learners (those who stayed for a long duration of 0.5-1 hour followed by short absence duration of 10 minutes-2 hours). Wang and Shao (2018) found that the total amount of observers and inspectors (those who stayed in the room for a very short duration) was much higher than intensive and normal learners.

In comparison to the Wi-Fi-based method, the archival questionnaire data-set provides data for undergraduate students at a building level. The observation of pattern A is unique to the granularity of observation offered by Wi-Fi-method and no comparable data could be found from other methods. However, in relation to pattern 'intensive learners', the questionnaire data set revealed that only 13 respondents reported leaving the library building within half an hour of their arrival. Majority of the questionnaire respondents stayed in the library building for more than two hours. Wang and Shao (2018) also found that as the occupancy duration increased, the number of times a user was absent (probably taking a break) also increased. The archival data-set shows that students studied for up to 13 hours. While not all of those students noted the intermediate periods of absence, 11 respondents recorded multiple entries and exit times or a note indicating that they took breaks. This occupancy pattern could be related to the pattern 'normal learners' revealed by the Wi-Fi-based method.

Mol's (1998) first point pertaining to the ontological politics was to unpack the sites of decision-making when it comes to choose a particular framing of the occupancy. I choose to analyse the archival records to understand how recent the concerns were pertaining to occupancy. But this method is also dependant on the availability and preservation of archival records. Similarly, with the sweeping method, I was able to draw the floor plans as I have the skill to create furniture layouts owing to my architectural education. I am not well-versed with Wi-Fi-based method and the analytical skills entailed. Moreover, the Wi-Fi-based method depends on the possession of Wi-Fi-enabled device, the sensors and the Wi-Fi network. Thus, the decision-making regarding which version to foreground could depend on the skills of the researcher, the tools which are available and the kind of access available to the

data. The enactment of occupancy is related to a network of other entities which are involved (de Laet and Mol, 2000).

Framing of occupancy interfering with framing of building and users
During the shadowing of the users, I observed how users shared a laptop:

> They begin working. User 1 reads notes on User 2's laptop … User 2 goes to get some prints. User 1 then gets up and goes somewhere. User 1 comes back and looks at the prints … User 2 goes down to buy a snack. He returns in five minutes … User 1 stands up … He wants to see if he can get a book. (Field notes, 30 May 2014)

The two users had one laptop which they both shared. During the duration of shadowing, the laptop remained at the study desk while the users took turns to go away from the desk. Thus, the Wi-Fi-enabled data might be affected by such user practices projecting the laptop-proxy user as the intensive learner, while the users might actually be away from the desk. Wang and Shao (2018) clarify that the Wi-Fi-enabled device serves as a proxy for the user and discuss the issue of a user possessing more than one device which might inflate the occupancy. While the Wi-Fi-based method did not collect any demographic data, the questionnaire analysis reveals that long-occupancy visits were made by students in second, third and fourth-years students. Moreover, 142 third-year students visited the library as compared to 24 first-year students, 93 second-year students and 24 fourth year students. Thus, the user in the Wi-Fi-based method is anonymous, while that in the archival method is rendered as a student of a particular subject and studying in a particular year. In contrast, the Wi-Fi-based method captures any person with a Wi-Fi-enabled device, whether that is a student or a member of staff.

Similarly, the building enacted by Wi-Fi-based method involved the presence of a Wi-Fi-enabled device. In this method, the enactment of the building is not linked to the seats. However, the sweeping method is inextricably linked to the seats and furniture. Any changes to the number of seats will affect the findings from the sweeping method. The enactment of building in the sweeping method accounts for the fluid nature of the building. There were instances during the sweeping survey when the furniture was moved by the users. These observations echo Mol's (1998) second point of stakes involved in choosing one version over other. The enactment of a certain version of occupancy in turn entails the version of user and the version of the building that is enacted. The implications of such dependencies might demand a reflexive approach towards existing BPE and POE methods.

Are these different versions of occupancy mutually exclusive?
Wang and Shao (2018) conducted an observational study to arrive at a value to approximate number of devices, which was integral to their algorithmic analysis. The findings from the unobtrusive observation method is thus 'included' in the findings of the Wi-Fi-based method. Wang and Shao (2018) suggested that during the term time, short-occupancy visits to the Knowledge Exchange room peaked during late-morning and lunchtime. In contrast, the long-occupancy visits peaked around 14:00-16:00. However, the archival questionnaire data-set reveal that for all occupancy durations, and especially long-occupancy visits, the arrival time between 9:00-12:00 was more frequent than other times of the day. In this instance, the findings from the two methods contrast despite the similar framing of the occupancy based on the time of arrival. It might because of the manifest absences involved in the framing of occupancy: the Wi-Fi-based method was limited to a particular room and the archival method only accounted for undergraduate students. Comparison between different data sets such as shadowing, observation survey and Wi-Fi-based data revealed the

intricacies of how the object of analysis for these different methods are connected. Shadowing data reveals the limitations of proxies for occupancy in the Wi-Fi-based analysis. This re-affirms Sailer *et al.,* (2013) suggestion that both manual and automated methods add value in understanding user behaviour and could not substitute one for another.

The politics of enacting occupancy

As discussed by Law and Mol (2008), the methods framed the object of the study differently, which in this case was occupancy. Through the analysis of a questionnaire survey, the occupancy was analysed through the time of entry and exit from the building. For Wi-Fi -based analysis, the occupancy was analysed in terms of the duration that a Wi-Fi-enabled device was present in the Knowledge Exchange room. The observation survey analysed the occupancy in terms of whether a seat in the building was occupied or not. Occupancy in the Wi-Fi-based analysis was not dependent on occupying furniture but on possessing a Wi-Fi-enabled device. Occupancy in the observational study was based on occupying a seat and those passing or in motion were not considered. The findings from each method were limited in terms of the granularity, temporality or spatial coverage. The potential of combining big data and small data to understand user-behaviour in buildings is yet to be realised. The politics of enacting occupancy is not conclusive. It opens up several questions. How we might study occupancy to improve performance of the buildings? Is it a matter of asking the buildings users how they want to be represented in occupancy studies? Who should decide the measures to study? Such questions foreground the performative nature of methods.

CONCLUSIONS

In this study, the framing of 'occupancy' as a research object was explored using a range of different research methods. The findings suggest that each method frames 'occupancy' differently. However, these different versions of occupancy relate to each other in a variety of manners. Thus, it becomes critical for the study of building occupancy, and building performance in more general, to be attentive and reflexive about the agency of research methods in shaping the realities about which we theorise. Methods are not innocent set of procedures. Methods are a process of enacting and crafting realities. Methods are political.

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