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**Tuuli Jylhä**

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## PREFACE

EuroFM offers a platform for facility management (FM) researchers, practitioners, and educators: together the EuroFM community can share, learn, and provide support and inspiration. This special companion proceedings not only shares the research results and ideas, but shows the power of collaboration between the researchers, practitioners, and educators. We are grateful to share this companion proceedings with the EuroFM community in its flagship event, European Facility Management International Conference 2020, this year arranged online.

The idea for this companion proceedings was kicked-off by the recognition of Prof. Mark Mobach and his team when they were awarded in November 2019 the 'Delta Prize', a leading practice-oriented research prize handed by Ingrid van Engelshoven, Minister of Education, Culture and Science, in their home country, The Netherlands. In [the report](#), the assessment committee honoured Prof. Mark Mobach and his research team for the impact their research in Facility Management has had on the crossroads of practice. In this companion proceedings, two research groups at [Hanze University of Applied Sciences](#) and [The Hague University of Applied Sciences](#), lead by prof. Mark Mobach, and their partners present themselves and share their results, knowledge, and experiences with the EuroFM network.

This companion proceedings consists of 16 short papers divided into 4 themes: insights into campus design; health care facilities from the patient view; healthy working and living; and facility design in the context of society. All papers are structured in the format of extended abstracts.

We would like to thank Prof. Mark Mobach and his research team for their collaboration and motivation to contribute to the EuroFM community and field. The papers provide valuable takeaways to researchers, practitioners, and educators and demonstrate the passion toward the FM field. Your contribution is highly appreciated.

Enjoy reading it!

### **Dr. Tuuli Jylhä**

Chair of the EuroFM Research Symposium Organising Committee  
EuroFM

### **Olga van Diermen**

Education Chair  
EuroFM

## ACKNOWLEDGEMENTS

Prof. Mark Mobach and his research team would like to gratefully acknowledge the honour of receiving Delta Prize (in Dutch 'Deltapremie') handed by Ingrid van Engelshoven, Minister of Education, Culture and Science, in The Netherlands in November 2019. The authors of the papers in companion proceedings of the European Facility Management International Conference 2020 are grateful to acknowledge the support of the [Netherlands Association of Universities of Applied Sciences](#) and the [Dutch Taskforce for Applied Research](#). They also thank [EuroFM](#) for the collaboration and the possibilities for sharing their results and ideas with the EuroFM community.

### Deltapremie

The 'Deltapremie' or Delta Prize is a new leading research prize in the Netherlands focusing on practice-oriented research by professors. The prize is developed for professors who have managed to repeatedly make a special difference with the social impact of their research over the years. It shows where practice and research can come together in an innovative way. Practice-oriented research has acquired a solid place in Dutch society. Almost 700 professors and more than 3,000 teacher-researchers are currently involved. The starting point of the research is always to find solutions for practice-based problems, also by partnering with practice. In this way, practice-oriented research provides applicable solutions to societal challenges.



An independent selection committee selected the winners. The committee consisted of six experts from Erasmus University Rotterdam, Innofest, Delft University of Technology, Netherlands Study Centre for Technology Trends, and the Association of Netherlands Municipalities. In the report the selection committee tributes Mark Mobach and his research group for the impact that they have on the crossroads of various domains from public transport to mental health. Mobach: "We see the prize as enormous encouragement to continue our research into space and organisation in healthcare, education, offices, and cities together with our partners. We extend our research to areas where there are perhaps fewer financial possibilities, such as research with the arts and frailty."

### Research focus area

With his research group, Prof. Mobach wants to contribute to the best buildings for people and organisations. He does so by devising better space and services in a multidisciplinary setting together with students, lecturer-researchers, Ph.D.-students, and postdocs. Better spaces and services for education, offices, and even cities that stimulate healthy behaviour, better healthcare buildings that reduce stress, but also prisons and stations that better meet the needs of society.

## INTRODUCTION ■

Organisations can perform better. Way better. Over the years, I have seen too many examples of spaces that hindered or frustrated the primary process of organisations. Food courts and offices being too noisy, classrooms too warm, universities too ugly to work in, pharmacies with privacy problems, hospitals requiring vastly inefficient walks, shopping malls and airports where people get lost, and factories with light shining in the wrong places. And this is just a concise list of examples that come to mind. If so terrible, what can we do about it? And is this even the responsibility of a facility manager?! I say: yes, it is! We are active in all corners of society. We have a clear responsibility for the user; to create spaces and services that actually work for them. More than ever, the current pandemic reveals the high relevance of facility management (FM) for the world. However temporary it may be, poor building designs will prove to have way more difficulties in adapting to this new reality than smart and flexible ones. We need better designs, not only of spaces, but also of the services that fit in and support the primary processes of organisations.

Given the large variety of organisations that our profession works in, we may need approaches that reflect a vast number of different practices- such as FM for education, factories, healthcare, offices, prisons, shops, etc.- or we can try to find properties that show universal value. Properties of spaces and services that support the performance of humans in all organisations. The latter is our quest. In order to do so, our research in FM should not be limited to the measurement of spaces in terms of perceptions and self-report, but also of actual behaviours and performance, and even of the changes in the human body. Can this be done? Are there not too many specific differences between organisations, even in the same line of business or sector? There may indeed be differences, but it always strikes me how many similar issues pop up in largely different organisations.

The current set of papers of these companion proceedings of our Dutch Research Groups at Hanze University of Applied Sciences and The Hague University of Applied Sciences can be seen in this light. It is part of a quest to find similarities between healthcare and offices, between public transport and prisons, and even between cities, small-scale organisations, and tiny spaces like lactation rooms and pods; and as well all other combinations. We seek to create cross-overs between these areas, in all possible and potentially fruitful ways. It may seem a largely diverse area of research, which is very true from a research perspective. However, be reminded that it is only a very limited representation of the areas where FM practitioners work in. So, there is still much to be learned! The set of current papers provides you with a glance of our research work in Groningen and The Hague, allowing you to become part of our quest for properties with universal value. All in the context of designing spaces and services that serve people in organisations better than they do now. By doing so, we are always looking for relevant improvements, always trying to show the added value of the right spaces and services for organisations and its impact on society.

The research of our groups is organised in four innovation labs: health space design, healthy workplace, healthy cities, and campus design. An innovation lab is a network of companies and educational and knowledge institutions focused on open innovation. The innovations contribute substantially to solutions for fundamental issues in society. Each innovation lab has a clear focus and can work on multiple projects and results. It has the character of a lively 'testing ground', in which researchers, teachers, students, and organisations work together on finding solutions for complex practical problems. There is room for experimentation and failure. Our labs are located in or near the organisations that we work with, and always with the questions of professional practitioners in mind.

### **Insight into campus designs**

Thousands of students, teachers, researchers, and entrepreneurs flock towards Dutch campuses every day to study, work, and relax. Therefore, a campus is a latent incubator of ideas and innovation. The purpose of the innovation lab campus design is to enhance the quality of the buildings and services on campus and to improve the cooperation between the different user groups. Our focal point here is the demands of businesses and institutions. In the provided examples we describe

possible improvements of the indoor environmental quality of classrooms, the impact of tiny spaces on student wellbeing, and the spaces and services that stimulate interaction between businesses and institutions on campus.

### **Health care facilities: a patient view**

In the innovation lab health space design, we develop and apply knowledge leading to an improved design of the built environment and a better organisation of patient care, the care for their loved ones, and health care staff. The resulting knowledge products can help health care institutions improve their performance and thus positively influence patients' health, mood and/or behaviour. In time this should lead to a reduction of operational costs. We present six of our projects. It deals with spaces and services for patients in hospitals (wayfinding, scanning, day treatment, clinic, palliative care), elderly care, care for mentally disabled people, and people with dementia.

### **Healthy working and living**

In the innovation lab healthy workplace, we develop and apply knowledge causing people in an office environment to exercise, relax and go outside more, and concentrate better. We use space and technology to promote healthy behaviour and examine their effects. Examples are indoor climate, lactation rooms, dynamic furniture, gamification, and office layout. The two papers included in this series focus on office refurbishment and the design of lactation rooms.

In the innovation lab healthy cities, we seek to enhance city dwellers' health and well-being. Investments are being made into a physical and social living environment protecting and improving the health of citizens. The right investments will also make it easier to make healthy choices. A wide variety of related aspects is studied, such as physical living environment, lifestyle, healthy behaviour, and health. The two included papers of our portfolio focus on urban decline and independent living.

### **Facility design in the context of society**

We always have some room for new areas that have raised our curiosity or that of our practice and/or knowledge partners. As a rule of thumb, we use an 80-20 ratio (80% in innovation labs, 20 % outside of these). So, there is always room for research 'outside the box'. This gives our research group the flexibility to formulate answers to new questions arising in society and allows for innovation and fresh ideas. In this context, we included three areas in a broader context of facility design for society: the professionalism of municipal real estate management, waste management and reduction of waste, and spaces and services to advance perceived cleanliness at public transport.

### **A way forward**

Space and organisation have always been completely interwoven. However, the topics originate from two completely different and still largely separated worlds: management and art. In black-and-white: in the Academy of Management there is hardly any attention for a spatial turn, just as there is silence of management topics in the Venice Biennale. But, in practice the professions of architect and manager are strongly interrelated. Architects can design spaces that people of organisations can work in properly. So, organisations depend on the rightness of their design decisions largely. In turn, organisations can contract and fund architects to create great buildings. Good contracting - exactly knowing what to ask of an architect and what not - is crucial for any building success. My main advice would be: always stick to the definition of the properties of your own profession and field of expertise. The better defined, the better built. But why is it by any means so hard to create buildings that actually work? We have done so for ages, however, there are so many ugly, boring, and dysfunctional buildings, that it can truly make you desperate. It can squeeze out one's last hope for better spatial worlds. Where to begin? The divide between the professions of architect and manager does not help. But there are also many opportunities to do a better job; and FM fits in perfectly.

FM can be the linking pin between space, infrastructure, people, and organisation. Because FM has the responsibility over the complete operational phase, it knows what works and what not. The profession knows how to please people in buildings and how to serve them. Moreover, it has implicit knowledge that can be used to create better buildings. For instance, by sharing professional experience and delivering focused user content into the design process. Moreover, infusing decision makers and designers of spaces and organisations with a condensed view of what users experience and how they respond- always supported with evidence- may also help. And to share experiences with a network of peers. A network such as EuroFM, learning from peers what spaces can support the performance of people in organisations and may even become a best practice and (perhaps even more importantly) what spaces do not! And please, let's not limit ourselves to the marketing of our best practices and the advertisements of our own successes, but let's start to focus on learning. Learning from failure being the most important constituent to create progress in FM!

FM may be the best liaison an organisation can desire. The profession is a linking pin between building-related professions, such as architects, interior designers, building services engineers, and real estate professionals on one side; and organisation-related professions, such as management, workers, and customers on the other. FM is a profession supporting organisations in creating buildings that work. In fact, it means that our students, as new generations of well-informed decision makers, need to be enabled to think and act integrally. To connect spaces and services and to align these with the primary process of an organisation. How does such a building look like? I dream a dot on the horizon.

We help each other in our organisation, no matter how busy we are. The management helps the workers, workers help the management. Especially when things go wrong, we are reliable partners. Social media and technology support us. As the workforce grows older, they still like to work here. The young and ageing workforces feel appreciated, recognized, and supported. A lot of work is done remotely, but if contact is necessary, we meet. We respect each other's boundaries and privacy. Because facilities are nearby, everyone ventures out as much as possible. That is why we mix, meet, and share easily, at every stage of our work life.

Our spaces are safe and secure. Each space is organised logically, invites you to be active and prevents inefficiencies. The acoustics are fine, just like the light, air, and temperature. The building is beautifully designed, we love being there. We feel good, because the spaces and services feel good. It mitigates our stress and tensions. The view is beautiful. There are gardens, greenery, and fresh water. The food is nice, fresh, tasty, and healthy. There is no nuisance from noise, stench, or litter. The space and surroundings invite you to go outside and be active. The building users can commute, cycle, and walk safely and healthy. The building is generative, (re)produces water, food, and energy. Like a sunflower, always focused on the sun.

We can design these buildings and organisations starting tomorrow. But how can it be done? Firstly, EuroFM can come into action. A network like EuroFM may not only support a better connection between research, education, and practice, but may also allow us as a community to learn from each other and actually realise such buildings. Secondly, as researchers we need way more commitment of FM practices. Especially for research funding. We need substantial and structural funding to grow intellectually as a field of expertise. I call on all of you: practice invest in us! Research funding allows us to create the human capital that you are so desperately waiting for: better knowledge for the bright and well-informed new workforce which are ready to act and innovate! Solely depending on funding by authorities may slow down the development of FM substantially, even with a potential risk of losing practical relevance and applicability. Working together more closely- in research, education, and practice- allows us to grow as a true community of learners in FM. Finally, we need the direct involvement of practitioners to improve our systems for open innovation and the relevance of our research questions. Such an approach can also make more national and international comparisons possible and allows us to use our network to its full potential.



The benefits of more intense cooperation can be substantial and create new relevant insights. Not only for the contracting organisations, but also for our students as a future workforce for practice. It is of highest importance that practice steps in to help us mature. Research can create new relevant knowledge which inspires scholars to teach different content; education can teach these newest insights to the students; practice can benefit because new staff - our alumni - will be their future colleagues. And that is why the connection of the different groups in EuroFM - the research network group, the education network group, and the practice network group - is of vital importance for the advancement in FM. With my research groups and my peers, I am really looking forward to such cooperation in the near future. Hopefully we can start soon!

**Prof. Dr. Mark Mobach**

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The Hague University of Applied Sciences, The Netherlands

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**THEME 1:**  
**INSIGHT TO CAMPUS DESIGN**

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Contributions by *Innovation Lab Campus Design*,  
Research Centre for Built Environment NoorderRuimte  
Hanze UAS

**The Influence of Indoor Environmental Quality on Perceived Quality of Learning in Classrooms  
for Higher Education**

*Henk W. Brink, Marcel G.L.C. Loomans, Mark P. Mobach, and Helianthe S.M. Kort*

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**How to Measure Campus Interactions**

*Sascha N. Jansz, Mark P. Mobach, and Terry van Dijk*

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**Living in a Pod: The Impact of Tiny Spaces on a Dutch University Campus**

*G. Johan Offringa, Anke D. Roos-Mink, Marc A. Roosjen, and Mark P. Mobach*

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# The Influence of Indoor Environmental Quality on Perceived Quality of Learning in Classrooms for Higher Education

Henk W. Brink<sup>1</sup>, Marcel G.L.C. Loomans<sup>2</sup>, Mark P. Mobach<sup>3</sup>, and Helianthe S.M. Kort<sup>4</sup>

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## ABSTRACT

**Background and aim** – In this study, it is pre-supposed that the indoor environmental conditions of classrooms can contribute to the quality of the educational process. Thermal, acoustic and visual conditions and indoor air quality (IAQ) may be extremely supportive in order to support the in-class tasks of teachers and students. This study explores the influence of these conditions on the perceived comfort and quality of learning of students in higher education.

**Methodology** – In a case study design, the actual IEQ of 34 classrooms which are spread over four school buildings in North Netherlands and 276 related student perceptions were collected. The measurements consisted of in situ physical measurements. At the same moment the perceived indoor environmental quality (PIEQ) and the perceived quality of learning (PQL) of students were measured with a questionnaire.

**Results** – Observed are high carbon dioxide concentrations and high background noise levels. A relation was observed between perceived acoustic and visual conditions, IAQ, and the PQL indicating that a poor IEQ affects the PQL. A linear regression analyses showed that in this study the perceived impact on the quality of learning was mainly caused by perceived acoustic comfort.

**Originality** – With the applied innovative measuring instrument it is possible to measure both the actual IEQ as well as the PIEQ and PQL. This method can also be used to assess a reference and intervention condition.

**Practical or social implications** – The applied measuring instrument provides school management with information about the effectiveness of improved IEQ and students' satisfaction, which can be the basis for further improvement.

**Type of paper** – Research paper.

## KEYWORDS

Acoustic comfort, indoor air quality, indoor environment, thermal comfort, quality of learning, cognitive performance, visual comfort.

## INTRODUCTION

This study explores the influence of classrooms' indoor environmental quality (IEQ) on the perceived quality of learning of users in higher education. In total, four factors, e.g. academic environment, learning community, safety, and institutional environment influence the educational outcomes of students and is often referred to as the school climate (Wang & Degol, 2016). The quality of learning, which is part of the schools' institutional environment, can influence students' educational outcomes positively. General environmental psychology literature teaches us that teachers and students respond to the experienced IEQ in a cognitive, emotional, and physiological way, which might differ from person to person (Bitner, 1992). This behaviour determines – partly - the extent of interactions between teacher and student which influences educational outcomes, i.e. the quality of learning. In this study, the possible influence of the actual IEQ and the perceived indoor environmental quality (PIEQ) on the perceived quality of learning (PQL) was examined.

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This study focusses on the IEQ, which is a system of the indoor air quality (IAQ) and thermal, lighting, and acoustic conditions (Frontczak & Wargocki, 2011). Mendell and Heath (2005) relate a poor IEQ to discomfort and distraction, which can impair the performance of students. One of the main causes of impaired performance among children are the poor acoustical conditions and there is an urgent need for acoustical measures in schools (Bluyssen, Zhang, Kurvers, Overtoom, & Ortiz-Sanchez, 2018). A comfortable and healthy IEQ in classrooms can also potentially influence teaching and learning positively (Dawson & Parker, 1998), which in turn increases the likelihood of a better academic achievement of students. Therefore, it is assumed that when students feel comfortable, they perform cognitively better (Xiong et al., 2018). Human cognitive reactions can be measured with the use of questionnaires and these reactions can illuminate the perceived quality of learning of students in higher education (Ashrafi & Naeini, 2016; Mongkolsawat, Marmot, & Ucci, 2014).

## STUDY DESIGN, PARTICIPANTS, PROCEDURES AND ANALYSES

In this case study, we analysed the influence of the actual IEQ in classrooms for higher education. These classrooms are located in four school buildings in the Northern part of the Netherlands. With the use of a self-composed questionnaire, students' perceptions were measured. The in-class physical measurements consisted of air temperature, relative humidity, carbon dioxide concentration, ambient sound pressure (at moment when the teachers speak and when they were quit), and illuminance level. Appendix 1 presents the measured physical indoor environmental parameters, the applied measuring equipment and the accuracy of this equipment. The personal characteristics and the perceived IAQ, thermal, acoustic and visual comfort, and the PQL was collected with a self-composed questionnaire. For this questionnaire we used relevant publications (Mongkolsawat et al., 2014; Gentile, Goven, Laike, & Sjoberg, 2018; Corgnati, Filippi, & Viazzo, 2007; Choi, Shin, Kim, Chung, & Suk, 2019). On forehand, we analysed the face and content validity of all selected statements for the PIEQ. Therefore, experts of The Hague University of Applied Sciences (UAS), DGMR Advisors for Construction, Industry, Traffic and Environment and Nijeboer-Hage Technical Advisors assessed all statements. Appendix 2 shows the statements which were analysed by the experts, the advice given, and which statements were used to determine the PIEQ. In addition, we translated all statements into Dutch and this translation has been modified by a bilingual expert. In addition, we set up an online survey tool (Ealyzer) which allowed respondents to fill in the bilingual questionnaire, with the use of a device. All the statements were evaluated on a 5-point-Likert scale ranging from strongly disagree, disagree, neutral, agree and strongly agree. Before the start of the observed lecture, first year students of the School of Facility Management of the Hanze University of Applied Sciences (UAS) were carefully instructed how to perform the physical measurements. A senior researcher of the Hanze UAS supervised these students during the in-class measurements.

In February and March 2020, 34 classrooms were examined by 159 first year students. The classrooms differed in size and capacity and varied from 35 to 118 persons. The Facility Management Department of the Hanze UAS informed all involved teachers on forehand about the research, the participation of the first-year students during the lecture, and the importance to collaborate in this study. No teacher has objected to the research, in a few cases the observation schedule was slightly adjusted to fit in to the time schedule of the teacher.

Multiple physical measurements were performed in a classroom at different positions, e.g. at the front, in the middle and at the back. These measurements were performed on three moments during the lecture, at the beginning of the lecture, after 20 minutes, and after 40 minutes after the start of the lecture. For this study, we used the physical measurements which were collected after about 40 minutes. After approximately 45 minutes from the start of the lecture, the first-year students asked all students present if they want to participate in the study. We have chosen for a period of 45 minutes because after 45 minutes normally there is a break, or the lecture is finished, and this period is long enough for thermal adaptation (Mishra, Derks, Kooi, Loomans, M G L C, & Kort, 2017).

After data collection, we exported the data from the survey tool into SPSS. Furthermore, we recoded all negative formulated statements and performed a Cronbach's alpha analyses to assess the internal validity of the statements addressing the perceived perceived IAQ (PIAQ), thermal comfort (PTC), acoustic

comfort (PAC), visual comfort (PVC), and PQL. In addition, average scores of the physical measurements, observed by a minimum of two and a maximum of four first year students, of a classroom were calculated and combined with the data of perceived comfort and PQL. Finally, we analysed correlations between the perception scales and the physical measurements and between the perceptions scales using the Pearson correlation coefficient. To determine the contribution of all indoor environmental factors to the PQL, we performed a multiple linear regression analysis. All statistical analyses were performed with IBM SPSS Statistics version 23.

**RESULTS**

Responses of 276 students were collected, who collaborated voluntarily in this study. The response rate was 37%. The mean age of the respondents was 22.2 years (SD 6.8 years) of which 50.4% was male. The Cronbach’s Alpha analyses of all perception scales showed that all statements for perceived comfort and quality of learning, contributed to the reliability of the scales, except for one statement which addressed thermal comfort and was removed from the results. Appendix 2 shows the statements and the Cronbach’s Alpha of the composed scales. The alpha value for the perception scales ranged from 0.73 to 0.88, showing that these scales have considerable reliability; therefore, we used the average perception scores of the five categories for further analyses. The highest perception score was for the PVC with an average score of 3.7 (scale from 1 to 5). The perception score of the PIAQ was rated the lowest with a score of 2.9. All observed indoor environmental parameters were within acceptable limits (NEN-EN 16798, 2019) except for the concentration carbon dioxide in ambient air and the average background noise level. The observed average air temperature at desk height of 22.2 °C and at floor height of 22.1 °C indicate that no vertical air temperature difference was observed. Furthermore, we analysed possible correlations between all measured IEQ parameters and perception scores. Table 1 presents all average perception scores, physical measurements and relevant Pearson’s correlation coefficients.

**Table 1** Actual IEQ scores, PIEQ scores and correlations.

		Pearson correlation						
		Mean	SD	PIAQ	PTC	PAC	PVC	PQL
Perceived indoor air quality	PIAQ	2.9 <sup>1</sup>	.9	n/a	-.166**	.206**	-	.181**
Perceived thermal comfort	PTC	3.3 <sup>2</sup>	.9	-.166**	n/a	-	-	.102
Perceived acoustic comfort	PAC	3.6 <sup>1</sup>	.9	.206**	-	n/a	-	.306**
Perceived visual comfort	PVC	3.7 <sup>1</sup>	.7	-	-	-	n/a	.229**
Perceived quality of learning	PQL	3.5 <sup>1</sup>	.8	.181**	.102	.306**	.229**	n/a
Outdoor air temperature	T <sub>out</sub>	5.2	2.4	-	.165**	-	-	-
Outdoor relative humidity	RH <sub>o</sub>	80.7	12.0	-	-	-	-	-
Indoor air temperature at desk-top height	T <sub>a</sub>	22.2	2.7	.186**	.149*	-	-	.062
Indoor air temperature at floor height	T <sub>afl</sub>	22.1	2.8	.165**	.166**	-	-	.091
Indoor relative humidity	RH <sub>i</sub>	39.8	5.8	-.152*	-.028	-	-	.008
Carbon dioxide concentration	CO <sub>2</sub>	1219.7	454.6	-.027	.105	-	-	.144*
Sound pressure level when teacher speaks	SPL	58.1	11.0	-	-	-.066	-	-.043
Background noise when teacher is not speaking	BGN	41.4	13.6	-	-	.009	-	-.021
Ambient illuminance	E <sub>amb</sub>	673.2	379.4	-	-	-	.042	-.038

\*p≤ 0.05\*\*p≤ 0.01\*\*\*p≤ 0.001; -no relation was expected; <sup>1</sup> Score is between 1 (very poor) to 5 (very good); <sup>2</sup> Score is between 1 (very cold) to 5 (very warm)

In addition, we performed a multiple linear regression analyses to determine the influence of all perception scales, as independent variables, on the perceived quality of learning, as dependent variable. When the PQL was predicted it was found that PAC (Beta = 0.237,  $p < .0001$ ) was the only significant predictor. The overall model fit was  $R^2 = 0.12$ .

## DISCUSSION AND CONCLUSION

The observed CO<sub>2</sub> concentrations, with an average well above the threshold of 1200<sup>1</sup> ppm for classrooms (NEN-EN 16798, 2019) were high, indicating that the IAQ in the observed classrooms was poor. Although previous findings (Brink, Mobach, Loomans, & Kort, 2019) showed significant relations between CO<sub>2</sub> concentration and PIAQ, the current results do not confirm this relation, possible because not enough cases with good IAQ was observed. The average observed indoor air temperature of 22.2°C is acceptable for most of the students, with an average perception score of 3.3, which is close to the neutral score of 3.0. This might explain that no relation was observed between PTC and PQL, although thermal comfort can potentially affect PQL negatively (Hoque & Weil, 2016). All other indoor environmental perception scores correlated with the PQL score, meaning that when the indoor environment factor was rated higher, also the PQL was higher. However, regression analyses showed that only the contribution of the perceived acoustic conditions was significant. The observed average background noise level of 41.4 dB(A) is high and might affect the speech intelligibility, which can influence the ability to hear the teachers voice negatively (Markides, 1989). Increased background noise, caused by i.e. ventilation systems in classrooms or students talking to each other, can affect students' mental and physical health negatively (Bluyssen et al., 2018; Persinger, Tiller, & Koren, 1999). Based on these findings we conclude that reducing background noise levels and reduced noise from other students can improve the acoustic comfort of students in classrooms significantly and will improve the perceived learning quality during lecture. Therefore, we advise school- and facility management to create an acoustic environment with background noise levels below 34 dB(A) (Cat. II EN 16798, 2019), in which students can concentrate well and are not distracted. Teachers can also contribute to improved acoustic conditions when they address students who talk to each other during lecture about their undesirable behaviour.

<sup>1</sup> The average observed outdoor concentration was 400 ppm.

## REFERENCES

- Ashrafi, S. E., & Naeini, H. S. (2016). Determination of effective factors on reduction of sick building syndrome in designing educational environments. *International Journal of Advanced Biotechnology and Research*, 7, 144-152.
- Bitner, M. J. (1992). Servicescapes: The impact of physical surroundings on customers and employees. *Journal of Marketing*, 56(2), 57-71.
- Bluyssen, P. M., Zhang, D., Kurvers, S., Overtoom, M., & Ortiz-Sanchez, M. (2018). Self-reported health and comfort of school children in 54 classrooms of 21 dutch school buildings. *Building and Environment*, 138, 106-123. doi:10.1016/j.buildenv.2018.04.032
- Brink, H. W., Mobach, M. P., Loomans, M. G., & Kort, H. S. (2019). The effect of indoor air quality in Dutch higher education classrooms on students' health and performance. Paper presented at the *Joint Meeting of the International Societies of Exposure Science (ISES) and Indoor Air Quality and Climate (ISIAQ) 2019. Abstract Book: The Built, Natural, and Social Environments: Impacts on Exposures, Health and Well-Being*, 361-362.
- Castro-Martínez, J. A., Roa, J. C., Benítez, A. P., & González, S. (2016). Effects of classroom-acoustic change on the attention level of university students. *Interdisciplinaria*, 33(2), 201-214. doi:10.16888/interd.2016.33.2.1
- Choi, K., Shin, C., Kim, T., Chung, H. J., & Suk, H. J. (2019). Awakening effects of blue-enriched morning light exposure on university students' physiological and subjective responses. *Scientific Reports*, 9(1), 1-8. doi:10.1038/s41598-018-36791-5
- Corgnati, S. P., Filippi, M., & Viazzo, S. (2007). Perception of the thermal environment in high school and university classrooms: Subjective preferences and thermal comfort. *Building and Environment*, 42(2), 951-959. doi:10.1016/j.buildenv.2005.10.027
- Frontczak, M., & Wargocki, P. (2011). Literature survey on how different factors influence human comfort in indoor environments. *Building and Environment*, 46(4), 922-937. doi:10.1016/j.buildenv.2010.10.021

- Gentile, N., Goven, T., Laike, T., & Sjoberg, K. (2018). A field study of fluorescent and LED classroom lighting. *Lighting Research & Technology*, 50(4), 631-650. doi:10.1177/1477153516675911
- Hoque, S., & Weil, B. (2016). The relationship between comfort perceptions and academic performance in university classroom buildings. *Journal of Green Building*, 11(1), 108-117. doi:10.3992/jgb.11.1.108.1
- Markides, A. (1989). Background noise and lip-reading ability. *British Journal of Audiology*, 23(3), 251-253. doi:10.3109/03005368909076507
- McDonald, D. D., Wiczorek, M., & Walker, C. (2004). Factors affecting learning during health education sessions. *Clinical Nursing Research*, 13(2), 156-167. doi:10.1177/1054773803261113
- Mendell, M. J., & Heath, G. A. (2005). Do indoor pollutants and thermal conditions in schools influence student performance? A critical review of the literature. *Indoor Air*, 15(1), 27-52. doi:10.1111/j.1600-0668.2004.00320.x
- Mishra, A. K., Derks, M. T. H., Kooi, L., Loomans, M G L C, & Kort, H. S. M. (2017). Analysing thermal comfort perception of students through the class hour, during heating season, in a university classroom. *Building and Environment*, 125(11), 464-474. doi:10.1016/j.buildenv.2017.09.016
- Mongkolsawat, D., Marmot, A., & Ucci, M. (2014). A comparison of perceived learning performance of Thai university students in fan-assisted naturally ventilated and air-conditioned classrooms. *Intelligent Buildings International*, 6(2), 93-111. doi:10.1080/17508975.2014.893863
- NEN-EN 16798. (2019). *Energy performance of buildings - ventilation for buildings - part 1 - module M1-6*. ( No. ICS 91.120.10; 91.140.01). Brussels: European Committee For Standardization.
- Persinger, M. A., Tiller, S. G., & Koren, S. A. (1999). Background sound pressure fluctuations (5 dB) from overhead ventilation systems increase subjective fatigue of university students during three-hour lectures. *Perceptual and Motor Skills*, 88(2), 451-456. doi:10.2466/PMS.88.2
- Wang, M., & Degol, J. L. (2016). School climate: A review of the construct, measurement, and impact on student outcomes. *Educational Psychology Review*, 28(2), 315-352. doi:10.1007/s10648-015-9319-1
- Xiong, L., Huang, X., Li, J., Mao, P., Wang, X., Wang, R., & Tang, M. (2018). Impact of indoor physical environment on learning efficiency in different types of tasks: A 3 x 4 x 3 full factorial design analysis. *International Journal of Environmental Research and Public Health*, 15(6), 1256. doi:10.3390/ijerph15061256

**APPENDIX 1: INDOOR ENVIRONMENTAL PARAMETERS, SYMBOLS AND DESCRIPTION OF MEASURING**

Variable	Symbol	Description Of Measuring
Outdoor air temperature	T <sub>out</sub>	The outside temperature and the outside humidity was derived from a reliable open source, <a href="http://www.weerplaza.nl">www.weerplaza.nl</a> , at the moment the occupant was questioned
Indoor air temperature at desktop height	T <sub>a</sub>	Air temperature in degrees Celcius (°C) and is measured with an TESTO 610 temperature and humidity sensor at desktop height (average 0.7m), accuracy ±0.5 °C @ -10 to +50 °C
Indoor air temperature at floor	T <sub>a fl</sub>	Air temperature in degrees Celcius (°C) and is measured with an TESTO 610 temperature and humidity sensor at desktop height (average 0.7m), accuracy ±0.5 °C @ -10 to +50 °C
Indoor relative humidity	RH <sub>i</sub>	Indoor relative humidity in percentage (%) and is measured with a TESTO 610 temperature and humidity sensor at desktop height (average 0.7m), accuracy ±2.5 % RH <sub>i</sub> @ 5 to 95 %RH <sub>i</sub>
Background noise when teacher is not speaking	BGN	Average sound pressure level in dB(A) over a period of 45 seconds and is measured with a Velleman DEM201, accuracy +/- 1.4 dB 94 dB @ 1 kHz
Sound pressure level when teacher speaks	SPL	Average sound pressure level in dB(A) over a period of 45 seconds and is measured with a Velleman DEM201, accuracy +/- 1.4 dB 94 dB @ 1 kHz
Carbon dioxide concentration	CO2	Parts per million carbon dioxide concentration (ppm CO2) is measured with a Atal ENV-MB350NV carbon dioxide sensor on the desktop, accuracy ±30 ppm + 5% of the actual reading
Ambient illuminance	E <sub>amb</sub>	Illuminance level in Lux and is measured with a VOLT CRAFT MS-1300, accuracy ± 5% + 10 digits @ < 10.000 lux

**APPENDIX 2: PERCEIVED INDOOR ENVIRONMENTAL STATEMENTS AND CRONBACH'S ALPHAS**

See footnote to Table for explanation of all variables used

English statement	Dutch statement	Advice	RS
Perceived Thermal Comfort (PTC) $\alpha = 0.73$			
It is too cold in here	Het is hier nu te koud	OK	R
It is too hot in here	Het is hier nu te warm	OK	
I have cold feet	Ik heb koude voeten	OK	R
I have warm feet	Ik heb warme voeten	OK	
I have cold hands	Ik heb koude handen	OK	R
I have warm hands	Ik heb warme handen	OK	
There is a draught in here	Het tocht hier	OK	R
I am troubled by a cold window or wall	Ik heb last van een koud raam of koude muur	OK	R
I am troubled by a warm radiator	Ik heb last van een warme radiator	DE <sup>1</sup>	n/a
I am stuffy	Ik heb het benauwd	OK	
Perceived Indoor Air Quality (PIAQ) $\alpha = 0.81$			
There is some stale air in here	Er hangt hier een muffe lucht	OK	R
There is a lot of fresh air in here	Er is hier veel frisse lucht	OK	
The air is dusty in here	De lucht is hier stoffig	OK	R
The classroom is properly ventilated	Het klaslokaal is goed geventileerd	OK	
There is a bad smell in here	Het stinkt hier	OK	R



Perceived Acoustic Comfort (PAC) $\alpha = 0.88$			
Students speaking outside the classroom interfere with my ability to hear in the classroom	Studenten die buiten het klaslokaal praten, verstoren mijn vermogen om te horen in het klaslokaal	OK	R
Students moving and mingling in the classroom interfere with my ability to hear in the classroom	Lopende of bewegende studenten in het klaslokaal verstoren mijn vermogen om te horen in het klaslokaal	OK	R
Noise from the instrumentation used in the classroom interfere with my ability to hear in the classroom	Lawaai van de apparatuur in de klas verstoort mijn vermogen om te horen in het klaslokaal	OK	R
Noise from people or instrumentation outside the classroom but inside the building interfere with my ability to hear in the classroom	Lawaai van mensen of apparatuur buiten het klaslokaal, maar in het gebouw verstoort mijn vermogen om te horen in het klaslokaal	OK	R
I experience prolonged noise disturbance	Ik ervaar langdurig geluidsoverlast	OK	R
I experience short noise disturbance	Ik ervaar kortdurende geluidsoverlast	OK	R
Noises that occur only once interfere with my ability to hear in the classroom	Geluiden die slechts eenmaal optreden verstoren mijn vermogen om te horen in het klaslokaal	OK	R
Noises that occur occasionally interferes with my ability to hear in the classroom	Geluiden die af en toe optreden verstoren mijn vermogen om te horen in het klaslokaal	OK	R
The noises I hear in the classroom bother me	De geluiden die ik hoor in het klaslokaal storen me	OK	R
The noise disturbs my concentration	Het geluid verstoort mijn concentratie	OK	R
Perceived Visual Comfort (PVC) $\alpha = 0.75$			
The visual comfort in the classroom is very bad	Het visueel comfort in het klaslokaal is zeer slecht	OK	R
The illumination provided by artificial sources in the classroom compared to the shape of the classroom itself (geometry of the classroom) is inadequate	De verlichtingssterkte van het kunstlicht in de klas in vergelijking met de vorm van de klas zelf (geometrie van het klaslokaal) is onvoldoende	DE <sup>2</sup>	n/a
The distribution of the light in the classroom is sufficient	De verdeling van het licht in het klaslokaal is voldoende	NA	
In the classroom the light rarely flickers	In het klaslokaal is zelden sprake van schitteringen	OK	R
In the classroom, I frequently experience unpleasant color sensations	In het klaslokaal ervaar ik regelmatig een onaangename weergave van kleuren	OK	R
The illumination provided by projectors appears to be inadequate	De verlichtingssterkte van projectoren is ontoereikend	OK	R
In the classroom, I frequently experience annoying reflections produced from the outside	In het klaslokaal ervaar ik regelmatig hinderlijke reflecties van buitenaf	OK	R
In the classroom, windows create dark areas	Ramen zorgen voor donkere gebieden (schaduwen) in het klaslokaal	OK	R
I can see well in this light	Ik kan goed zien in dit licht	OK	
It is dark in the classroom	Het is donker in dit klaslokaal	OK	R

The light seeping through windows appears to be inadequate	Er komt onvoldoende daglicht binnen door de ramen	DE <sup>3</sup>	n/a
Perceived Quality of Learning (PQL) $\alpha = 0.85$			
I was able to concentrate well during the lecture	Ik kon mij goed concentreren tijdens de les	OK	
I was very alert during the lecture	Ik was zeer alert tijdens de les	OK	
I was very productive during the lecture	Ik was zeer productief tijdens de les	OK	
I can remember the content of the lecture well	Ik kan de lesstof goed onthouden	OK	
I was able to solve complicated problems during lecture well	Ik kon ingewikkelde vraagstukken makkelijk oplossen tijdens de les	OK	
I was able to understand the lecture well	Ik kon de les goed begrijpen	OK	
I was able to read well during the lecture	Ik kon goed lezen tijdens de les	OK	
I was able to type well during the lecture	Ik kon goed typen tijdens de les	OK	

RS= Reverse score for calculating alpha and average perception score

OK=Statement is relevant

DE=Statement is deleted

NA=Statement needed adjustment

1) Expert stated that many classrooms in The Netherlands do not have radiators

2) Expert advised to rephrase this item because this statement is difficult to understand

3) Expert indicated that this question is not valid because there is always a combination of daylight and artificial light in the classroom, so the amount of daylight cannot be assessed by the respondent

# How to Measure Campus Interactions

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## ABSTRACT

**Background and aim** – To better facilitate on campus-interactions between business and university employees, campus directors first need to know where these interactions, which can lead to knowledge sharing and valorisation, take place. This paper investigates if location-based measurement systems are a viable option to measure where one-to-one interactions between business and university employees take place on a campus.

**Methods / Methodology** – Using desk research (literature search) the five measurement methods (GPS, Wi-Fi tracking, RFID badges, surveys, and observations) are compared.

**Results** – Measurement methods were compared in using six criteria: accuracy, data loss, false positives, implementation costs, personalia collection, and privacy. Location-based measurement methods cannot (yet) be effectively employed to measure campus interactions, due to insufficient accuracy and the need for very high participation rates. Location-based measurement methods in smaller, contained spaces can be very effective.

**Originality** – This study includes the effects of scale on the viability of location-based measurement methods for interaction. It gives an overview of the current state of measurement accuracy and applicability.

**Practical or social implications** – Our results support campus directors in applying methods allowing them to learn where campus interactions take place.

**Type of paper** – Research paper.

## KEYWORDS

Campus, interaction, global positioning system, Wi-Fi tracking, badges, survey, observation.

## INTRODUCTION

As part of their valorisation efforts, many universities are actively attracting companies to their campuses to create a meeting place where the different campus users, such as faculty, business employees, and students, can interact (Buck Consultants International, 2014; TU Delft, 2014; Vrije Universiteit Amsterdam, 2014). As described by Jansz, van Dijk, & Mobach (2019), a chain of events is assumed, where (un)planned meetings lead to interaction, cooperation, knowledge sharing, and eventually to innovation and valorisation.

As facility directors' main concern is to supply the appropriate spaces and services to support the primary process (NEN, 2018), in this case valorisation, it is of interest to them to be able to evaluate current (un)planned meeting locations. This will allow them to find what factors make these spaces and services successful and could therefore be applied in future campus designs. However, to be able to elevate these meeting places, these factors first have to be identified.

As the goal is to facilitate interaction between the different campus users of company and university employees, a measuring system should include both these user groups and preferably be able to differentiate the two. Furthermore, to ensure the meeting contributes to the goal of valorisation, it

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should take place between two (or more) campus users. Moreover, the users would not otherwise have found each other (i.e., unplanned meetings) and have sufficiently new knowledge to share to make the meeting productive (i.e., complementarity). As an unplanned interaction can only occur when both participants are in close proximity, to reveal such meeting places a location-based measurement system seems a viable option. This paper aims to investigate whether location-based measurement systems are indeed a viable option to measure where interactions take place on a campus. Digital meetings are excluded, as these can be performed without being present on a campus. We will compare these methods through literature research, with a focus on practical implementation by FDs on campuses and who want to learn which locations currently facilitate interaction between different campus users (faculty and business).

## METHODS

Currently, more and more options for location-based measurements are being developed. This study will compare the most used or most easy to implement options on Dutch campuses. Available methods were retrieved, selected, and compared by performing a desk research based on relevant literature. These are: GPS, Wi-Fi tracking, RFID badges, surveys, and observations.

## RESULTS

### GPS

The global positioning system (GPS) is a satellite-based global navigation system that provides a precise location at any point on the Earth's surface (Krenn, Titze, Oja, Jones, & Ogilvie, 2011, p. 2). Nowadays, many smartphones have the ability to use GPS to create location data. To be able to use this data an app would have to be developed that collects the data and sends it on. It can then be combined with an (open source) map to create an overview of where people's wearable devices are on campus.

### Wi-Fi tracking

When a Wi-Fi enabled device sends out a search signal to connect to a Wi-Fi router, this signal can be recorded by a tag, which sends it on to a beacon. This beacon collects the signals from several tags located in the space, calculating the location of the search signal. As described by Ray (2018), Wi-Fi tracking can be a good option if you have a newly-installed and fairly dense Wi-Fi coverage that supports this real time location system (RTLS). Moreover, you need to have the budget to install the necessary tags.

### Badges

Sociometric radio-frequency identification (RFID) badges that can be experimentally applied to collect data within bounded settings, such as within organizations, schools, or at conferences (Elmer, Chaitanya, Purwar, & Stadtfeld, 2019) a number of human sensor technologies have been proposed to incorporate direct observations in behavioral studies of face-to-face interactions. One of the most promising emerging technologies is the application of active Radio Frequency Identification (RFID). These badges can record if participants are facing each other. RFID badges are typically worn on the chest by participants (possibly hidden under a name tag) and measure if another study participant's badge is in close proximity (within 1.6 m) and in an angle that indicates that these two people are actually facing each other (approximately 65 degrees angle). Other options are microphones to detect alternate speaking and Bluetooth beacons to register location in a space (Bernstein & Turban, 2018). As the architectural layout of the space can affect this location calculation the space has to be tested in advance (Elmer et al., 2019) a number of human sensor technologies have been proposed to incorporate direct observations in behavioral studies of face-to-face interactions. One of the most promising emerging technologies is the application of active Radio Frequency Identification (RFID). In addition, the information from the badges has to be collected through either 'reading' them after the participants return the badges or beacons connecting to the badges. Consequently, in space-related studies RFID methods are mostly used in closed settings (e.g., a single room).

### Survey

Asking participants to fill out a questionnaire is a standard research method and will be included as the 'industry standard' comparison method for the location-based methods. The survey will have to include a map-based application that allows participants to indicate where they meet other campus users. This

will rely more on the participants recollection of past interactions instead of real time self-reports and/or direct observations and may therefore include a higher risk of bias.

**Observations**

Finally, direct observations on location can be used to track interactions on campus. Based on an observation protocol, researchers cover a particular space (generally a single room) and visually observe the people in that space. If possible, participants of an interaction may also be asked to fill in an additional survey after the interaction was observed.

Each of these five measurement methods has different measurement units and defines an interaction differently. GPS and Wi-Fi tracking measure physical location only. An interaction could then be defined as a certain proximity for a certain duration of time. For instance, interaction is a situation where distance and duration of participants’ meetings are respectively maximal 2 meters and minimal 2 minutes. For badges Bernstein & Turban (2018) defined this as badges facing each other, recording alternate speaking, and within a distance of 10 meters.

**SELECTION CRITERIA**

As discussed above, the following five methods have been compared: GPS, Wi-Fi tracking, badges, survey, and observations. Based on a literature six selection criteria were deduced and applied: accuracy, data loss, false positives, implementation costs, personalia collection, and privacy.

**Table 1** Comparison of measurement methods.

Measurement unit	GPS	Wi-Fi tracking	RFID Badges	Survey	Observations
Selection criterion	Physical distance & duration (2 meters / 2 min)	Physical distance & duration (2 meters / 2 min)	Badges facing each other, alternate speaking, within 10 meters	Self-indicated meeting location	Researcher location registration
Accuracy	Horizontal: 7-13 meters. Vertical: problematic	3-5 meters when connected to 3 beacons. insufficient outdoor coverage	Depends on architectural layout, can cover one room.	NA	NA
Data loss	The longer the measurement the higher the data loss	When moving from one beacon to the next continuous data is lost (cannot track a person)	Badge battery life	Partial responses	Cannot observe several meetings at once
False positives	Co-working may register, vertical differentiation is lost	Co-working may register, Double counting phones and laptops same user	Hawthorne effect	One meeting may be indicated by all participants (double counting)	Hawthorne effect
Implementation costs	High. app development, promotion	High. Beacons range from \$40-\$90 each, many are needed to cover entire campus	Medium, depending on number of badges and beacons	Low, depending on cost for map implementation survey tools are low cost	Medium, high time commitment, low development costs.
Personalia collection (incl. base location)	When installing the app	Not possible	When registering the badge	Included in survey	Deduction or survey after observation
Privacy	When downloading app	Not possible, push notification?	When registering badge	When completing survey	When entering room? Signage?

**Measurement accuracy**

The five different methods each have a different level of accuracy. Average horizontal position accuracy for Smartphone GPS is accurate between 7-13 meters (Merry & Bettinger, 2019), However, vertical positioning is still a challenge and the urban structures on a campus may greatly influence accuracy (Krenn et al., 2011). Wi-Fi tracking is generally accurate up to 3-5 meters but only when connected at least three access points (Ray, 2018). As badges are applied in a specific area (a certain room specifically

equipped for the study) accuracy is dependent on the measurement of badges facing each other and alternate speaking, as well as distance. A study by Bernstein and Turban (2018) used a sociometric badge with an infrared (IR) sensor (direction), microphone (speaking), accelerometer (body movement), and a Bluetooth sensor (spatial location). An interaction was recorded when two or more badges were facing each other, detected alternating speaking, and were within 10 m of each other. A sensitivity analysis showed the results to be robust at shorter distances as well (Bernstein & Turban, 2018). The accuracy of these features can be affected by the architectural layout and should therefore be tested in each specific setting (Elmer et al., 2019) a number of human sensor technologies have been proposed to incorporate direct observations in behavioral studies of face-to-face interactions. One of the most promising emerging technologies is the application of active Radio Frequency Identification (RFID). For surveys the accuracy of the interaction location is dependent on the participant, who has to accurately remember, locate, and indicate the location. For observations the same applies, but for the researcher, who has to collect this data while performing the observations. Due to these accuracy differences GPS can be used for measurements on the campus scale (outdoors), Wi-fi tracking on the buildings scale (indoors), and badges and observations on the scale of a single room. Surveys can be applied on any scale, depending on the specific survey questions and chosen distribution of the survey.

### Data loss

Especially when a study runs for a longer period of time, data loss becomes an issue. Recording devices may run out of battery life, loose connection, etc. For GPS, Krenn et al. (2011) stated that data loss increases substantially after four days. For Wi-Fi tracking, being able to maintain a connection with at least three access points throughout the campus is a tall order, as tags will have to be installed everywhere. It is therefore to be expected that data loss or reduced accuracy, will occur when participant move between buildings or through low coverage areas. For badges the battery life may pose an issue, although in a closed application (e.g., a fixed setting of a maximum one-day event) this should not be a problem. As participants will receive and hand in their badges when entering and leaving the space, loss of badges should also be manageable. For surveys, data loss may occur in the form of partial responses, while observations are limited by the number of observers, who can only observe one meeting at the time.

### False positives

When using only location measurements to capture interactions there is a risk of including people who are co-working with desks that are close together, yet who are not interacting with each other. This would lead to false positives, creating a higher number of measured interactions than are actually occurring. This compromises content validity. For GPS, vertical measurement is still challenging. This adds a risk that people on different floors are registered as interacting when they are on the same horizontal location. Wi-Fi tracking may double-count participants when both phone and laptop are Wi-Fi enabled. For surveys, multiple participants of the same interaction may fill in the survey, making it hard to identify how many meetings were actually captured. There is also a risk of selection bias, where the selection of participants asked to fill out the survey, or the self-selection of those who decide to do so, creates a bias in the results (NCI, 2020). Similarly, there may be an observation bias when researchers are not properly trained. Finally, the knowledge of participants that they are being observed may change their behaviour (Hawthorne effect, Franke & Kaul, 1978), leading to a higher amount of interactions than would normally have taken place. As participants know that this is the expected behaviour and try to conform. Moreover, this may affect all methods, as privacy law requires that participants are informed before the start of data collection.

### Implementation costs

Each method will have its own associated cost, which may be higher or lower based on the needed hardware and software. For GPS, an app will have to be developed that can track GPS location and share this with the researcher in a private and secure way. It will also need to include appropriate questions to collect personalia and permissions. Finally, the app will have to be hosted and promoted. This makes it an expensive method. For Wi-Fi tracking, tags need to be distributed (costing approximately 40-80 euros each) resulting in high cost when covering a single building or even the whole campus. For badges, costs range depending on the functionality of the badges and the area to be covered, making it a medium high cost method for room sized applications. Surveys are a lower cost option, especially when the

needed software is already available, e.g., through university connections. If not, an application able to record locations in the survey may have to be developed. For observations, costs are largely dependent on the time investment needed by the researchers. As each researcher can only observe one interaction at a time, many researchers may be necessary to cover a building or campus.

### Personalia collection

For location data the complementarity of participants requires background information of participants. Information about the home location of participants and the differentiation between university / business employees would be necessary. Moreover, the possibility to ask single-meeting related questions, e.g., through push notifications or additional questions, would improve the data with respect to complementarity and planned vs unplanned meetings.

### Privacy

Privacy laws have become stricter. For example, Dutch privacy law now states that permission has to be acquired from each participant individually before data collection has started (Wet AVG, 2018). As GPS will require the participant to download an app, this app can include a request for permission. The same works for badges (during registration) and a survey (first survey question) However, this is more complicated for Wi-Fi tracking as participants are recorded as anonymized points and there is no direct contact with the participant to ask additional questions. It is possible to ask for permission during observations, but this would influence the flow of the interaction and may affect the results.

## DISCUSSION

When comparing the accuracy of the different location-based methods with different definitions of an interaction, the accuracy of GPS and Wi-Fi tracking is currently insufficient (respectively 7-13 meters and 3-5 meters). Both are not sufficiently accurate to comply to the 2-meters criterion. Especially, taking into account limitations of accuracy for GPS (indoor, vertical) and for Wi-Fi tracking (outdoor).

Furthermore, location-based methods (GPS, Wi-Fi tracking, badges) requires both parties to participate in the data collection to be able to measure interaction. This is limited by compliance. If only one party is sharing his/her location, we cannot measure the proximity to another campus user and the interaction will not be recorded.

It is difficult to make an estimation of how many interactions can be expected during a certain time period, especially when looking at unplanned interactions. However, these unplanned interactions are the reason why universities wish to stimulate companies to (re)locate on campus. The assumption is that unplanned meetings between business and university employees will result in knowledge sharing, valorisation, and innovation (Jansz et al., 2019). For instance, let us assume that each business employee on campus has one useful, knowledge sharing, unplanned meeting per year with a university employee. Moreover, let us assume that a campus has 3,000 business employees and 18,000 university employees. Ideally, we could then measure 66 interactions per week and 3,000 interactions per year. However, it is not likely that all employees will participate in the study. Table 2 shows how many meetings could be measured at certain participation rates of both company and university employees, ranging from full participation to a more realistic assumption of 100 company and 180 university employees (4% and 1%, respectively). However, this would only lead to app. 1 interaction a year (0,02 a week). This would require data collection to last for a very long period of time to be effective, enlarging the risk of data loss and further reducing participation levels.

**Table 2** Measurable interactions at a certain percentage of participants.

# employees		% participating		# interactions	
<i>Company</i>	<i>University</i>	<i>Company</i>	<i>University</i>	<i>A year</i>	<i>A week</i>
3,000	18,000	100%	100%	3,000	66.7
30	18,000	1%	100%	30	0.7
30	180	1%	1%	0.3	0.0

The fact that location-based interaction measurement requires at least two participants to be part of the study makes it unsuitable for large populations, such as a campus. Application in smaller populations or populations where a (very) high participation rate can be guaranteed, such as the use of badges in a single room during an event, would be more appropriate.

## CONCLUSIONS

GPS and Wi-Fi tracing are currently not suitable for the measurement of campus interactions. Its accuracy is not yet high enough to define an interaction (maximal 2 meters) from measurement data. In addition, application of any location-based measurement method that requires both interaction partners to participate in the study cannot be applied on a campus scale. Unless high participation rates can be guaranteed, which is very unlikely in most cases. This is due to the very low number of interactions per set of recording devices, potential data loss, and low participation rate (when only a small percentage of the total population is participating). Not to mention the cost, complexity, and potential data loss on a campus scale! In contrast, location-based measurement methods in smaller, contained spaces can be very effective, for instance, RFID badges in a single room during an event.

When looking at a specific space or room, both badges and observations may be appropriate. In this case badges would have the advantage of being able to record multiple interactions at once, while researchers can only record one observation at a time. However, additional context of the interactions that could be included in observations is lost when using badges. Hence, it is concluded that the most efficient and cost-effective method to use on a campus scale is still a survey. This allows researchers to include questions about specific interactions. At this stage it seems the best option for studying campus interactions: proven technology, relatively low-tech, reliable, valid, and relatively cheap. However, potential drawbacks of this method may be participants' poor memorization of (past) interactions, limited spatial awareness (poor accuracy of reported map locations), possible risk of double counting, and selection bias (it may be hard to find participants from all over the campus).

## REFERENCES

- Bernstein, E. S., & Turban, S. (2018). The impact of the 'open' workspace on human collaboration. *Philosophical Transactions of the Royal Society B*, 373(1753), 1–8. <https://doi.org/10.1098/rstb.2017.0239>
- Elmer, T., Chaitanya, K., Purwar, P., & Stadtfeld, C. (2019). The validity of RFID badges measuring face-to-face interactions. *Behavior Research Methods*, 51, 2120–2138. <https://doi.org/10.3758/s13428-018-1180-y>
- Franke, R. H., & Kaul, J. D. (1978). The Hawthorne Experiments: First Statistical Interpretation. *American Sociological Review*, 43(5), 623–643.
- Jansz, S., Dijk, T. van, & Mobach, M. (2019). Critical success factors for campus interaction spaces and services – a literature review. *Journal of Facilities Management*.
- Krenn, P. J., Titze, S., Oja, P., Jones, A., & Ogilvie, D. (2011). Use of Global Positioning Systems to Study Physical Activity and the Environment: A Systematic Review. *American Journal of Preventive Medicine*, 41(5), 1–20. <https://doi.org/10.1016/j.amepre.2011.06.046>
- Merry, K., & Bettinger, P. (2019). Smartphone GPS accuracy study in an urban environment. *PLoS ONE*, 14(7), 1–19. <https://doi.org/10.1371/journal.pone.0219890>
- NCI. (2020). Definition of selection bias - NCI Dictionary of Cancer Terms - National Cancer Institute. Retrieved March 17, 2020, from <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/selection-bias>
- NEN. (2018). *NEN-EN-ISO 41011*. Delft.
- Ray, B. (2018). WiFi Location Tracking: Is It The Right Technology For Your Application? Retrieved March 16, 2020, from <https://www.airfinder.com/blog/wifi-location-tracking>
- Wet AVG. (2018, May 16). Uitvoeringswet Algemene verordening gegevensbescherming. Retrieved March 16, 2020, from <https://wetten.overheid.nl/BWBR0040940/2020-01-01>



# Living in a Pod: The Impact of Tiny Spaces on a Dutch University Campus

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## ABSTRACT

**Background and aim** – In practice, phone pods and office booths, hereafter referred to as pods, have proven their added value and popularity in open-plan offices. How would that work in another context, such as in higher education? This study explores use and user perceptions of these pods in an atrium on a Dutch university campus.

**Methods / Methodology** – After placing nine pods, the effects were studied through document analysis, guest journey, direct observation (behaviour, indoor climate, bacteria, fungus), interview, and survey.

**Results** – Students use the pods mainly for seven activities: meeting, project work, noise-free work, study, phone call, relaxation, or hang out. Students report a positive general experience of the pod, a very positive experience when entering the pod, and hardly any negative experiences. They feel at ease and the pods ensure better concentration. Finally, pod users reported to be a little less nervous than other atrium users.

**Originality** – The studied pods are mostly applied in open-plan offices. By placing them in an atrium at a Dutch university campus the pods are exposed to different users, generating new user-related findings.

**Practical or social implications** – In order to perform well, students need a variety of places on campus. An atrium is normally crowded, loud, and noisy. Pods provide an extra option, a space within a space, that students use and appreciate. By adding these tiny spaces to their repertoire, universities seem to be better aligned with user needs. Facility managers and researchers could consider experimenting with pods in other lively contexts.

**Type of paper** – Research paper

## KEYWORDS

Acoustic privacy, noise reduction, pod, students, tiny spaces, university campus, workplace.

## INTRODUCTION

Noise and noise control are common challenges in many settings and for many organizations. Indoor noise in residential, school, work and commuting settings influences human health and behaviour, e.g. blood pressure and cortisol levels (Park & Evans, 2016). In open-plan offices noise is a recurrent problem. Workspaces within 10 feet of co-workers receive higher noise ratings, whereas enclosed areas are rated less noisy (Sundstrom, Burt, & Kamp, 1980). In such settings, noise levels are associated with increased distraction, reduced privacy, increased concentration difficulties, increased use of coping strategies, self-rated loss of work performance, and noise distraction of cognitively demanding work and phone conversations (Kaarlela-Tuomaala, Helenius, Keskinen, & Hongisto, 2009).

People can respond very differently to unwanted ambient noise, such as knocking it out with i-pods (Greene & Myerson, 2011) and/or mental seclusion (Zijlstra, Hagedoorn, Lechner, van der Schans, & Mobach, 2020). Architecture and interior design may also be viable options to exclude noise from work. The introduction of tiny spaces, a space within a space, may provide facility managers with new options to respond to complaints of their building users about unwanted noise. In practice, phone pods and office booths, hereafter referred to as pods, have proven their added value and popularity in open-plan

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offices. But how would that work in another context, such as in higher education? This study explores use and user perceptions of these soundproof spaces in an atrium on a Dutch university campus.

## THEORY

Many organizations ensure that sound can actually be heard, such as in concert halls and in classrooms or at busy reception desks or counters in atria with a lot of noise. It is interwoven with the primary process. Basically, sound allows workers to do their job. However, an important property of sound is that it can also spread undesirably. Most relevant is an unwanted sound or noise at the receiver. Acoustic privacy depends on the strength of the sound source, the decrease in sound from source to receiver, and the ambient noise or the noise at the receiver (Cavanaugh, Farrell, Hirtle, & Waters, 1962). The sound decrease is, for instance, related to the sound absorption of the floor, ceiling, and interior (Watson, 1928).

Acoustics and architecture are important factors to control noise. For most building users, depending on the task at hand speech intelligibility and noise reduction are critical factors to perform well. Noise has important effects, for instance, it can negatively influence workers' health (Schneider, Paoli, & Brun, 2005). A more nuanced, but nevertheless influential, impact can be found in other sectors. For instance, in food courts the taking of orders can be compromised by abundant noise (Navarro & Pimentel, 2007), in class rooms noise may interfere with the lessons (Brink, Mobach, Loomans, & Kort, 2020) and coincide with heart rates of teachers (Tielser & Oberdörster, 2006), and in hospitals, noise from snorers, doors, and infusion alarms can disturb patients' sleep and mitigate recovery (Roos-Mink & Mobach, 2016). Moreover, noise levels also decrease face-to-face social interaction, particularly when interrupting others and/or communicating information that a person would rather others not hear (Park & Evans, 2016).

In open spaces, noise can create an imbalance between communication and concentration tasks of users. Well-known problems in offices are noise that distracts others from doing their work or conversations that may not be overheard by others (Wang and Bradley, 2002). On a university campus, similar patterns were expected. Some students may want to focus and concentrate. Conversations of other students may hinder them from doing so. Such an unwanted distraction, in which noise is a source of nuisance, can interfere with their need to do focus work. This imbalance can create tension at those who have to concentrate. It may even prevent them from doing what they need to do.

Bending the acoustics in a desired direction is a complex issue. Numerous variables play a role. As a baseline, we can safely argue that a thick wall from floor to ceiling works best, and by doing so, creating acoustic separation (Mobach, 2009a). However, in practice facility managers frequently apply more nuanced noise-reducing measures if complaints emerge. In healthcare sound absorbing tiles have shown positive effects, for instance, on the working environment (Blomkvist, Eriksen, Theorell, Ulrich, & Rasmanis, 2005) and on the rehabilitation of patients (Hagerman et al., 2005). Moreover, low-noise floors and doors, soundproofing (conversations, footsteps), single rooms (coughing, sighing), and even the right trash can promote recovery the recovery of patients (Roos-Mink & Mobach, 2016). And an approach with soft materials creating absorption in the counter area of a community-based pharmacy combined with hard materials and an increase of ambient noise at the queue improved perceived privacy (Mobach, 2009b). In offices, the combination of a high absorption ceiling and a sufficiently high screen in open-plan offices with cubicles proved essential to achieve adequate speech privacy (Wang & Bradly, 2002).

In this respect, tiny spaces are relatively new. We will explore how students actually use these pods and how they perceive them in a lively context and a lot of ambient noise.

## METHODS

Six concise studies were carried out. A total of nine pods from the Finnish producer Framery were delivered at Hanze University of Applied Sciences (UAS) Groningen in September 2019. Pods included three O-pods, three Q-pods, and three 2Q-pods (Figure 1). All pods were placed in the atrium (Figures 2 and 3). Most pods were placed at the centre of the atrium, where it is very busy most of the time.



Framery O

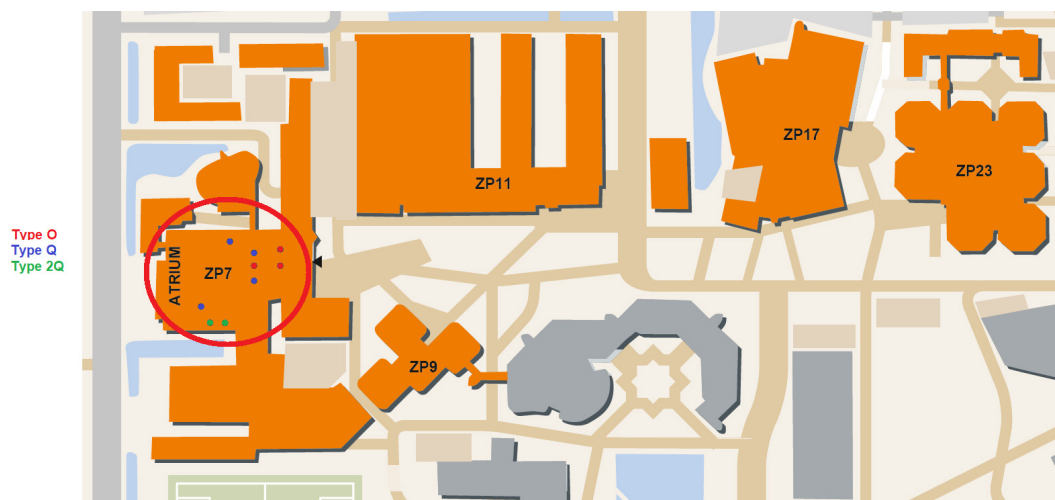
Framery Q

Framery 2Q

**Figure 1** The three types of pods.



**Figure 2** Picture of atrium with several pods visible.



**Figure 3** Campus map including atrium and positions of pods.

The research was carried out by first-year bachelor students of the School of Facility Management (FM) of Hanze UAS. Students participated in the study as part of an introductory bachelor research course. Research was performed in September and October 2019. Students were supervised by honours students and three researchers of the research group FM.

Each study was carried out by a project group of approximately five students. Each of the six groups focused on different themes and aspects regarding the pods. Consequently, the study was organized around six research questions: 1) Who use the pods and what for? (Type of user / Gender / Personality / Type of pod), 2) How are the pods being used and experienced? (Type of pod / Hospitality), 3) How are pods left behind? (Trash / Interior Climate), 4) How much are the pods used? (Duration / Occupation / Frequency, repeated use), 5) How do atrium users versus pod users feel about the pods? 6) To what extent are atrium users versus pod users stressed?

Data were gathered using guest journeys, direct observations, interviews, interior climate measures (temperature, humidity, and CO<sub>2</sub>-level), samples of bacteria and fungus, surveys (N = 59 + 49 + 43 + 62 + 93 + 70 = 376), and document analysis / literature study (on extraversion, workplace trends, interior climate norms, hospitality criteria, and stress definitions).

**RESULTS**

Students use the pods mainly for seven activities: meeting, project work, noise-free work, study, phone call, relaxation, or hang out. The single –person pods O were used less than the multiple person pods Q and 2Q. Students report a positive general experience of the pod, a very positive experience when entering the pod, and hardly any negative experiences. They feel at ease and the pods ensure better concentration. However, pod users do feel that they are being watched. They report a lack a visual privacy. Moreover, atrium users would also like more information about the pods, for instance, how do they work, what are they for, possible rules, and developments.

Survey results showed positive perception scores of building users (Table 1). Moreover, many users were very positive about the pods. The location (atrium centre) and number (nine) of the pods elicit the least amount of enthusiasm.

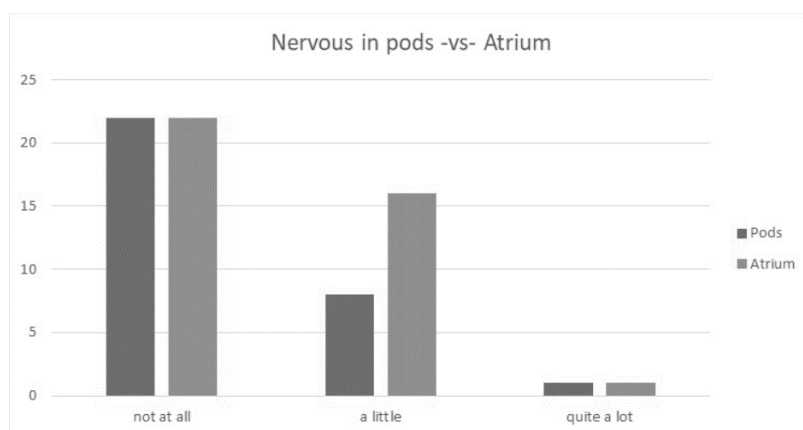
**Table 1** Mean evaluations of the pods; overall (N=90), users (N=21), and non-users (N=69).

Question	Overall	Users	Non-Users	Diff.
I am satisfied with the exterior	4.04	4.10	4.03	0.07
I find the pods functional	3.94	4.43	3.80	0.63*
My first impression of the pods was positive	3.83	4.24	3.71	0.53*
I think the pods fit into the atrium	3.67	4.00	3.57	0.43
I find the pods pleasant	3.66	4.10	3.52	0.58*
I would like to make use of the pod	3.56	4.29	3.33	0.96*
I think the pods add value to the atrium	3.50	3.76	3.42	0.34
I think they are on the right spots	3.18	3.52	3.07	0.45
I feel the number of pods in the atrium is sufficient	3.11	2.62	3.26	0.64*
I am bothered by the pods in the atrium	1.49	1.29	1.55	0.26

\*p < .05.

On all aspects, users are more positive about the pods than non-users. T-tests for independent samples show that the five largest differences are significant at the .05 level. The largest difference was found for wanting to (re)use the pod, followed by whether there are enough pods, and functionality. Regarding the exterior, the difference is negligibly small, which makes sense.

Finally, pod users reported to be a little less nervous than other atrium users (Figure 4).



**Figure 4** Users reporting nervousness in pods and atrium.

## DISCUSSION AND CONCLUSION

The studied pods are mostly applied in open-plan offices. By placing them in an atrium at a Dutch university campus the pods are exposed to different users, generating new user-related findings.

The current paper must be regarded as a summary of what believed to be the best and most interesting results of the students' studies. Findings were exploratory in nature and had limitations. Representativeness of survey samples was not always checked properly. However, because of the different methods used, combined with the consistency of findings across studies, methods, and our personal observations and experiences, the sum of these exploratory studies provide an interesting sketch of the use, user, and their perceptions of the pods in the context a busy atrium in higher education.

However, pod users do feel that they are being watched and report that they are unsatisfied with the number of pods. This suggests that users want more pods and on more private locations. Be aware of the fact that an atrium may not be specifically designed as a workplace. In many cases, it is an open space to meet, have lunch, or a coffee. Consequently, it is a very lively place with a lot of users. This shows that pods contribute to the acoustic privacy, but poor positioning can have adverse effects on the visual privacy of pod users. Be reminded that in our case most pods were at the busy centre of the atrium where it is very busy most of the time.

In order to perform well, students need a variety of places on campus. An atrium is normally crowded, loud, and noisy. Pods provide an extra option, a space within a space, that students use and appreciate. By adding these tiny spaces to their repertoire, universities seem to be better aligned with user needs. Facility managers and researchers could consider experimenting with pods in other lively contexts.

## ACKNOWLEDGEMENTS

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## REFERENCES

- Blomkvist, V., Eriksen, C.A., Theorell, T., Ulrich, R., & Rasmanis, G. (2005). Acoustics and Psychosocial Environment in Intensive Coronary Care. *Occupational and Environmental Medicine*. 62(3): e1.
- Brink, H.W., Mobach, M.P., Loomans, M.G., & Kort, H.S. (2019). Classrooms' indoor environmental conditions affecting the academic performance of students and teachers: a systematic literature review. Under review.
- Cavanaugh, W.J., Farrell, W.R., Hirtle, P.W., & Waters, B.G. (1962). Speech Privacy in Buildings, *Journal of the Acoustical Society of America*, 34(4): 475-492.
- Greene C., & Myerson J. (2011). Space for thought: designing for knowledge workers. *Facilities*, 29(1/2), 19-30.

- Hagerman, I., Rasmanis, G., Blomkvist, V., Ulrich, R., Eriksen, C.A., & Theorell, T. (2005). Influence of Intensive Coronary Care Acoustics on the Quality of Care and Physiological State of Patients. *International Journal of Cardiology*. 98(2): 267-70.
- Kaarlela-Tuomaala A., Helenius R., Keskinen E., & Hongisto V. (2009). Effects of acoustic environment on work in private office rooms and open-plan offices -longitudinal study during relocation. *Ergonomics*, 52 (11), 1423±1444. <https://doi.org/10.1080/00140130903154579>
- Mobach, M.P. (2009a). *Een organisatie van vlees en steen*. Assen: Koninklijke Van Gorcum.
- Mobach, M.P. (2009b). Counter Design Influences the Privacy of Patients in Health Care. *Social Science & Medicine*. 68(6): 1000-1005.
- Navarro, M.P.N., & Pimentel, R.L. (2007). Speech Interference in Food Courts of Shopping Centres. *Applied Acoustics*. 68(3): 364-375.
- Park, G. & Evans, G.W. (2016), "Environmental stressors, urban design and planning: implications for human behaviour and health", *Journal of Urban Design*, 21(4), 453-470.
- Roos-Mink, A., & Mobach, M.P. (2016). Hospital noise. *Hospital Healthcare Europe*, pp. 125-127. Retrieved from: <https://hospitalhealthcare.com/latest-issue-2016/hospital-noise/>
- Schneider, E., Paoli, P., & Brun, E. 2005. *Noise in Figures*. *Risk Observatory*. Bilbao: European Agency for Safety and Health at Work.
- Sundstrom E., Burt R., & Kamp D. (1980). Privacy at Work: Architectural Correlates of Job Satisfaction and Job Performance. *Academy of Management Journal*, 23(1), 101-117.
- Tiesler, G. & Oberdörster, M. (2006). Noise- A Stress Factor? Acoustic Ergonomics of Schools. *EuroNoise*. Conference paper, Tampere, Finland: May 30- June 1.
- Wang, C., & Bradley, J.S. (2002). Prediction of the Speech Intelligibility Index Behind a Single Screen in an Open-Plan Office. *Applied Acoustics*. 63(8): 867-883.
- Watson, F.R. (1928). Acoustics of Auditoriums. *Science*. 67(1735): 335-338.
- Zijlstra, E., Hagedoorn, M., Lechner, S.C.M., van der Schans, C.P., & Mobach, M.P. (2020). The experience of patients in an outpatient infusion center: A qualitative study. In preparation.
- Zijlstra, E., Hagedoorn, M., Krijnen, W.P., van der Schans, C.P., & Mobach, M.P. (2019). The effect of a non-talking rule on the sound level and perception of patients in an outpatient infusion center. *PLoS ONE*, 1–15

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**THEME 2:**  
**HEALTHCARE FACILITIES - A PATIENT VIEW**

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Contributions by *Innovation Lab Health Space Design*,  
*Research Centre for Built Environment NoorderRuimte*  
*Hanze UAS*

**Facilities for Palliative Care: Patterns and Contrasts**

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## Facilities for Palliative Care: Patterns and Contrasts

Ria M.G. Martens<sup>1</sup>, Stefan C.M. Lechner<sup>2</sup>, Sam A.M. Bruintjes<sup>3</sup>, Petrie .F. Roodbol<sup>4</sup>, and Mark P. Mobach<sup>5</sup>

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### ABSTRACT

**Background and aim** – Palliative care consists of a multitude of factors, such as psychological and spiritual, in addition to or integrated with nursing and facility management. Stewart, Teno, Patrick, & Lynn (1999) have developed a framework that helps understand how structure and process affect the quality of dying. Exploration of the environment of patients in palliative care in hospices, nursing homes, and hospitals by mapping social-spatial experiences to advance the quality of dying will add to the body of knowledge.

**Methods / Methodology** – 57 Employees, volunteers, supervisors, patients, and family were interviewed semi-structured by 7 bachelor thesis students on facilities in Dutch palliative care, after which secondary analysis was performed by one of the authors.

**Results** – Respondents pointed out the importance of spaces and services for spirituality, and indicated that they feel that a sense of control over facilities is important. Connections have been found between spirituality and facilities, and differences between types of roles and types of accommodation. The study illustrates important elements of facilities, such as domestic furniture or decoration, and to the role of spirituality.

**Originality** – Across the field of palliative care in the North of the Netherlands, bachelor thesis students have interviewed staff, volunteers, patients, and family about an interrelated multitude of aspects, including spaces, services, and spirituality.

**Practical or social implications** – Application of findings can potentially contribute to improved alignment of facilities with the needs of patients and their beloved ones in palliative care. Differences in opinions of the different groups require further investigation.

**Type of paper** – Research paper.

### KEYWORDS

Facility management, healthcare, palliative care, space, spirituality, service, quality of dying.

### INTRODUCTION

The interrelatedness of palliative care with facility management seems to be unexplored territory. According to the WHO (2014) palliative care is an approach that improves the quality of life of patients and their families facing the problems associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial, and spiritual. Palliative care integrates the psychological and spiritual aspects of patient care in order to enhance the quality of life of patients. Palliative care is not limited to specialist palliative care services, but includes primary and secondary level care (WHO, 2014). So, the process of dying does not only concern the medical specialists. Facility management is also inextricably interwoven with the delivery of this special care. For instance, the delivery of special services for food, cleaning, and laundry as well as spaces for homeliness, privacy, overnight stays, and spirituality may be crucial supportive factors for patients and their beloved ones (Martens, Witkamp, Mobach, & Roodbol, 2020). In this perspective, facility managers are invited to deliver exactly those spaces and services that fulfill the patient's needs in their final stage of life. But what exactly are these?

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## LITERATURE STUDY

Evidence based design interventions with facility services and spatial structures in palliative care are scarce. This is surprising, because there is an increasing demand from practice. In this context, two developments are relevant. Firstly, a high-quality customer experience (Pine & Gilmore, 1998) is more and more key for customers (Walker, 2020). Secondly, according to the WHO the number of people ageing 65 or above is estimated to grow from 524 million in 2010 to 1.5 billion in 2050 (WHO, 2011). It is only a matter of time that these needs will emerge at ageing populations. More palliative patients and family will expect a high-quality of the experience of dying with dignity. (A complete negation of which is exemplified in the undignified circumstances of many dying patients during the pandemic Corona crisis.) The delivery of the right spaces and services may be crucial. It seems to be a relatively new area in which facility management potentially can add value for the benefit of patients.

Facility management and palliative care do not generate any hit on Google Scholar. Research into palliative care seems to focus on treatments and/or avoidable pain to enable the patients to die with dignity (UN, 2000). Whereas, facility management research focuses on space, infrastructure, people, and organization (European Committee for Standardization, 2006). However, to die with dignity may require better integration.

Stewart et al. (1999) have defined a conceptual framework specifying quality of life and quality of health care indicators, and integrating both. The framework shows that the quality of dying is a broad and complex concept. It is one of the few frameworks that includes patient factors and combines these with the structures, processes, and outcomes of care. For instance, it includes the patient and family situation, the physical environment of care, the satisfaction of patients and family, and the quality of dying.

Stewart et al. (1999) reported that patients and relatives focus increasingly on peace of mind, comfort, and spiritual understanding when arriving at the end of life phase. For many dying persons, attending to spirituality and transcendence is essential. In a recent definition Visser, Garsen, & Vingerhoets (2010) argue that spirituality refers to one's striving for and experience of a connection with the essence of life of which the experiences of meaning in life and connectedness are central elements. Patients and relatives emphasize personal dignity and the meaningfulness of life rather than physical symptoms or functioning (Puchalski, 2012; Rabitti et al., 2020; Stewart et al., 1999). Physical and cognitive functioning may be important, but in the end-of-life phase other factors matter too. For instance, psychological, social, and spiritual well-being, social functioning, physical comfort, and meaningfulness of life are factors that influence perceived quality of life and dying. Thus, spirituality and related elements are defining elements of facilities for palliative care. Furthermore, in this context a sense of dignity, self-esteem, and control are important elements of psychological well-being. Also, the degree of which patients and families feel they are presented with and can understand various options, are in control, and can make choices autonomously is critical for customer experiences. For instance, a scheduled visit on the calendar of the patient rather than of the health care provider may provide a sense of control.

The structure of care includes the organization of care, support services available, and the physical environment of care. Supportive environments that provide quiet and privacy may greatly improve quality of life. Moreover, the formal support services available (and being accessible) within the health care setting could help to meet the needs of patients and their families. The site of death or the physical location of the patient during the dying process, and the site characteristics (e.g., aesthetics, noise, and opportunities for social interaction) can strongly affect quality of life of dying persons, according to Stewart et al. (1999).

This current paper is an exploration into the services and spaces that facility managers can provide for patients and their relatives in palliative care, and by doing so, to meet their needs, provide dignity, and alleviate their grief.

## METHODS

In recent years, bachelor thesis students collected interview data on aspects of palliative care. In this current study, this information was compiled and re-examined. All complete transcripts were collected

by one of the authors and were subject to a secondary analysis (Heaton, 2004). The interviews were coded and analysed based on non-medical factors of Stewart's conceptual model of quality of life of dying patients and their family (Stewart et al., 1999). Facility management tends to focus on practical matters; however, a crucial element of palliative care is spiritual well-being. Therefore, it was included in this research.

The sample consists of 57 interviews conducted by 7 different researchers. The interviewees were selected by the interviewers based on availability. The interviewees were associated with various types of organizations, i.e. hospices, nursing homes, hospitals, and a patient meeting centre. The interviewees were active in various roles, i.e. as volunteers, supervisors, employees, experts, patients, or family. An overview of the sample is shown in Table 1 below.

**Table 1** Sample (type of organization and role).

Type of organization	Qty	Role	Qty
Hospice	32	Volunteer	27
Nursing Home	9	Supervisor	19
Hospital	5	Employee	5
Patient Meeting Center	10	Patient & Family	5
Other	1	Expert	1
Total	57	Total	57

Semi-structured interviews were conducted with topic lists and open questions (Berg, 2009). As mentioned, the interviews were conducted as part of a set of different smaller studies into palliative care, using different topic lists. In all cases, the original interview topic was palliative care, with an emphasis on services and spaces. The interviews lasted an average of 45 minutes (min. 20 minutes, max. 82 minutes, sd = 19 minutes) and were verbatim transcribed by the interviewers. A total of 57 interviews was used for this secondary analysis.

After careful reading, the interviews were coded by one of the authors. Coding was carried out on the basis of a code list consisting of the inductive label 'sense of control', and the deductive labels 'facilities', 'interior', and 'spirituality', in line with Miles and Huberman (1994). The labels correspond with Stewart's factors satisfaction with healthcare, support services, site characteristics, and spirituality.

The analysis had to be exploratory, because antecedents and outcomes in this research field need further scrutiny. Firstly, the sense of control over the environment, and spirituality were analysed on the basis of quotations of interviewees. Additionally, the sample consisted of different types of organizations and roles of interviewees. Groups have been compiled based on the availability of the number of interviews per group: 32 interviews with respondents in hospices were compared with 14 interviews in nursing homes and hospitals, and 27 interviews with volunteers were compared with 19 interviews with supervisors. These two specific selections were made based on numbers and indications in the data that differences would be found there. Subsequently, the tactic to find contrasts and patterns, and the tactic to count have been used to generate meaning to the qualitative data, as suggested by Miles and Huberman (1994). Quotations from the different groups were examined for patterns with specific tools that are available in the Computer Aided Qualitative Data Analysis System (CAQDAS)<sup>1</sup>. The most obvious differences between the different groups were explored with two matrix analyses.

## RESULTS

Quotations about facilities and interior were frequently found in the dataset. In addition, inductive quotations were discovered about sense of control. Although none of the interviews had spirituality as a research topic, related quotations were nevertheless identified.

### Sense of control over the facilities

Most of the quotations by respondents are about sense of control (403) and the environment or facilities (360), and a combination of both in 64 of those cases. Examples of control over facilities are the operation of room lighting, awning, privacy, or even cooking by the family. Respondents mentioned:

<sup>1</sup> The CAQDAS used was Atlas.ti, version 8.4.24.0

“... we can fix that ourselves ...” (supervisor in a nursing home), patients have “... their own sheets and pillow cases ...” (volunteer in a hospice), or “The U-Haul drives up. And cabinets, furniture, chairs, everything is unloaded ...” (supervisor in a hospice).

The top 10 comments about building and facility services are as follows:

1. welcoming (56),
2. homeliness (54),
3. view from the window (52),
4. furniture (50),
5. scent (46),
6. decoration (40),
7. colour (40),
8. bathroom (34),
9. lighting (32) and,
10. garden (31).

These quotations cover the interior (81), the environment (325), and the opinion about interior and environment (81), such as:

“that [other home] was much more impersonal” (patient transferred to another nursing home) or “I’ve never heard anyone about the colours” (supervisor in a nursing home).

Other aspects that contribute to feelings or statements about the facilities are, for example, windows that can be opened, music, or the atmosphere of the room in general. All in all, a volunteer mentioned that:

“... the interior of the room is considered important...” (volunteer in a hospice).

**Spirituality**

Spirituality emerged clearly from the data. This means that although spirituality was not part of the research question of the secondary data, 78 comments about spiritual well-being were spontaneously made by more than half of the respondents (30 out of 57). Respondents reported issues like the availability of a spiritual care provider, the needs of patients and family to talk about the questions of life and the acceptance of fate, the presence of a Bible or wake box, rituals, and taboos. Examples of typical quotes can be found in Table 2.

**Table 2** Quotations on spiritual well-being.

Factor	Quote	Respondent
Counselling and care	“At the intake we always ask whether they are religious”	Supervisor nursing home
Wish to talk	“My family and friends have had enough of talking” and “they have questions about their life”	Supervisor hospice
Acceptance of fate	“What should I do at my house?” Interviewer: “That is something that you have ended.” Interviewee: Yes”	Patient hospice
Meaningfulness of life	“We actually still celebrate life here”	Supervisor hospice
Rituals	“... read from the Bible.”	Supervisor nursing home
Taboos	“So beautiful, I didn’t expect that”	Patient hospice

**Spirituality and facilities**

Spirituality was mentioned in combination with facilities and spaces. A supervisor in a hospice mentioned: ‘We have a so-called ‘wake box’, ‘And it contains, for example, a bible.’ A volunteer in a patient meeting centre reported on the shape of the table: ‘The oval tables bring people closer together. There is more distance at the round tables.’, and another volunteer in a hospice said that: ‘Some people want to be

read from the Bible.’ ‘We have a large white candle and it is always lit when a guest has died’, or ‘... talking to a pastor or a vicar and all that is very welcome ... there is just room for here ... in the guest’s room usually.’ (volunteer in hospice).

**Matrix analysis**

Matrix analyses were carried out on differences between groups in the sample. Hospices were compared with combined results at nursing homes and hospitals (Table 3), and supervisors were compared with volunteers (Table 4). For each group the total number of quotations, the number of quotations per respondent, and the relative number of quotations are listed consecutively.

**Table 3** Number of quotations per respondent’s role in hospices vs. nursing homes and hospitals.

(1)	Quotes Hospices (n=31)			Quot. Nurs.Homes & Hospitals (n=14)		
	(2)	(3)	(4)	(5)	(6)	(7)
Factors	Absolute	Respondent	Relative	Absolute	Respondent	Relative
Facilities	166	5.4	3.2	126	9	
Interior	105	3.4		142	10.1	2.6
Sense of Control	181	5.8	2.2	214	15.3	
Spirituality	87	2.6	2.6	43	3.1	

Note 1: Quotations reported by all roles.  
 Note 2: Row 2 and 5: absolute number of quotations derived from CAQDAS. Row 3 and 6: average number of quotations per respondent. Row 4 and 7: number of quotations relative to the group compared.

As can be seen in Table 3, respondents in hospices report 3.2 more on facilities, 2.2 times as much on sense of control and 2.6 times more on spirituality. Respondents in nursing homes and hospitals report 2.6 times more on interior.

The following table (Table 4) shows that supervisors report 2.1 times more on facilities and 4.9 times more on sense of control. Volunteers report 4.2 times more on interior and 2.2 more on spirituality.

**Table 4** Number of quotations of supervisors vs. volunteers

(1)	Supervisors (n=19)			Volunteers (n=27)		
	(2)	(3)	(4)	(5)	(6)	(7)
Factors	Absolute	Respondent	Relative	Absolute	Respondent	Relative
Facilities	163	8.6	2.1	112	4.2	
Interior	11	0.6		65	2.4	4.2
Sense of Control	221	11.6	4.9	64	2.4	
Spirituality	28	14.7		87	3.2	2.2

Note 1: Quotations reported in all types of organizations  
 Note 2: Row 2 and 5: absolute number of quotations derived from CAQDAS. Row 3 and 6: average number of quotations per respondent. Row 4 and 7: number of quotations relative to the group compared.

In summary, respondents in hospices report facilities, sense of control, and spirituality relatively more. In nursing homes and hospitals respondents reported the interior more often. In addition, supervisors are relatively more aware of facilities and sense of control, whereas volunteers are relatively more concerned with interior and spirituality. Lastly, to indicate where sense of control over the environment and spirituality coincide, the comments about a Christian woman, who:

“... had a very large wooden crucifix. Very bluntly said, it was a huge obstacle, but she was so attached to it. So, that’s why it could stay.” (employee in a hospice, respondent 29)

## DISCUSSION

Facilities for palliative care require a sense of homeliness and welcome. This exploratory research indicates that reported facilities should enable autonomy and self-control, like room lighting and awnings. The layout should provide privacy. The facility should ideally offer views from room windows, homely furniture and decoration, a pleasant colour scheme and scent, and a kitchen and bathrooms. Moreover, spiritual well-being plays an important role in palliative care. Interviewees on facility services spontaneously reported experiences related to spirituality and questions of life. Statements about facilities and spaces, co-occur with statements linked to spiritual aspects. For instance, the availability of a Bible or the possibility of a separate space for consultation with a spiritual counsellor. These aspects can be used in palliative facility redesign, and add to the body of knowledge of spirituality in palliative care (Murray, Kendall, Boyd, Worth, & Benton, 2004; Stewart et al., 1999).

Furthermore, we found that the field of palliative care related to facilities is still uncharted territory and has many nuances. Interviews at different locations with different respondents show large differences between groups. First of all, respondents at hospices reported the sense of control over facilities more frequently than respondents at nursing homes and hospitals. In addition, supervisors reported frequently on sense of control, whereas volunteers focused more on interior aspects. These contrasts are an indication that supervisors and people in nursing homes and hospitals have different needs with regards to the sense of control, which require different properties of a facility.

The present dataset is promising. The size and diversity of this research may seem a pitfall, but it provides initial clues and ideas to further explore this terrain and to formulate new research questions. The differences, similarities, and more in-depth insight into the requirements for spiritual well-being may lead to further investigation of this dataset on all factors, e.g. applying Stewart's model. In any case, research into privacy and single or multi-person rooms as corroboration of Martens et al. (2020) may also be a good follow-up of this current palliative design research.

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The authors declare that they have no competing interests.

## REFERENCES

- Berg, B. L. (2009). *Qualitative research methods for the social sciences* (7th ed.). Upper Saddle River, NJ, USA: Pearson Education.
- European Committee for Standardization. (2006). EN 15221-1. *Facility Management. Part 1: Terms and definitions*. Brussels: CEN.
- Heaton, J. (2004). *Reworking qualitative data*. London, UK: SAGE Publications.
- Martens, R.M.G., Witkamp, F.E., Mobach, M.P., & Roodbol, P.F. (2020). *Facilities for End-of-Life Care in the Hospital Environment*. Under review.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis, an expanded sourcebook* (2nd ed.). Thousand Oaks, CA, USA: Sage Publications.
- Murray, S. A., Kendall, M., Boyd, K., Worth, A., & Benton, T. B. (2004). Exploring the spiritual needs of people dying of lung cancer or heart failure: A prospective qualitative interview study of patients and their carers. *Palliative Medicine*, 18(1), 39-45. doi:<https://doi.org/10.1191/0269216304pm837oa>
- Pine II, J. B. & Gilmore, J. H. (1998). Welcome to the experience economy. *Harvard Business Review*, 4(76), 97-105.
- Puchalski, C. M. (2012). Spirituality in the cancer trajectory. *Annals of Oncology*, 23(Supplement 3), 49-55. doi:<https://doi.org/10.1093/annonc/mds088>
- Rabitti, E., Cavuto, S., Iani, L., Ottonelli, S., De Vincenzo, F., & Costantini, M. (2020). The assessment of spiritual well-being in cancer patients with advanced disease: Which are its meaningful dimensions? *BMC Palliative Care*, 19(26), 1-8. doi:<https://doi.org/10.1186/s12904-020-0534-2>

- Stewart, A. L., Teno, J., Patrick, D. L., & Lynn, J. (1999). The concept of quality of life of dying persons in the context of health care. *Journal of Pain and Symptom Management*, 17(2), 93-108. doi:[https://doi.org/10.1016/S0885-3924\(98\)00131-6](https://doi.org/10.1016/S0885-3924(98)00131-6)
- UN. (2000). *CESCR general comment no. 14: The right to the highest attainable standard of health (art. 12)* Office of the High Commissioner for Human Rights. Retrieved from <https://www.refworld.org/pdfid/4538838d0.pdf>
- Visser, A., Garssen, B., & Vingerhoets, A. (2010). Spirituality and well-being in cancer patients: A review. *Psycho-Oncology*, 19(6), 565-572. doi:<https://doi-org.nlhlg.idm.oclc.org/10.1002/pon.1626>
- Walker. (2018). *Customers 2020. A Progress Report, More Insight for a New Decade*. Retrieved from website: <https://www.walkerinfo.com/docs/WALKER-Customers2020-ProgressReport.pdf>
- WHO. (2011). *World health statistics 2011*. Geneva, Switzerland: World Health Organization.
- WHO. (2014). *Global atlas of palliative care at the end of life, january 2014*. London, UK: Worldwide Palliative Care Alliance.

## Clinic Redesign with the Patient in Context

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### ABSTRACT

**Background and aim** – The objective is to develop the redesign of patient clinics by a living lab consisting of a multidisciplinary group of designers (interior design, facility design, organization design) and art students in participation with end-users and health care professionals at a Dutch university hospital.

**Methods** – Participatory research was conducted in multidisciplinary communities within the context of the hospital. Spatial design ideas are based on observations, site visits and interviews with various stakeholders.

**Results** – Four different themes or atmospheres have been created that can form the basis for further redesign of hospital wards. The spheres were: creating recharging possibilities for patients, creating delight at patients, seducing patient movements (inside out), and stimulating independency.

**Originality** – The living lab combines integrality, multidisciplinary, and participation with evidence-based design in a real-life context at a Dutch university hospital.

**Practical or social implications** – New designs, capable of having positive impact on patient health, are interesting for other hospitals and healthcare institutions. This allows them to combine prevention with cost reduction. Moreover, better buildings are also relevant for innovation and commercial purposes of the construction industries and for cost benefits for insurance companies.

**Type of paper** – Research paper.

### KEYWORDS

Evidence-based design, patient clinic redesign, healing environment, living lab, multidisciplinary, participatory design.

### INTRODUCTION

The living lab 'Patient in Context' focuses on spatial design ideas for the best clinical ward in a Dutch university hospital. The context of the living lab is a planned redesign of patient clinics. Results can be used for spatial-related field experiments and inspiration of professional clinical hospital designers and decision makers. The main focus of the experiments is a transformation from passive into active patient behaviours during hospital admission. The design should allow for flexibility to create different spatial clinical settings easily. Measurements will be multidisciplinary, linking architectural and organizational designs to medical outcomes.

### LITERATURE STUDY

Nowadays single or multi-person hospital rooms have a standard interior, with prominent beds, bedside tables and television, which emphasizes being a patient. Patients show lack of activity and are mainly passive and only seem to react upon what healthcare professionals require. The spatial design, for instance, the prominent presence of a bed in these rooms, seems to be inextricably interwoven with patient inactivity (Annemans, 2015). Research shows that passiveness especially affects vulnerable patients. It may worsen their physical condition by affecting stress, sleep, infections, malnutrition, and loss of muscle mass. However, patient experiences in hospitals and their relationships with the environment are increasingly taken seriously. Applications of evidence-based design (EBD) in healthcare have grown rapidly in recent years. Studies indicate that well-designed physical settings play an important role in

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making hospitals safer and more healing for patients, and better places for staff to work in (Ulrich et al., 2008).

Thanks to studies on the ideal healthcare environment, like the “Fable hospital” (Sadler et al., 2011), new insights on the relationship between spatial design, patient health, and economic benefits have emerged. This living lab will have substantial benefits for society, because it can decrease healthcare costs. Costs related to poor designs can be avoided by introducing better designs of spaces, such as design properties that reduce patient falls, patient transfers, adverse drug events, health care-acquired infections, length of stay, nursing turnover, and staff injuries (Sadler et al., 2011). Application of established evidence-based innovations (e.g. Sadler et al., 2011; Ulrich et al., 2008) contributes to knowledge development and valorisation in the design world and medical world. Table 1 below shows effective design factors and respective healthcare outcomes.

**Table 1** Effective design factors and healthcare outcomes.

Design factors	Healthcare outcomes
Access to daylight	1,2,3,4,5,6
Views of nature	1,3,4,5,6
Family zone (social interaction)	1,3,6
Improved wayfinding	3,6
Decentralisation of facilities	6
1. Reduced pain. 2. Improved patient sleep. 3. Reduced patient stress. 4. Reduced depression. 5. Reduced length of stay. 6. Increased patient satisfaction.	

**RESEARCH METHODOLOGY**

The design process of the living lab is participatory and multidisciplinary in nature. Therefore, relevant stakeholders from various medical disciplines of the hospital are part of a participatory design process. The project is propelled by the arts, architecture, and facility management, and embedded in a research centre for built environment. The living lab uses arts and design as a game-changer for patient outcome. Designers and art students are able to critically explore the world through art and design and to represent, convey, and implement ideas in a functional and purposeful way. Working from multidisciplinary communities they search for unexpected combinations.

For this study, 14 students from different art disciplines, such as interior architecture, graphic design, fine arts, and facility management were supervised by an arts teacher, facility management teacher, and a healthcare researcher. The group spent a week in a pressure cooker to design the best hospital ward that stimulates active patient behaviours. Students spoke with experts from the hospital, employees, a few patients, and site visits and observations were made. Structured and unstructured methods were used (Tomitsch et al., 2018).

**RESULTS**

In the course of the project week, multidisciplinary working groups were formed on the basis of common interests around four emerging themes in initial design meetings and discussions with peers, teachers, and hospital staff. The four themes were: recharging, delight, inside-outside, and independency.

**Recharging**

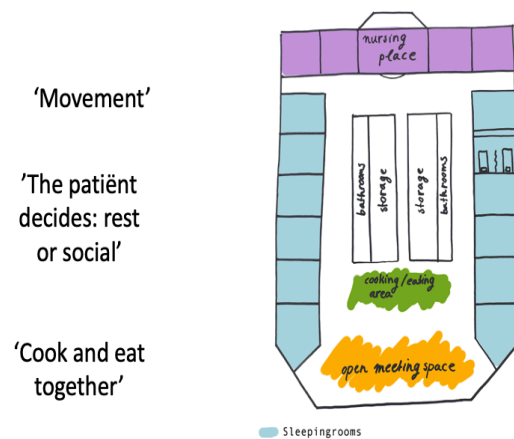
The theme ‘Recharging’ is based on the biophilia theory. Designing healthcare buildings with nature has a therapeutic influence that has been transferred through evolution. Biophilic design has a positive effect on the length of stay and satisfaction of the patient. For instance, patients exposed to nature and sunlight have a shorter post-operative stay, better emotional well-being and less complications such as headache and nausea. Gardens also have the advantage of promoting social interaction. Design groups involved in ‘Recharging’ proposed to use the balconies in the inner street on each floor differently, by



converting them into indoor gardens. By connecting the gardens with stairs, 'Recharging' aimed to stimulate movement and interaction and to seduce patients to increase their own mobility. On the roof a roof garden was imagined, where one can enjoy fresh air and daylight.

**Delight**

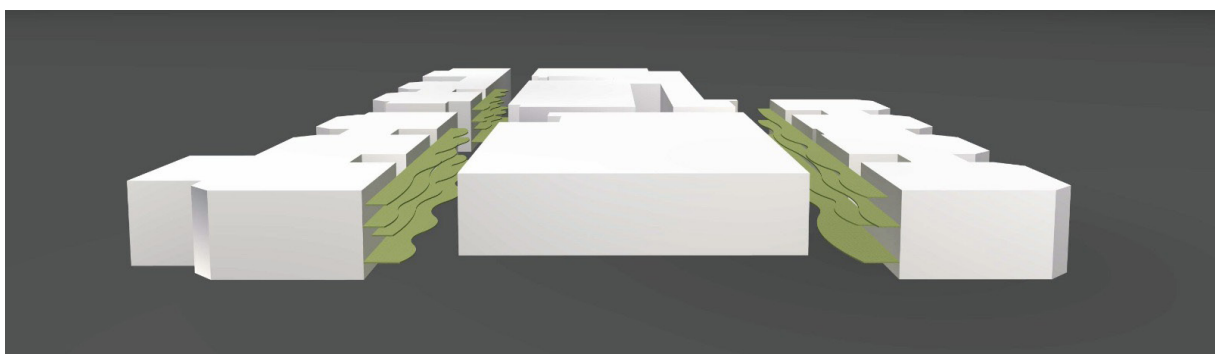
'Delight' design groups aimed to get patients out of their rooms by creating an attractive central meeting area. This was done by using nudging factors, such as daylight, comfort, and facilities for daily actions. More daylight responds to our biological needs, has a positive effect on sleep, depression and pain relief and ensures a shorter and better recovery. Daylight is better utilized by placing facilities that do not require daylight- such as the bathroom- in the middle section, and by increasing transparency. An attractive open meeting space sought to create delight at patients and staff. For instance, this space at the building facade tempts you to meet family or other patients, cook or eat a meal, play a game, or read a book (see Figure 1 below).



**Figure 1** Imagined new floorplan.

**Inside outside**

'Inside-Outside' proposes to 'reverse' the design of the department. Rooms are reduced to simple single rooms. There is a central cooking and dining facility for patients who are not confined to bed. In this way, staff can better monitor whether patients are eating their meals which prevents malnutrition, and patients are seduced to exercise and interact socially. Staff is not placed at the corners of the building, but in the middle of the department. This allows an optimal view of patients and rooms. Transforming the inner street of the hospital into a horizontal park increases the patient's room to move (see Figure 2). By austerity of the room, creating places for daily activities and adding nature, physical activity and social interaction are stimulated, which may potentially contribute to a shorter stay.



**Figure 2** Imagined horizontally connected balconies.

## Independency

High quality wayfinding in a hospital environment can avoid stressful situations. People do not get lost. Good design and signage inform people about well a destination. This allows them to relax during their wayfinding task. In this context, our student-designers have proposed to improve wayfinding through icons. 'Independency' of patients is stimulated with wearables that allow them to stay independent of place and time. In this line of thought wearables form the link between doctor, nursing staff, the patient, and the context. It communicates, for example, when the doctor or nursing staff is ready to meet the patient at the ward. With the wearable, waiting is transformed into possible exploration of hospital spaces, a more relaxed attitude, and increased well-being.

## DISCUSSION

With their design ideas, a new generation of upcoming designers has shown how- in their view- patient activity can be stimulated. For instance, by applying with sensory experience and daily needs. By doing so, attention is paid to both the physical and mental condition of the patient. If we want to indicate the essence of these ideas, it is striking that they are organized over the aesthetic and the functional axe. The aesthetic axe depicts visual contrast between attractive common areas and less attractive private areas, making common areas function like a magnet, and by doing so, creating traffic. Moreover, the functional axe emphasizes the organizational contrast between plain facilities in the private area and luxurious facilities in the common area. By moving along the axis of aesthetics and functionality, researchers can apply these in small-scale interventions and collecting evidence about its impact on patients' health and recovery. This approach should allow future designers and facility managers to apply evidence-based knowledge during the design process enriching hospital buildings.

A future living lab applying these proposed and related interventions in a real-life context will have the advantage of valorisation and application. Especially, through an involvement of medical specialists. With their help, in a living lab the impact of theoretically proposed design properties on patient health can be tested in practice. In case of clear positive relations with patient outcomes, it can be replicated in other healthcare settings. EBD is a developing field of study that holds great promise, for patients, their beloved ones, and healthcare staff. The multidisciplinary approach creates new possibilities for designs that have an impact on the real world. Hence, it is expected that the design of the living lab and the related outcomes can be transferred to other healthcare settings, and by doing so, activate patients and advance their health.

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## REFERENCES

- Annemans, M. (2015). *The experience of lying: Informing the design of hospital architecture on patients' spatial experience in motion*. [Doctoral dissertation, KU Leuven] Leuven, Belgium.
- Sadler, B. L., Berry, L. L., Guenther, R., Hamilton, D. K., Hessler, F. A., Merritt, C., & Parker, D. (2011). Fable hospital 2.0: The business case for building better health care facilities. *Hastings Center Report*, 41(1), 13-23. doi:<https://doi.org/10.1002/j.1552-146X.2011.tb00093.x>
- Tomitsch, M., Wrigley, C., Borthwick, M., Ahmadpour, N., Frawley, J., Kocaballi, B., . . . Loke, L. (2018). *Design. think. make. break. repeat. A handbook of methods*. Amsterdam, the Netherlands: BIS Publishers.
- Ulrich, R. S., Zimring, C., Zhu, X., DuBose, J., Seo, H., Choi, Y., . . . Joseph, A. (2008). A review of the research literature on evidence-based healthcare design. *Health Environments Research & Design Journal*, 1(3), 61-125. doi:<https://doi.org/10.1177/193758670800100306>

## Work Processes and Building Reconstruction at Elderly Care

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### ABSTRACT

**Background and aim** – A Dutch healthcare organisation modernizes its real estate portfolio to meet today's requirements and acquired an office building for conversion into a nursing home for elderly with dementia. The purpose of the research has been to study the design principles for elderly with dementia, for innovative and smart application in work processes and the acquired building.

**Methods** – Using multiple-method qualitative research design, bachelor thesis students of a university of applied sciences explored the reconstruction of the acquired building and related healthcare processes.

**Results** – Application of design principles for the elderly with dementia were studied, among which were interior design, catering process, and connection with the neighbourhood. Feasible interior ideas were elaborated, intentions for change in the catering process were confirmed by stakeholders, and an action plan for neighbourhood connections was delivered. Elements are being used for a final design. Implementation has to be checked with close scrutiny.

**Originality** – The application of design principles for elderly with dementia (design, favourable state, beautiful moments) together with changes in work processes of health care employees aiming at patient-centred care is a new combination.

**Practical or social implications** – When a healthcare organisation chooses a new care concept, not only the surroundings change. Also, the processes around people and the way we take care of them change. In many ways a new concept can only succeed when the employees and the way they work change as well.

**Type of paper** – Research paper.

### KEYWORDS

Building reconstruction, elderly with dementia, healthcare processes, patient-centred care.

### INTRODUCTION

Staff shortages and costs in the healthcare industry continue to create challenges for resource allocation (SIA, 2018; WHO, 2019). A healthcare organisation in North Netherlands is realigning its' real estate portfolio, and replacing old buildings that no longer meet contemporary requirements with up-to-date accommodation. At the same time, the opportunity has been taken to examine work processes. It would be two birds with one stone if these new work processes could be done more efficiently in a building that is refurbished, adaptable to changes, and more effective for a better quality of life (QoL). The studied healthcare organisation serves 15,054 clients, of which 8,325 residential, and employs 5,943 employees, of which 4,178 at 27 residential care locations (KwadrantGroep, 2019a). The healthcare organisation acquired a governmental office building in the centre of a rural village with 2,900 inhabitants (CBS, 2019) and is planning to reconstruct this building into a nursing home for 30 elderly with dementia.

The traditional form of nursing home care delivery, with assigned care providers which are allocated to a closed unit with a common living room, will change. For instance, in several themed areas with different atmospheres and activities. Patient-centred care in the refurbished building will allow residents to enjoy the day in a way that suits their individual needs (KwadrantGroep, 2019b). The preceding changes of the living environment are inextricably interwoven with employee work processes

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and patient contacts. This also implies that employee policy principles need to be revised, including mobility and training (KwadrantGroep, 2019b). The healthcare organisation expects transformation of traditional nursing homes into patient-centred care with inclusive or generational living. The focus of the healthcare organisation is on improving QoL for residents. Contribution of the design of a living space is presupposed. The aim of the study is to gain insights into the interaction between patients, employees, and the refurbished building.

**LITERATURE**

The proposed patient-centred healthcare concept is based on the principles of environment for elderly with dementia developed by geriatrician Anneke van der Plaats (Van der Plaats & De Boer, 2014; Verbaeck & Van der Plaats, 2008) and widely supported in the Netherlands. These principles are design for elderly with dementia, a favourable state, and beautiful moments (Verkerk, Van Hoof, Aarts, De Koning, & Van der Plaats, 2018). Moreover, Verkerk et al. (2018) studied four cases where traditional settings were transformed in alignment with these principles. In a news broadcast from a nursing home, Van der Plaats said:

*“The brain in all brain patients is completely dependent on the environment. So, a favourable environment gives favourable behaviour. And an unfavourable environment gives unfavourable behaviour. That’s the base.”* [translated] (Nieuwsuur, 10 July 2019).

Unfortunately, she was admitted to a nursing home herself as she was diagnosed with dementia. The subject of her work and studies. Fortunately, the home met the aforementioned principles. Other research indicated that group residents needed less help with everyday activities and were more socially involved (Te Boekhorst, Depla, De Lange, Pot, & Eefsting, 2009). Employees indicated that they need time and more staffing to enable better care delivery (Van Hoof et al., 2016).

**METHODS**

Bachelor thesis students and interns performed multiple method research (Denzin & Lincoln, 1994; Saunders, Lewis, & Thornhill, 2009) at a Dutch healthcare organisation. They studied the application of factors of Verkerk’s design principles for elderly with dementia (et al., 2018). Methods and samples are shown in Table 1.

**Table 1** Methods and Sample.

Aspects	Researchers	Methods	Sample
Entrance	2 Real Estate (RE) bachelors	Phenomenological research	5 locations
Garden	Facility Management (FM) bachelor	Phenomenological research	5 locations
		Semi-structured interviews	3 employees, 2 headmasters, 2 experts
Catering	FM bachelor	Semi-structured interviews	2 relatives of a resident, 4 employees, 4 experts, 2 managers
Labour conditions	Part-time bachelor Law	Semi-structured interviews	2 employees, 3 staff advisors, 2 managers
Interior	Arts bachelor	Phenomenological research, expert interviews and design	Various locations, 3 experts
Connection w/neighb.	2 Social Work & 3 RE bachelors	Phenomenological research,	4 locations, 3 participating organisations
		design research	

The studies were conducted in two consecutive semesters in 2018 and 2019. In both semesters, individual students and student project groups from different disciplines examined different factors of the research assignment. The factors were chosen by the students and aligned in consultation with the staff

of the healthcare organisation and university. The methods used were field and expert interviews, design research, and phenomenology executed according to Saunders et al. (2009). The students studied the phenomenon by visiting nursing homes and other locations, workshops for dementia, workshops for design experts, interviews with staff, family, and community members, and by conducting design research. All studies were assessed according to the requirements of the students' own curriculum. After finalization of the first semester, the sub-studies were made available, summarized, and presented to the healthcare organisation. Moreover, a follow-up was made in the subsequent semester by a specific inquiry into the connection with the community. This paper may also be regarded as being part of an evaluation of the collaboration, and proceeds with a new student project.

## RESULTS

The healthcare organisation intended to implement a completely new care concept. They were aware of the fact that designing health spaces can be extremely challenging, especially when combining this with a new work concept. Not only is design of the spaces important, the way in which people will work in this new concept is also a challenge that must be addressed. The conducted studies helped clarify parts of the health space design or contributed to the processes people will work with in the new concept. Six focal areas were identified in the respective studies: entrance, garden, catering process, labour conditions, interior, and connection with the neighbourhood. The studies by the bachelor thesis students on the entrance, garden, catering and labour conditions were of a descriptive nature, with recommendations. The studies on the interior and the connection with the village have focused on design and practical deployment. The latter resulted in implementation plans.

### Entrance

Respondents reported that light and open spaces were experienced as positive and dementia-friendly, which had to be well-arranged, recognizable, and inviting. Space that is busy, modern, business-like, dark, and cluttered was experienced less positive.

### Garden

The physical environment, daytime activities by residents, and work processes were examined at the garden. Regarding the physical environment, interviewees reported that safety for residents is the most important aspect for designing a garden. In addition, independent access to the garden is needed. Furthermore, employees suggested that activities of the residents and their own work processes could be shifted towards the garden, allowing for more time to be spent there. In this context, employees reported expected improvements of QoL of residents and of employee satisfaction.

### Catering process

Traditionally, nursing homes prepare food by self-cooking. In the proposed concept, self-cooking systems are replaced by pre-prepared food service systems. By doing so, the healthcare organisation reported expectations to improve QoL. For instance, by creating an experience around cooking, more flexibility, and smart use of scent. However, employees and family were used to the fact that self-cooking is the standard. Consequently, the benefits and flexibility of the pre-prepared food service system cannot yet be predicted.

### Labour conditions

Document analysis and interviews showed three issues regarding labour conditions: (1) physical workload, including lifting, support stocking work, and lack of workspace, (2) psychological workload, including work stress, staff shortage, self-managing teams, and communication, and (3) inappropriate behaviour, such as misunderstood behaviours of residents.

### Interior

Based on three interviews with experts, various site visits and supervision by an art teacher, the following aspects were identified: orientation, characteristic and predictability, use of light and colours, acoustics, senses, seating areas, and views. These aspects were applied in design sketches such as in the following example (Figure 1)<sup>4</sup>.

<sup>4</sup> For more design sketches, see <https://edu.nl/pyy7m>



**Figure 1** Design for the care of elderly with dementia, sketching i.e. characteristic, use of light and colours, senses, and seating areas.

### Connection with the neighbourhood

In line with a Dutch national policy, the municipality is participating in the 'dementia-friendly municipality' program. Aiming at a better integration of elderly with dementia in society. The municipality, the studied healthcare organisation, and other social parties encourage citizens to participate in the life of residents. At this particular healthcare organisation previous investigations showed that connection with the neighbourhood could be an important element to improve QoL, and at the same time to reduce workload. Employees of the healthcare organisation can establish a sustainable connection with inhabitants of the village by collaborating with organisations in the same community. Interviews with residents identified three 'villager' organisations that actually wanted to collaborate: a care centre for people with disabilities, a kindergarten, and a church. These organisations also aim to make a meaningful contribution for elderly with dementia.

### DISCUSSION

The starting point of this research has been to investigate how a living environment can be created for people with dementia, based on the ideas of Van der Plaats & De Boer (2014). In this particular case, the project started with a group of students from various disciplines with the aim to achieve a multidisciplinary result. QoL is a central outcome in care for the elderly with dementia. Changes in interior and creating a connection with the community, for example, seemed to be directly related to QoL. The involved research students were in close contact with the real-life context of people with dementia, were able to talk extensively with healthcare organisation project staff, and finalized their studies with design ideas and a feasible implementation plan. These studies changed the perspective of healthcare organisation project staff and helped sharpen the perspective of how the project will work once it is completed. Other performed studies were also valid, but did not yield any new innovative ideas, nor could they prove the effect on QoL. Nevertheless, the catering study confirmed the refurbishment plans.

Proof of concept and evidence-based design is essential for efficient, effective and patient-centred care. Reconstruction for the elderly with dementia based on the aforementioned principles (i.a. Van der Plaats & De Boer, 2014) will have to take into account work processes and future developments, such as generational living. The research neither rejected or confirmed current project operations and requirements; it has been used for inspiration. Finally, it may be worth mentioning that the initial research question about design principles for elderly with dementia changed into a puzzle. Especially, on how the effects on residents with dementia can be investigated fruitfully and respectfully, while at the same time the environment changes and care is delivered. Additional research will be needed to support these changes. Better insight into the interaction between patients, environment, and employees will contribute to a better QoL and preferably lower healthcare costs. It is for these reasons that long-term research is urgently necessary.

In final thesis projects, students and their degree program supervisors tend to diverge and demarcate.

On the other hand, clients want integrated solutions. Convergence of student from different studies is the challenge for research, practice and education. This is a calling for applied science and better alignment with educational processes.

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## REFERENCES

- CBS. (2019). *Population by postal code*. [Database]. Heerlen, The Netherlands: CBS.
- Denzin, N. K., & Lincoln, Y. S. (1994). *Handbook of qualitative research*. Thousand Oaks, CA, USA: Sage Publications.
- KwadrantGroep. (2019a). *Jaarverslag 2018* [Annual Report 2018]. Drachten, The Netherlands: KwadrantGroep.
- KwadrantGroep. (2019b). *Herziene businesscase* [Reviewed Business Case]. Drachten, The Netherlands: KwadrantGroep.
- Nieuwsuur. (2019). In Ouddeken M. (Ed.), *Dementie-expert heeft nu zelf dementie en geeft stokje over aan haar zoon* [Dementia expert has dementia herself now and hands over to her son]. [Television Report], July 10, Hilversum, The Netherlands: NOS. Retrieved from <https://www.youtube.com/watch?v=xNAvI9X4rp0>
- Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students* (5th ed.). Harlow, England: Pearson.
- SIA. (2018). *Europe - demand for nursing staff on the rise, UK sees biggest shortage of nurses*. London, UK: Staffing Industry Analysts (SIA).
- Te Boekhorst, S., Depla, M., De Lange, J., Pot, A. M., & Eefsting, J. A. (2009). The effects of group living homes on older people with dementia: A comparison with traditional nursing home care. *International Journal of Geriatric Psychiatry: A Journal of the Psychiatry of Late Life and Allied Sciences*, 24(9), 970-978. doi:<https://doi.org/10.1002/gps.2205>
- Van der Plaats, A., & De Boer, G. (2014). *Het demente brein: Omgaan met probleemgedrag* [The demented brain: Dealing with problem behaviour] (Dutch, 1 ed.). The Netherlands: G. de Boer.
- Van Hoof, J., Verbeek, H., Janssen, B. M., Eijkelenboom, A., Molony, S. L., Felix, E., . . . Wouters, E. (2016). A three perspective study of the sense of home of nursing home residents: The views of residents, care professionals and relatives. *BMC Geriatrics*, 16(1), 169. doi:<https://doi.org/10.1186/s12877-016-0344-9>
- Verbaeck, B., & Van der Plaats, A. (2008). *De wondere wereld van dementie: Vanuit nieuwe inzichten omgevingszorg bieden aan dementerenden* [The wonderful world of dementia: offering environmental care to people with dementia based on new insights] (Dutch, 1 ed.). Maarsse, The Netherlands: Elsevier.
- Verkerk, M. J., Van Hoof, J., Aarts, S., De Koning, S., & Van der Plaats, A. (2018). A neurological and philosophical perspective on the design of environments and technology for older people with dementia. *Journal of Enabling Technologies*, 12(2), 57-75. doi:<https://doi-org.nlhgh.idm.oclc.org/10.1108/JET-11-2017-0043>
- WHO. (2019). Countries are spending more on health, but people are still paying too much out of their own pockets. Retrieved from <https://www.who.int/news-room/detail/20-02-2019-countries-are-spending-more-on-health-but-people-are-still-paying-too-much-out-of-their-own-pockets>

# Improving the Quality of Life with Challenging Behaviour through Architecture: A Case Study at a Dutch Very-Intensive-Care Facility

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## ABSTRACT

**Background and aim** – Challenging behaviour, such as aggression towards oneself, others, or objects, arises in interaction with the environment and may prevent individuals from participating in society and enjoying a high quality of life (QoL). Literature suggests that architects can contribute to prevention, by influencing challenging behaviour before rather than after its occurrence. The objective is to explore how architecture can contribute to the quality of life of intellectually impaired (and autistic) individuals showing challenging behaviour (CB).

**Methods** – The case study is based on interviews with residents and care providers, and direct observations of their daily life.

**Results** – Residents turn out to be dependent on the (visual) connection with the care provider and may experience stress from the behaviour of fellow residents. They also may experience stress when faced with unexpected situations and by sensory overload.

**Originality** – The relevance of architecture for CB reduction is new to this particular field of healthcare.

**Practical or social implications** – If these preliminary findings can be confirmed, they provide a basis for developing guidelines to design better environments for intellectually impaired individuals showing CB. Architecture might promote choice in interpersonal distance, by generous floorplans, a variety of spaces, and escape possibilities. Predictability might be enhanced by providing visual overview and previews into rooms. Finally, architecture that promotes sensory adjustment might improve the QoL of individuals showing CB by preventing sensory overload, and by doing so, mitigate related behaviours

**Type of paper** – Research paper.

## KEYWORDS

Architecture, autism, challenging behaviour, intellectual impairment, quality of life.

## INTRODUCTION

In recent years we have seen a lively debate on the best living environments for intellectually impaired individuals showing challenging behaviour, such as self-injury and various forms of aggression towards persons or objects. From an architect's point of view this raises the question how architecture can contribute to creating environments that help reduce such behaviour. Although architecture cannot cure challenging behaviour, it does have impact on the occurrence of particular activities or psychological states (e.g., stress), which in turn affects behaviour.

Challenging behaviour is defined by Emerson (1995) as culturally abnormal behaviour(s) of such intensity, frequency, or duration that the physical safety of the person or others is likely to be placed in serious jeopardy, or behaviour which is likely to seriously limit or deny access to the use of ordinary community services. It includes self-injury and various forms of aggression. The main reasons for showing challenging behaviour include a desire to increase social attention, to escape undesirable situations, to adjust levels of sensory stimulation, or to increase access to preferred objects or activities (Emerson, 1995).

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A high percentage of intellectually impaired people showing challenging behaviour have a diagnosis on the autism spectrum (Carpenter, 2011).

According to Simó-Pinatella et al. (2013):

*“...challenging behavior is one of the largest barriers to ensuring that people with intellectual disabilities [...] are able to participate in the community. These difficulties have become one of the main causes of social exclusion”* (p. 4582).

In the Netherlands, two cases illustrate living conditions bare of dignity, a sense of home, and choice. In 1988, images reached the media of a young woman chained naked to a wall, showing the helplessness of caregivers in handling challenging behaviour. That this helplessness did not vanish became apparent in 2011: videos were published of a Dutch boy chained to the wall in a barren environment. Both persons' quality of life (QoL) improved greatly with a change, not only of their treatment, but also of their living environment (Van Zijl, 1999; Vriesema, 2012). In an effort to prevent individuals from escaping or becoming aggressive, towards themselves, others, or the physical environment, spaces are sometimes made to feel sterile, stripped of a sense of home and in some cases even inhuman. Healthcare organizations tend to respond by trying to contain challenging behaviour through policies and procedures (Farrell, Shafiei, and Salmon, 2010), which may create a chain of risk reduction that compromises the QoL of individuals showing this behaviour:

*“Lack of control over one's [physical, interpersonal and programmatic] environment may lead to a vicious cycle of behavior. Environmental factors lead to an onset of behavior which challenges others, which in turn leads to the person's environment becoming more restrictive (less access to activities, less control etc.). This restrictive environment may in turn lead to an increase in behavior, which may lead to further environmental restrictions”* (Parris and Watson, 2011, p. 30).

This current research is motivated by the hypothesis that besides by appropriate treatment, people's QoL can be enhanced also by architecture. Architecture can be seen as an enabler of prevention, since it affects the occurrence of particular activities or psychological states, and by doing so, mitigates challenging behaviour before rather than after its occurrence. With their research on evidence based design, Roger Ulrich et al. (2008) demonstrated the effect of the physical environment, such as nature views and daylight, on patient outcomes. Moreover, spatial features like crowdedness, lack of privacy, or too much noise directly lead to stress (Mobach, 2009). Stress can also be triggered by an environment that causes uncertainty, lacks control, and presents too much novelty (Sternberg, 2009). At the same time, the physical environment has the potential to affect social relationships and the connection between people by stimulating chance encounters that might lead to a deeper connection (Mobach, 2009). In this context, the built environment is considered one of the most crucial factors influencing a person's QoL (Health Council of the Netherlands, 2009). The World Report on Disability (WHO, 2011) recommends creating enabling environments, environments – physical, social, and attitudinal – that do not disable, but foster participation and inclusion.

As mentioned, an important relation exists between challenging behaviour and the environment (Carpenter, 2011; Farrell et al., 2010). Farrell et al. even state that:

*‘manipulating the environment (physical and cultural) clearly offers one way to reduce CB (challenging behaviour ...’* (Farrell et al., 2010, p. 1649).

However, knowledge seems to be lacking of *how* architecture can contribute to the QoL of intellectually impaired individuals showing challenging behaviour, *how* enabling environments can be created for them.

## METHOD

To gain insight into how architecture can contribute to the QoL of people with an intellectual impairment, and possibly autism, showing challenging behaviour, we conducted qualitative research with a case study at a Dutch very-intensive-care facility. Our research group consists of researchers with backgrounds in architecture, facility management, healthcare, and real estate.

The very-intensive-care facility, in use since 2013, is located in a residential care park. The first author (henceforth, the researcher) designed this facility. Residents whose former living condition, treatment, and behaviour turned into an undesirable dead-lock, can be transferred to the facility, where they receive intensive treatment in small groups. The most stable group of four individuals, living in the facility since its opening five years ago with the highest level of communication skills was selected.

The interviews and observations took place in April/May 2018. During one week, the researcher was part of residents' daily life for observation and to conduct unstructured interviews with two members of the group, seven care providers, and the team manager, all of which was recorded. Five of the interviewed care providers are the group's primary care providers; the others provide care to other groups but function as a stand-in, if necessary. The latter provided insight into differences and similarities with other groups.

Since the members of the group have difficulties expressing themselves or their spatial experiences, only two of the residents were interviewed. A translating care provider was present at the interviews who adjusted questions to the individual's capacities.

All participants were informed on the study, and the fact that the researchers is also the architect of the facility, in written form and orally by the manager and all of them, or their legal guardians, signed consent forms to be observed and interviewed. The transcribed interviews and observations were analysed roughly following the QUAGOL (Dierckx de Casterlé et al. 2011). The findings of the case study were also compared with related work. To enhance the findings' trustworthiness, intermediary findings were discussed with a professional, who works in healthcare and real estate and is also a mother of a child with an intellectual impairment showing challenging behaviour.

The case study is still in progress. Therefore, our preliminary findings need to be confirmed by multiple triangulation.

## RESULTS

The case study is still in process. Therefore, our preliminary findings need to be confirmed by multiple triangulation. However, a first initial analysis shows a few topics that may be relevant.

Residents seemed to be dependent on the (visual or auditory) connection with the care provider. The nearness, visual or auditory, to their care providers provides them a sense of safety. At the same time, they may experience stress from the behaviour of fellow residents. The self-regulation of interpersonal distance, nearness to the care provider and distance from potentially frightful encounters with fellow residents, seems to be crucial for their QoL. The participating care providers also report a need for connection to the resident in visual and auditory sense, since it makes it possible to recognize the state the individual is in. They can immediately make a connection when the resident shows the first signs of stress and influence a possible onset of challenging behaviour.

Also, individuals showing CB experience stress when faced with unexpected situations, e.g. somebody entering a room unexpectedly, not knowing who is behind a door or around a corner. It appears crucial that the residents have overview and see visitors and other residents approaching and see what is happening at the place they are heading toward. Again, overview promotes the visual connection with the care providers and enhances their sense of safety. Not only unexpected situations, but also unexplainable noise, e.g. the gurgling sound of a nearby bath being emptied, may cause fear and lead to an onset of challenging behaviour. Other noises, like screaming and smashing doors may cause stress. Several care providers stated that the transfer of sound between the apartments was often a reason for the onset of challenging behaviour at night.

## NEXT STEPS

To gain deep insight into the group's daily life, more available data will be analysed and interpreted by multiple triangulation. Available data include personal files, incident reports, lists of reparations, and pictures of three different walks through the building. The mix of resident-centred data sources, various methods, and investigators with different backgrounds will provide a rich and credible representation of residents' life in the built environment.

Future research, specifically focused on intellectually impaired individuals showing challenging behaviour, is needed to better understand and confirm the relevance of our current findings. Moreover, empirical research on the similarities and differences between the needs of individuals showing challenging behaviour and the needs of autistic people is recommended.

## REFERENCES

- Buntinx, W. H. E., and Schalock, R. L. (2010). Models of disability, quality of life, and individualized supports: Implications for professional practice in intellectual disability. *Journal of Policy and Practice in Intellectual Disabilities*, 7(4), 283-294.
- Carpenter, P. (2011). Environmental interventions. In S. Hardy, and T. Joyce (Eds.), *Challenging behavior and people with learning disabilities: A handbook* (109-117). Brighton: Pavilion Pub.
- Dierckx de Casterlé, Bernadette, Chris Gastmans, Els Bryon, and Yvonne Denier. 2012. "QUAGOL: A Guide for Qualitative Data Analysis." *International Journal of Nursing Studies* 49 (3): 360-371. doi:10.1016/j.ijnurstu.2011.09.012.
- Emerson, E., and Bromley, J. (1995). The form and function of challenging behaviours. *Journal of Intellectual Disability Research*, 39(Pt 5), 388-398.
- Farrell, G. A., Shafiei, T., and Salmon, P. (2010). Facing up to 'challenging behavior': A model for training in staff-client interaction. *Journal of Advanced Nursing*, 66(7), 1644-1655. Health Council of the Netherlands. (2009). *The hospital as a healing environment*. The Hague: Author.
- Mobach, M. P. (2009). *Een organisatie van vlees en steen*. Assen: Koninklijke Van Gorcum.
- Parris, A., and Watson, K. (2011). Environmental interventions. In S. Hardy, and T. Joyce (Eds.), *Challenging behavior and people with learning disabilities: A handbook* (29-47). Brighton: Pavilion Pub.
- Simó-Pinatella, D., Font-Roura, J., Alomar-Kurz, E., Gine, C., Matson, J. L., and Cifre, I. (2013). Antecedent events as predictive variables for behavioral function. *Research in Developmental Disabilities*, 34(12), 4582-4590.
- Sternberg, E. M. (2009). *Healing spaces: The science of place and well-being*. Cambridge, Mass: Harvard University Press.
- Ulrich, R. S., Zimring, C., Zhu, X., DuBose, J., Seo, H., Choi, Y., . . . Joseph, A. (2008). A review of the research literature on evidence-based healthcare design. *Health Environments Research and Design Journal*, 1(3), 61-125.
- Van Zijl, F. (1999, July 23). Foto Jolanda Venema leidde tot omslag in zwakzinnigenzorg. *De Volkskrant*. Retrieved from <https://www.volkskrant.nl/wetenschap/foto-jolanda-venema-leidde-tot-omslag-in-zwakzinnigenzorg~a520595>
- Vriesema, I. (2012, January 4). In Sliedrecht is hij blij: Daar zit hij niet vast. *NRC*. Retrieved from <https://www.nrc.nl/nieuws/2012/01/04/in-sliedrecht-is-hij-blij-daar-zit-hij-niet-vast-12147502-a993874>
- WHO (2011). *World report on disability*. Geneva: WHO.

# Controlling the Stimulation of Senses in Design for Dementia

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## ABSTRACT

**Background and aim** – This study applied deduced critical success factors for sensory stimulation of individuals with dementia in a real-life architectural design in The Netherlands. The design was prepared by an architect, a consultant, and staff; and subsequently assessed by family members in a meeting applying interactive virtual reality. The aim was to determine if virtual reality would allow for improvements of a preliminary evidence-based design.

**Methods** – A combined approach of desk research and action research, based on deduction and application, building information modelling, virtual reality, and questionnaires with different stakeholders.

**Results** – Ten critical success factors to sensory stimulation were derived from literature: lighting, noise, sensory clues, visibility, orientation clues, wayfinding, interior, space, spatial articulation, and privacy. All factors were applied in the design of a nursing home special care unit. Family members showed neutral or positive evaluations on most factors. However, when compared with the current old building, the new building design was evaluated lower for its capabilities of interaction (staff, fellow residents) and orientation. The results also suggest positive expectations with respect to sensory stimulation, for instance, spatially-related possibilities for privacy, active behaviors, and autonomy.

**Originality** – The study reports on a combination of classical deductive methods, practical application, action research, and virtual reality. It shows that active engagement of family members of people with dementia, by applying virtual reality in an open discussion, can improve a deduced evidence based design. **Practical or social implications** – Active engagement of family members in the assessment of an evidence based design does not only improve architectural design, but also our understanding of the mechanisms of action of architecture for individuals with dementia and their spatially-related needs.

**Type of paper** – Research paper.

## KEYWORDS

Action research, application, deduction, dementia, evidence based design, healthcare, virtual reality.

## INTRODUCTION

Evidence exists that the built environment has an impact on the well-being of individuals with dementia (Calkins, 2009). Even a small improvement in environmental quality can make a large difference for the competence of a person with major limitations (Ferdous & Diaz Moore, 2015). It is pre-supposed here that a better understanding of the influences of environmental characteristics in individuals with dementia can improve their well-being and quality of life. Thus, it is our challenge to re-dedicate our efforts, to develop appropriate environmental strategies, and to implement them in practice (Brawley, 2001). The societal relevance is high, because poor well-being leads to behavioral problems in healthcare institutions. And caregivers are the ones to deal with these problems, creating an even higher work pressure and a potential risk of work overload and sick leave. In the context of our study in The Netherlands this problem will increase. The number of individuals with dementia is expected to double to half a million people over the next 25 years (Alzheimer Nederland, 2019) on an estimated population

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of 18 million (Stoeldraijer, van Duin, & Huisman (2017). Hence, society can potentially benefit from environments that respond to the needs of people with dementia. May the built environment perhaps even be regarded as a preventive medicine? (Brawley, 2001).

In this context, several researchers have published relevant literature reviews providing a wonderful overview of the field (e.g., Fleming, Crookes, & Sum, 2008; Van Hoof, Kort, Duijnste, Rutten, & Hensen, 2009; Marquardt & Schmieg, 2009). A common theme in these reviews is the concept of controlling sensory stimulation. Marquardt, Bueter, & Motzek (2014) have argued that there is sufficient evidence available to come to a consensus on the positive effect of appropriate sensory environments on agitation in people with dementia. However, they contend that findings also indicate a need to control sensory stimulation preventing a reverse effect. The balance between sensory overstimulation or sensory overload and sensory deprivation seems to be key (Day, Carreon, & Stump, 2000). Furthermore, controlling sensory stimulation is needed to allow for individual differences and preferences, in accordance with person-centered care, described by Kitwood (1997). This means that the amount of sensory stimulation needs to be adjusted to individual persons with dementia, or to put it differently, that the building/ rooms should allow different intensities/ ranges of sensory stimulation.

This paper explores the meaning and scope of controlling sensory stimulation in a nursing home special care unit (SCU) in The Netherlands. Moreover, it describes the elaboration of strategies that are expected to enhance control in this architectural design.

## METHODS

First, we established relevant features of the physical environment that are known to play an important role in sensory stimulation. The features were derived from scientific literature, allowing us to define critical success factors. Second, we formulate strategies to elaborate these factors in the design of the SCU. Third, an interactive design was presented to staff and family (next of kin) of individuals with dementia in a 3D-rendering through Building Information Modelling (BIM) on a life size screen. The presentations were given by the architect and a consultant, the walkthrough was performed by an experienced gamer, and the session was moderated by a supervisor of the research team. The design was evaluated by the participants on eight dimensions, of which four are relevant in the current stage of the design: Privacy, Social Interaction, Support of Orientation and Autonomy.

## RESULTS

### Critical success factors

From literature 10 critical success factors to sensory stimulation were derived (Table 1). The factors consisted of lighting, noise, sensory clues, visibility, orientation clues, wayfinding, interior, space, spatial articulation, and privacy.

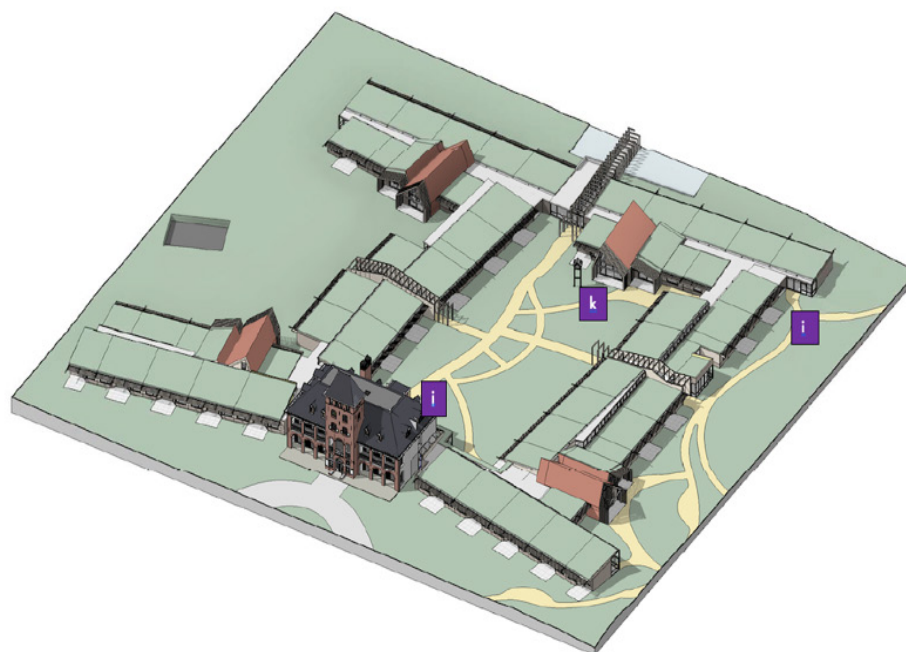
**Table 1** Critical success factors to sensory stimulation.

	Critical success factor	Reference
1	Lighting Lighting improves visibility, circadian rhythm, sleep patterns Bright-light therapy reduces agitation  Vision and light levels influence independence	Garre-Olmo et al., 2012; Van Hoof et al, 2009 Cohen-Mansfield, 2001; Marquardt et al., 2014 Van Hoof et al., 2009
2	Noise Noise is related to confusion, poor sleep, distraction, fear, agitation Sounds and noise trigger confusion	Garre-Olmo et al., 2012 Van Hoof et al., 2009
3	Sensory clues Multi-sensory clues reduce unwanted behavior Meaningful decision points improve orientation Reference points and visible endings of a corridor improve orientation  Meaningful sensory input—activity sounds, resident sounds, activity levels, smells, lighting, colors, heat, & touch	Marquardt et al., 2014 Marquardt & Schmieg, 2009 Marquardt & Schmieg, 2009 Zeisel et al., 2003

Critical success factor		Reference
4	<p>Visibility</p> <p>Ability to locate dining room from bedroom improves orientation</p> <p>Physical prompts (yellow doors, mirrors on doors) improve finding</p> <p>Strong color contrast improves visibility</p> <p>Direct visible access to relevant spaces improves orientation</p> <p>Activity spaces at end of paths</p> <p>Visibility of outside-area's improves finding</p>	<p>Bidewell &amp; Chang, 2010</p> <p>Cohen-Mansfield, 2001</p> <p>Marquardt et al., 2014</p> <p>Marquardt &amp; Schmiege, 2009</p> <p>Zeisel et al., 2003</p> <p>Marquardt &amp; Schmiege, 2009</p>
5	<p>Orientation clues</p> <p>Visual clues: signs improve orientation</p> <p>Visual clues: ensure visibility, minimize clutter improves orientation</p> <p>Landmark recognition helps orientation</p>	<p>Van Hoof et al., 2014</p> <p>Van Hoof et al., 2014</p> <p>Kessels, 2011</p>
6	<p>Wayfinding</p> <p>Straight lay-out, simple structures of circulation space improve orientation</p>	<p>Marquardt &amp; Schmiege, 2009</p>
7	<p>Interior</p> <p>Home-like, residential personalized environment</p> <p>Unique designs of common spaces, non-repetitive</p>	<p>Marquardt et al., 2014;</p> <p>Zeisel et al., 2003</p> <p>Marquardt &amp; Schmiege, 2009;</p> <p>Zeisel et al., 2003</p>
8	<p>Space</p> <p>Spatial generosity, accessibility, small scale per dwelling unit enhance freedom, social contacts</p>	<p>Van Steenwinkel, 2017;</p> <p>Marquardt &amp; Schmiege, 2009</p>
9	<p>Spatial articulation</p> <p>Enhanced / natural environments</p> <p>Legibility of functions of places</p> <p>Well-ordered, identifiable places improve orientation</p>	<p>Marquardt et al., 2014</p> <p>Marquardt &amp; Schmiege, 2009</p> <p>Van Steenwinkel et al., 2014</p>
10	<p>Privacy</p> <p>Degree of privacy-personalization reduces aggression</p>	<p>Zeisel et al., 2003</p>

**Design strategies in preliminary design of a Dutch SCU**

The current design is in a preliminary stage. Therefore, the design features are limited to the site of the nursing home (location), lay-out, spacing, and the use of lighting/natural light. The site of the design and the floorplan are included in Figures 1 and 2 respectively. Table 2 shows the elaboration of each critical success factors into a related design strategy.



**Figure 1** Site plan (©MAAK Architectuur/Nexit Architecten).



Figure 2 Floorplan (©MAAK Architectuur/Next Architecten).

Table 2 Design strategies to implement critical success factors.

Critical success factor	Related design strategy	List, Fig 2
1 Lighting	Lighting improves visibility, circadian rhythm, sleep patterns Bright-light therapy reduces agitation Vision and light levels influence independence	a b
2 Noise	Noise is related to confusion, poor sleep, distraction, fear, agitation Sounds and noise trigger confusion	c
3 Sensory clues	Multi-sensory clues reduce unwanted behavior Meaningful decision points improve orientation Reference points and visible endings of a corridor improve orientation Meaningful sensory input—activity sounds, resident sounds, activity levels, smells, lighting, colors, heat, & touch	d e f
4 Visibility	Ability to locate dining room from bedroom improves orientation Physical prompts (yellow doors, mirrors on doors) improve finding Strong color contrast improves visibility Direct visible access to relevant spaces improves orientation Activity spaces at end of paths Visibility of outside area's improves finding	g h i
5 Orientation clues	Visual clues: signs improve orientation Visual clues: ensure visibility, minimize clutter improves orientation Landmark recognition helps orientation	See strategies h and i j k

	Critical success factor	Related design strategy	List, Fig 2
6	Wayfinding Straight lay-out, simple structures of circulation system improve orientation	Simple square structure; see strategies h and i.	l
7	Interior Home-like, residential personalized environment	See strategy d, living rooms are decorated in different styles.	
	Unique designs of common spaces, non-repetitive		
8	Space Spatial generosity, accessibility, small scale per dwelling unit enhance freedom, social contacts	Generous space in circulation space, living rooms and outside covered wandering paths.	m
9	Spatial articulation Enhanced / natural environments	See strategy d	
	Legibility of functions of places	Only single function spaces, old building is an exterior and interior landmark	n
	Well-ordered, identifiable places improve orientation		
10	Privacy Degree of privacy-personalization reduces aggression	Single bedrooms	o

### End-user evaluation

In a 3D-rendering presentation of the BIM-model, family members of 6 residents of the present SCU, and one member of staff evaluated the design. Participating family members were asked to represent all 27 residents with dementia. Participants of the interactive design session filled out a questionnaire evaluating the design on eight dimensions, of which four are relevant for controlling sensory stimulation. Participants were asked to evaluate the design, using a 7-point Likert scale, assessing a) the present accommodation and b) the design of the new accommodation.

**Table 3** Evaluation of the results (N=7).

Items	Average	
	a	b
	Current (before 3D)	Expected (after 3D)
1 Privacy		
a There are sufficient places to withdraw and to be alone	5.33	6.67
b There are sufficient places to withdraw and not be disturbed by unwanted stimuli	5.00	6.67
c Residents have insufficient personal space	2.00	5.00
2 Social interaction		
a Residents have sufficient interaction with staff	6.00	5.60
b Residents have sufficient interaction with fellow residents	5.80	5.67
c Residents have sufficient interaction with visitors	5.33	5.60
d Residents have sufficient interaction with other people	5.20	5.50
e There are sufficient room and places to engage in social interaction	4.83	6.80
3 Support of orientation		
a The building offers sufficient challenges to come into action	3.50	6.50
b The building supports orientation in place	4.60	3.60
c The building supports orientation in time	5.00	4.40
d The building triggers curiosity as to what's behind the corner	4.00	6.00



Items	Average	
	a	b
	Current (before 3D)	Expected (after 3D)
4 Autonomy		
a There are sufficient choices in activities	3.20	4.50
b There are sufficient different atmospheres /environments to choose from	2.80	6.25
c There is sufficient variety in attractive places to dwell	3.83	6.33

The results show that end-user evaluation after the design session was neutral or positive. The items 2a and 2b (interaction with staff or fellow residents) and 3b and 3c (orientation support) were assessed lower. (The current SCU design will be changed to improve these items.) The results also suggest positive expectations with respect to sensory stimulation, for instance, spatially-related possibilities for privacy, active behaviors, and autonomy.

## CONCLUSION

The current approach, using virtual reality of a SCU design to allow family members of individuals with dementia to scrutinize design quality, has revealed benefits. Firstly, end user-participation provides useful feedback for architects, allowing them to refine their design. Secondly, the current approach is helpful in imagining a new built environment and actively engages family members of individuals with dementia in a new building design, and by doing so, allows them to prepare for a new situation in which their beloved ones will come to live.

## REFERENCES

- Alzheimer Nederland. (2019). *Factsheet cijfers en feiten over dementie*. Retrieved from website: [www.alzheimer-nederland.nl/factsheet-cijfers-en-feiten-over-dementie](http://www.alzheimer-nederland.nl/factsheet-cijfers-en-feiten-over-dementie)
- Bidewell J.W., & Chang, E. (2010), Managing Dementia Agitation in residential aged care, *Dementia* 10(3) 299-315, doi: 10.1177/1471301211407789
- Brawley, E.C. (2001), Environmental design for Alzheimer's disease: A quality of life issue. *Aging & Mental Health*, 5:sup1, 79-83, doi: 10.1080.713650005
- Calkins, M.P. (2009). Evidence-based long term care design. *NeuroRehabilitation*, 25, 145-154, doi: 10.323/NRE-2009-0512
- Cohen-Mansfield, J., (2001) Nonpharmacological Interventions for Inappropriate Behaviors in Dementia, *American Journal of Geriatric Psychiatry*, 9:4 Fall 2001, doi: 10.1007/s11940-013-0257-2
- Day, K., Carreon, D., & Stump, C. (2000), The Therapeutic Design of Environments for People With Dementia: A Review of the Empirical Research, *The Gerontologist* 40, 397-416, Retrieved from <https://academic.oup.com/gerontologist>.
- Ferdous, F., & Diaz Moore, K. (2014). Field observations into the Environmental Soul: Spatial Configuration and Social Life for People Experiencing Dementia. *American Journal of Alzheimer's Disease & Other Dementias* 30(2), 209-218, doi: 10.1177/15333317514545378
- Fleming, R., Crookes, P.A., & Sum, S. (2008) *A review of the empirical literature on the design of physical environments for people with dementia*. Retrieved from: <https://ro.uow.edu.au/cgi/viewcontent.cgi?article=3923&context=hbspapers>
- Garre-Olmo, J., López-Pousa, S., Turon-Estrada, A., Juvinyà, D., Ballester, D., & Vilalta-Franch, J., (2012) Environmental Determinants of Quality of Life in Nursing Home Residents with Severe Dementia, *JAGS* 60, 1230-1236, doi: 10.1111/j.1532-5415.2012.04040.x
- Kessels, R.P.C., Van Doormaal, A., & Janzen, G. (2011), Landmark Recognition in Alzheimer's Dementia: Spared Implicit Memory for Objects Relevant for Navigation, *PLoS ONE*, 6(4) 1-7, doi:10.1371/journal.pone.0018611
- Kitwood, T. (1997), *Dementia Reconsidered: The Person Comes First*, Bristol, 1997
- Marquardt, G., Bueter, K., & Motzek, T. (2014), Impact of the design of the Built Environment on People with Dementia: An Evidence-Based Review, *Health Environments Research & Design Journal*, 8(1), 127-157

- Marquardt, G., & Schmiege, P., (2009), Dementia-Friendly Architecture: Environments That Facilitate Wayfinding in Nursing Homes, *American Journal of Alzheimer's Disease & Other Dementias*, 24(4), 333-340. doi: 10.1177/1533317509334959
- Stoeldraijer, L., van Duin, C., & Huisman, C. (2017). Bevolkingsprognose 2017–2060: 18,4 miljoen inwoners in 2060. Den Haag: Centraal Bureau voor de Statistiek.
- Van Hoof, J., Kort, H.S.M., Duijnste, M.S.H., Rutten, P.G.S., & Hensen, J.L.M. (2009) The indoor environment and the integrated design of homes for older people with dementia. *Building and Environment*, 45(2010), 1244-1261, doi :10.1016/j.buildenv.2009.11.008
- Van Hoof, J., Marquardt, G., & Demiris, G., (2014) in O'Brien, D. (Ed.). *Evidence Based Design Journal 1: Aged Care*, 1-69, Retrieved from: <http://ebdjournals.com/journals/aged-care>
- Van Steenwinkel, I., Dierckx de Casterlé, B., & Heylighen, A. (2017) How architectural design affords experiences of freedom in residential care for older people, *Journal of Aging Studies*, 41(2017), 84-92, doi: 10.1016/j.jaging.2017.05.001
- Zeisel, J., Silverstein N.M., Hyde, J., Levkoff, S., Lawton, M.P., & Holmes, W. (2003) Environmental Correlates to Behavioral Health Outcomes in Alzheimer's Special Care Units, *The Gerontologist* 43(5) 697-711. doi:10.1093/geront/43.5.697

## The Patient Journey in a Hospital Environment

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### ABSTRACT

**Background and aim** – Patients undergo one or more medical interventions in a hospital. In the hospital, patients are surrounded by spaces and services. The output in a hospital is the patients' outcome. To gain understanding about a holistic experience of patients, we assessed the experience and well-being of patients at specific focal points of the entire patient journey: from the arrival, to the diagnosis and the actual treatment in a hospital.

**Methods** – This article describes three field experiments that were conducted in a Dutch hospital. First, in an age-simulation study the effect of route complexity and physical ageing was assessed during 108 wayfinding tasks. Second, in a quasi-randomized experiment the use of a motion-nature projection was assessed during a diagnostic scan (N = 97). Lastly, in a quasi-randomized experiment the effect of a non-talking rule during an outpatient infusion treatment was assessed (N = 263).

**Results** – A wide variety of patients visit a hospital and all patients of course bring an opinion of their own and experience their hospital visit differently. However, patients benefit from a simple building structure during wayfinding, inexpensive beamers to project nature during diagnostics, and a mix of treatment places with respect to social interest during infusion treatments.

**Originality** – There is little discussion about the holistic experience of patients, that concerns the cognitive, emotional, physical, and social well-being of patients. In our study we applied a holistic and patient-centered approach.

**Practical or social implications** – The well-being of patients can be significantly improved when the built, natural, and sound environment is taken into account with respect to individual differences.

**Type of paper** – Research paper.

### KEYWORDS

Built environment, evidence-based design, hospital, environment, spaces and services, patient experience, multimethod.

### BACKGROUND

For patients and their relatives, a hospital visit is often an anxious and uncertain event. Patients are often concerned for a diagnosis and/or treatment for their disease in an outpatient or inpatient setting. The process a patient is exposed to in a hospital can be seen as a chain of actions (Fitzsimmons & Fitzsimmons, 2006). This chain of actions is also called a journey and patients may encounter different healthcare spaces and services during a hospital visit. Understanding the holistic experience of patients will allow us to positively influence the well-being of patients.

An increasing demand and new technologies often require changes in the hospital building. Buildings costs for Dutch hospitals are expensive and amount approximately around €3,000 per square meter. Recent developments in the healthcare real estate funding system in the Netherlands have heightened the need that hospitals have to refund these building costs. Moreover, market forces create a competitive healthcare system. This 'pushes' healthcare providers to differentiate with spaces and services. However,

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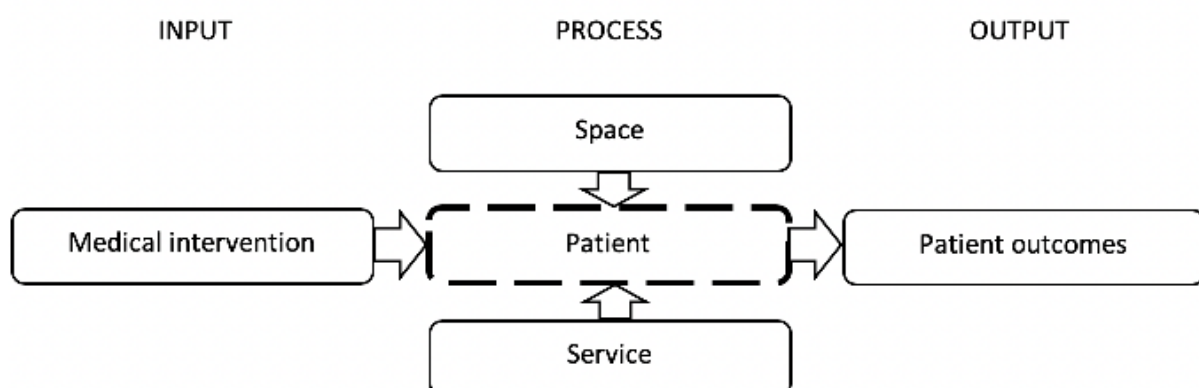
building decisions are still mainly based on intuition and not on scientific evidence (Becker & Parsons, 2007). But how can hospitals be designed in a way that it actually improves patients' experiences and well-being?

Associated research to understand the patients' experience is conducted from a wide variety of perspectives like quality of healthcare, services, and spaces. According to the Donabedian model (Donabedian, 1988), the quality of healthcare contains contextual aspects in which healthcare is delivered (structure), the interaction between patients and healthcare providers by the delivery of healthcare (process), and the effect of healthcare on the health status of patients (outcome). Donabedian (1988) argues that a good structure (material resources, human resources, and organizational structure) positively influence the process, which in turn positively influences the patients' health.

In healthcare, the physical surroundings can potentially create hospital environments into healing environments (Dijkstra, Pieterse, & Pruyn, 2006; Stichler, 2001). When design solutions are based on scientific evidence it can be defined as evidence-based design (Ulrich, Quan, Zimring, Joseph, & Choudhary, 2004). The focus of evidence-based design is that environmental surroundings can influence patients both positively and negatively (Becker & Parsons, 2007; Ulrich et al., 2008; Ulrich, 1981). The hospital environment can potentially improve the healing process of patients, by reducing the length of stay, severity of pain, pain medication, levels of anxiety, levels of fatigue, and increasing the quality of sleep, mood, or overall satisfaction with healthcare (Dijkstra et al., 2006; Harris, Ross, McBride, & Curtis, 2002; Ulrich et al., 2004).

From a service perspective, it can be stated that in a hospital a variety of healthcare services are offered. The experience of a service is an offering as any service or good: service organizations are not solely delivering a service, but also create a memorable experience to sell them better (Pine II & Gilmore, 1998). However, a hospital visit is not primarily an experience to sell, but it is about the provision of good healthcare and the well-being of patients. In this sense, a hospital may need a different approach to create a different kind of positive experience and affect well-being, and may benefit from different designs.

So far, however, there has been little discussion about the holistic experience of patients, that concerns the cognitive, emotional, physical, and social well-being of patients. In our study we apply a holistic and patient-centered approach (Figure 1). Patients undergo one or more medical interventions in a hospital. In the hospital, patients are surrounded by spaces and services. The output in a hospital is the patients' outcome. To gain understanding about the holistic experience of patients, we assessed the experience and well-being of patients at specific focal points of the entire patient journey: from the arrival, to the diagnosis and the actual treatment in a hospital.



**Figure 1** Patient-centered approach in a hospital environment

### ARRIVAL AT THE HOSPITAL

The patients' journey in a hospital starts with entering the building and following a route to find the way in the built environment to the destination of the patients' appointment. This destination can be a diagnostic, outpatient, or inpatient clinic.

Zijlstra et al. (2016) have argued that hospitals are spacious in size due to the increasing demand of healthcare services. The population of the Netherlands is rapidly ageing and is expected to be doubled in 2050. Hospitals include many areas for patients and staff. In addition, university hospitals contain also areas for education and research. Wayfinding in such complex building settings might be particularly difficult for vulnerable people like elderly.

Wayfinding is a dual-task performance, which requires cognitive and sensorimotor skills (Li, Lindenberger, Freund, & Baltes, 2001). Memorizing the destination and actually moving through the building can be seen as a divided attention task. Elderly experience even basic movements as walking challenging (Davis, 2012). Patients may become (extra) stressed when lost during a hospital visit, better design may prevent such problems. Therefore, support from the built environment is most importantly for elderly persons to find their way in a hospital.

The built environment, like multi-level buildings or multi-building settings, affects the type of wayfinding strategy people use. For example, in multi-level buildings it seemed most efficient to firstly move to the correct floor to find the destination, while in multi-building settings it seemed most efficient to firstly move to the correct building to find the destination (Hölscher, Büchner, Meilinger, & Strube, 2008; Hölscher, Meilinger, Vrachliotis, Brösamle, & Knauff, 2006). Facilities such as signage can help people in wayfinding, but also hinder when not done appropriately (Rousek & Hallbeck, 2011).

It is unknown whether the effect of route complexity (i.e., number of building- and floor changes) on wayfinding differs for elderly people with ageing-related physical impairments in both sensory and motor skills.

## DIAGNOSTIC SCAN

Diagnostic scans play a critically important role in the diagnosis and treatment of diseases. Therefore, after patients have entered the hospital, they often have to undergo a diagnostic scan.

A diagnostic scan is often an anxious event for patients because patients are usually concerned and anxious that they have a serious disease (Munn & Jordan, 2011). Not to mention that the medical technological development of medical devices and equipment continues to advance. In consequence, the hospital environment is becoming more unhuman from the patients' perspective and patients can become overwhelmed by these unknown technological innovations (Dantendorfer et al., 1997).

Various studies have shown that patients' experience elevated levels of anxiety for a diagnostic scan (Carlsson & Carlsson, 2013; Heyer et al., 2015; Katz, Wilson, & Frazer, 1994). A large percentage of patients (37%) experienced moderate to high levels of anxiety for a magnetic resonance imaging (MRI) scan. Although the level of anxiety for a CT scan is similar compared to MRI, this is still an underestimated problem, (Heyer et al., 2015). High levels of anxiety for a CT scan can become a major problem, because it may potentially influence the quality of images due to motion artifacts and may also increase health risks due to an increase in radiation exposure (Bischoff et al., 2009; Gerber, Kantor, & McCollough, 2010).

The physical surroundings and facilities of a diagnostic room may influence the patient experience. An increasing body of evidence showed that nature sights can positively influence people and can reduce psycho-physiological stress (Malenbaum, Keefe, Williams, Ulrich, & Somers, 2008; Monti et al., 2012; Tanja-Dijkstra et al., 2014; Ulrich, 1984; Vincent, Battisto, Grimes, & Mccubbin, 2010). However, it is unknown whether a projection of nature in a diagnostic room can mitigate anxiety and physiological arousal.

## TREATMENT IN OUTPATIENT INFUSION CENTER

After diagnosis, a growing number and high variety of patients receive treatments for cancer or chronic diseases, such as muscle or vascular diseases, in outpatient infusion centers. The number of day care treatments has increased over five times in the last 20 years and the group of patients with the diag-

nosis cancer has grown the fastest (Dutch Hospital Association (NVZ), 2016). This increasing demand for day care treatments can be explained by rising healthcare costs year over year. Therefore, patients should stay as short as possible in hospitals and preferable do not stay overnight.

Patients may cope differently with this stressful situation. During these treatments, some patients may prefer a treatment environment that allows them to contemplate and rest (i.e., little noise), whereas others may prefer a treatment environment that distracts them and provides them with the opportunity to talk to fellow patients and visitors (Browall, Koinberg, Falk, & Wijk, 2013). According to the WHO, it is essential for patients to rest and recover without disturbances (Berglund, Lindvall, & Schwela, 2000). With this fact and the risks of infections, new hospital designs provide more single rooms or cubicles. However, the individual preference of patients with respect to social contact is of great interest.

Human-related sounds were reported the most by patients, like talking, laughing, and coughing (Mackrill, Cain, & Jennings, 2013; Park et al., 2014). However, some patients may not be disturbed by these human-related sounds and may feel safe and secure when they hear others, while others may experience it as annoying and may feel helpless because they cannot escape from the noise (Cohen, Evans, Stokols, & Krantz, 1986; Johansson, Bergbom, Waye, Ryherd, & Lindahl, 2012).

Quiet-time interventions may control the actual sound level by encouraging patients to rest and relax (Lower, Bonsack, & Guion, 2003). However, their study manipulated multiple variables, such as a restriction of visitors, reducing staff movements, encouraging of closing doors, reduced light intensity, and lowered volume of technical equipment.

It is still unknown which individual element of quiet-time intervention effectively reduced the sound level. Therefore, it is important to study specifically the influence of the sound of talking on the actual and perceived sound levels in a single intervention study.

## METHODS

This article describes three field experiments for each journey step that were conducted at the University Medical Center of Groningen (UMCG) in the Netherlands. An overview of the methods are presented in Table 1.

## RESULTS

### *Arrival at the hospital*

The findings of the first study (Emma Zijlstra et al., 2016) revealed that persons on more complex routes (i.e., more floor and building changes) walked less efficiently than persons on less complex routes. In addition, simulated elderly participants performed worse in wayfinding than young participants in terms of speed. Moreover, results showed that simulated elderly persons had higher heart rates and respiratory rates compared to young people during a wayfinding task.

### *Diagnostic scan*

The findings of the second study (Emma Zijlstra et al., 2017) showed that the use of motion nature projection in computed tomography (CT) imaging rooms was effective in mitigating psycho-physiological anxiety compared to no-intervention. Results showed that motion nature projection had a negative indirect effect on perceived anxiety through a higher level of perceived pleasantness of the room. In addition, heart rate and diastolic blood pressure were lower when motion nature was projected.

### *Treatment in outpatient infusion center*

The findings of the last study (Emma Zijlstra et al., 2019) showed a statistically significant, but rather small reduction of the non-talking rule on the actual sound level at an outpatient infusion center, with an average of 1.1 dB(A). Half of the patients preferred a talking condition, around one-third of the patients had no preference, and the remaining group of the patients preferred a non-talking condition. The results suggest that patients who preferred non-talking, perceived the environment more negatively compared to the majority of patients and perceived higher levels of anxiety.

Table 1 Study characteristics and main results for each journey step

Study	Method	Participants and setting	Intervention	Outcome measures	Main results
Arrival at the hospital (Zijlstra et al., 2016)	Age-simulation field experiment Data retrieved by time and distance observations and physiological measurements	75 bachelor students studying Facility Management who performed wayfinding tasks (42 participants performed two wayfinding tasks, 33 performed one) Multi-level multi-building hospital setting	Nine routes with different levels of complexity (number of building and floor changes) 59 of the total 108 wayfinding tasks were performed wearing gerontologic ageing suits (simulated typical physical limitations of elderly, such as changes in sight, hearing and limited mobility of the whole body)	Wayfinding performance (route efficiency and walking speed) Physiological outcomes (heart rate and respiratory rate)	A significant effect of number of building changes on route efficiency ( $p = 0.008$ ) Routes that required building changes were walked less efficient ( $p < 0.001$ ) Simulated elderly performed worse in walking speed ( $p < 0.001$ ) Simulated elderly had higher heart rates and respiratory rates ( $p < 0.001$ )
Diagnostic scan (Zijlstra et al., 2017)	Quasi-randomized experiment Data retrieved by medical observations and self-reported measurements	97 participants who underwent a cardiac Computed Tomography (CT) scan Radiology department	Intervention condition: Motion nature projection Control condition: No projection	Perceived anxiety Pleasantness room Physiological arousal (heart rate and blood pressure) Perceived contact with radiographer Administration of medication Patient characteristics	Motion nature projection indirectly affected perceived anxiety through a higher level of perceived pleasantness of the room ( $p = 0.017$ ) Heart rate and diastolic blood pressure were lower when motion nature was projected ( $p = 0.042$ , $p = 0.040$ )
Treatment in outpatient infusion center (Zijlstra et al., 2019)	Quasi-randomized experiment Data retrieved by sound observations and self-reported measurements	263 participants who received treatment for cancer (62%) or chronic illness (38%) Outpatient infusion center (shared room with 8 treatment places)	Intervention condition: Participants requested not to talk to fellow patients and visitors during treatment Control condition: Participants allowed to talk to fellow patients and visitors	Sound environment Perceived anxiety Perceived environment Perceived pleasantness of room Satisfaction with healthcare Patient preferences	Small reduction of non-talking rule on sound level with an average of 1.1 dB(A) ( $p < 0.001$ ) Patients who preferred non-talking perceived the environment more negatively ( $p = 0.038$ )

## DISCUSSION AND CONCLUSION

To gain understanding about the holistic experience of patients, the aim of this study was to investigate the influence of the physical environment (built, natural, sound, and psychosocial environment) on the patients' well-being during different aspects in a patient journey. First, results showed that the complexity of the built environment and simulated physical ageing negatively influenced wayfinding performance. Second, results showed that the influence of the natural environment positively affected the patients' well-being during diagnostic scans. Third, results showed that a rule of conduct had a minor influence on the sound environment and results showed that preferences for social interest differed between individuals.

First, the results of these studies showed that space influenced patient outcome. Individuals experienced the hospital environment differently depending on the stage of the patient journey. In addition, findings showed that patient outcome depends on a variety of individual factors, such as physical, medical, and psychosocial aspects.

During wayfinding, the built complexity (i.e., more floor and building changes) influenced the wayfinding performance (i.e., efficiency) of all participants (Emma Zijlstra et al., 2016). In addition, the physiological outcomes of simulated elderly were also negatively affected, by having higher heart rates compared to young participants. They suggest that physical aspects of individuals, such as physical ageing, influence the experience and well-being of patients. Understanding the influence of the built environment and physical ageing will improve the wayfinding interventions and design of hospital environments. Consequently, these improvements potentially will lead to more autonomy of elderly in finding their way.

During diagnostics, the natural environment positively influenced the patient outcomes (Emma Zijlstra et al., 2017). Patients perceived less anxiety and physiological arousal when motion nature was projected. In addition, a medical factor of patients influenced the effect of motion nature projection on the physiological patient outcomes. Patients who did not receive beta-blockers were positively affected by motion nature projection and had lower heart rates when motion nature was projected. Understanding the influence of the natural environment and associated influence of medical factors can improve the effective use of an inexpensive and simple solution as a beamer.

Moreover, during the treatment, the sound environment was only slightly influenced by a non-talking rule of conduct (Emma Zijlstra et al., 2019). However, they argue that a psychosocial factor of interest in social contact influenced the perceived level of anxiety. Results have shown that different subgroups in patients can be defined regarding this factor, such as patients who prefer talking, patients who prefer non-talking, and patients without a preference.

Findings of these studies of Zijlstra et al. (2020) showed that a wide variety of patients visit a hospital and all patients of course bring an opinion of their own and experience their hospital visit differently. These different outcomes in stage and individuals emphasize that one size does not fit all in a hospital environment. Each journey step and patient group requires different space solutions. For instance, patients benefit from a simple building structure during wayfinding, inexpensive beamers to project nature during diagnostics, and a mix of treatment places with respect to social interest during infusion treatments. The well-being of patients can be significantly improved when the built, natural, and sound environment is taken into account with respect to individual differences.

In addition to spaces, Zijlstra (2020) argues that solutions can also be found in the alignment of spaces with services. First, by moving service points to decision points to improve wayfinding performance. Second, to allocate space to patients according their needs. To fulfill the needs of patients they should have the opportunity to choose where to receive the treatment, for example, a place to rest in silence or to interact with others. When assigning patients to treatment places or rooms, the planning department should be aware of the different preferences of patients. The role of healthcare professionals is to gather this information from patients in advance.



The results of these studies (Emma Zijlstra et al., 2016, 2017, 2019) show that it is of great importance to listen carefully to patient needs, as many of the results raised questions about the differences in outcomes. A hospital environment can have great impact on patient outcomes, by remaining critical and creative during the building process, according to Zijlstra (2020).

## REFERENCES

- Becker, F., & Parsons, K. S. (2007). Hospital facilities and the role of evidence-based design. *Journal of Facilities Management*, 5(4), 263–274. <https://doi.org/10.1108/1472596071082259>
- Berglund, B., Lindvall, T., & Schwela, D. (2000). New WHO guidelines for community noise. *Noise & Vibration Worldwide*.
- Bischoff, B., Hein, F., Meyer, T., Hadamitzky, M., Martinoff, S., Schömig, A., & Hausleiter, J. (2009). Trends in radiation protection in CT: Present and future status. *Journal of Cardiovascular Computed Tomography*, 3(2), 65–73.
- Browall, M., Koinberg, I., Falk, H., & Wijk, H. (2013). Patients' experience of important factors in the healthcare environment in oncology care. *International Journal of Qualitative Studies on Health and Well-Being*, 8, 1–10.
- Carlsson, S., & Carlsson, E. (2013). The situation and the uncertainty about the coming result scared me but interaction with the radiographers helped me through: A qualitative study on patients' experiences of magnetic resonance imaging examinations. *Journal of Clinical Nursing*, 22, 3225–3234.
- Cohen, S., Evans, G. W., Stokols, D., & Krantz, D. S. (1986). *Behavior, health, and environmental stress*. New York: Plenum press.
- Dantendorfer, K., Amering, M., Bankier, A., Helbich, T., Prayer, D., Youssefzadeh, S., ... Katschnig, H. (1997). A study of the effects of patient anxiety, perceptions and equipment on motion artifacts in magnetic resonance imaging. *Magnetic Resonance Imaging*, 15(3), 301–306.
- Davis, B. (2012). The elderly population. In *Environmental Psychology for Design* (pp. 133–154). New York: Fairchild.
- Dijkstra, K., Pieterse, M., & Pruyn, A. (2006). Physical environmental stimuli that turn healthcare facilities into healing environments through psychologically mediated effects: systematic review. *Journal of Advanced Nursing*, 56(2), 166–181.
- Donabedian, A. (1988). The quality of care: How can it be assessed? *Jama*. Retrieved from <http://jama.jamanetwork.com/article.aspx?articleid=374139>
- Dutch Hospital Association (NVZ). (2016). *25 jaar patiënt in beeld*. Retrieved from [https://www.nvz-ziekenhuizen.nl/\\_library/35423/Brancherapport\\_2016\\_NVZ.pdf](https://www.nvz-ziekenhuizen.nl/_library/35423/Brancherapport_2016_NVZ.pdf)
- Fitzsimmons, J. A., & Fitzsimmons, M. (2006). *Service management: Operations, strategy, information technology*.
- Gerber, T. C., Kantor, B., & McCollough, C. H. (2010). Radiation dose and safety in cardiac computed tomography. *Cardiology Clinics*, 27(4), 665–677.
- Harris, P. B., Ross, C., McBride, G., & Curtis, L. (2002). A place to heal: Environmental sources of satisfaction among hospital patients. *Journal of Applied Social Psychology*, 32(6), 1276–1299.
- Heyer, C. M., Thüring, J., Lemburg, S. P., Kreddig, N., Hasenbring, M., Dohna, M., & Nicolas, V. (2015). Anxiety of patients undergoing CT imaging: An underestimated problem? *Academic Radiology*, 22(1), 105–112.
- Hölscher, C., Büchner, S. J., Meilinger, T., & Strube, G. (2008). Adaptivity of wayfinding strategies in a multi-building ensemble: The effects of spatial structure, task requirements, and metric information. *Journal of Environmental Psychology*, 29(2), 208–219. <https://doi.org/10.1016/j.jenvp.2008.05.010>
- Hölscher, C., Meilinger, T., Vrachliotis, G., Brösamle, M., & Knauff, M. (2006). Up the down staircase: Wayfinding strategies in multi-level buildings. *Journal of Environmental Psychology*, 26(4), 284–299. <https://doi.org/10.1016/j.jenvp.2006.09.002>
- Johansson, L., Bergbom, I., Wayne, K. P., Ryherd, E., & Lindahl, B. (2012). The sound environment in an ICU patient room- A content analysis of sound levels and patient experiences. *Intensive and Critical Care Nursing*, 28(5), 269–279.
- Katz, R. C., Wilson, L., & Frazer, N. (1994). Anxiety and its determinants in patients undergoing magnetic resonance imaging. *Journal of Behavior Therapy and Experimental Psychiatry*, 25(2), 131–134.
- Li, K. Z. H., Lindenberger, U., Freund, A. M., & Baltes, P. B. (2001). Walking while memorizing: Age-related differences in compensatory behavior. *Psychological Science*, 12(3), 230–237. Retrieved from <https://journals-sagepub-com.proxy-ub.rug.nl/doi/pdf/10.1111/1467-9280.00341>

- Lower, J., Bonsack, C., & Guion, J. (2003). Peace and quiet. *Nursing Management*, 34(4), 40A-40D.
- Mackrill, J., Cain, R., & Jennings, P. (2013). Experiencing the hospital ward soundscape: Towards a model. *Journal of Environmental Psychology*, 36, 1–8.
- Malenbaum, S., Keefe, F. J., Williams, A. C. de C., Ulrich, R., & Somers, T. J. (2008). Pain in its environmental context: Implications for designing environments to enhance pain control. *Pain*, 134(3), 241–244.
- Monti, F., Agostini, F., Dellabartola, S., Neri, E., Bozicevic, L., & Pocecco, M. (2012). Pictorial intervention in a pediatric hospital environment: Effects on parental affective perception of the unit. *Journal of Environmental Psychology*, 32, 216–224.
- Munn, Z., & Jordan, Z. (2011). The patient experience of high technology medical imaging: A systematic review of the qualitative evidence. *Radiography*, 17(4), 323–331.
- Park, M. J., Yoo, J. H., Cho, B. W., Kim, K. T., Jeong, W.-C., & Ha, M. (2014). Noise in hospital rooms and sleep disturbance in hospitalized medical patients. *Environmental Health and Toxicology*, 29, 1–6.
- Pine II, J. B., & Gilmore, J. H. (1998). Welcome to the experience economy. *Harvard Business Review*, 4(76), 97–105.
- Rousek, J. B., & Hallbeck, M. S. (2011). Improving and analyzing signage within a healthcare setting. *Applied Ergonomics*, 42(6), 771–784. <https://doi.org/10.1016/j.apergo.2010.12.004>
- Stichler, J. F. (2001). Creating healing environments in critical care units. *Critical Care Nursing Quarterly*, 24(3), 1–20.
- Tanja-Dijkstra, K., Pahl, S., White, M. P., Andrade, J., Qian, C., Bruce, M., ... Slater, M. (2014). Improving dental experiences by using virtual reality distraction: A simulation study. *PLoS ONE*, 9(3), 1–10.
- Ulrich, R., Quan, X., Zimring, C., Joseph, A., & Choudhary, R. (2004). *The role of the physical environment in the hospital of the 21st century: A once-in-a-lifetime opportunity*.
- Ulrich, R.S., Zimring, C., Zhu, X., DuBose, J., Seo, H., Choi, Y., ... Herndon, M. (2008). *A review of the research literature on evidence-based healthcare design*. *Health Environments Research & Design Journal* (Vol. 1).
- Ulrich, Roger S. (1981). Natural versus urban scenes some psychophysiological effects. *Environment and Behavior*, 13(5), 523–556.
- Ulrich, Roger S. (1984). View through a window may influence recovery. *Science*, 224, 420–421.
- Vincent, E., Battisto, D., Grimes, L., & Mccubbin, J. (2010). The effects of nature images on pain in a simulated hospital patient room. *HERD: Health Environments Research & Design Journal*, 3(3), 42–55.
- Zijlstra, E. (2020). *Patient-centered hospital design: Understanding the holistic experience of the patient journey (in press)*. Dissertation. Groningen: University of Groningen/Hanze University of Applied Sciences.
- Zijlstra, E., Hagedoorn, M., Krijnen, W. P., van der Schans, C. P., & Mobach, M. P. (2016). Route complexity and simulated physical ageing negatively influence wayfinding. *Applied Ergonomics*. <https://doi.org/10.1016/j.apergo.2016.03.009>
- Zijlstra, E., Hagedoorn, M., Krijnen, W. P., van der Schans, C. P., & Mobach, M. P. (2017). Motion nature projection reduces patient's psycho-physiological anxiety during CT imaging. *Journal of Environmental Psychology*, 53, 168–176. <https://doi.org/10.1016/j.jenvp.2017.07.010>
- Zijlstra, E., Hagedoorn, M., Krijnen, W. P., van der Schans, C. P., & Mobach, M. P. (2019). The effect of a non-talking rule on the sound level and perception of patients in an outpatient infusion center. *PLoS ONE*, 1–15.

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**THEME 3:**  
**ASPECTS ON HEALTHY WORKING AND LIVING**

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Contributions by *Innovation Labs Healthy Workspace* and *Healthy Cities*,  
Research Centre for Built Environment NoorderRuimte  
Hanze UAS

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## Tool Development and Application for Vital Workspace: A Dutch Example of Facility Management Valorisation

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### ABSTRACT

**Background and aim** – The aim of this paper is present how application of the innovative Indoor Comfort Index (ICI) method reveal the actual indoor environmental quality (IEQ) and the perceived IEQ and its influence on office workers productivity. Application of this tool in a pre and post-test after an office refurbishment, will reveal the effectiveness of this intervention. The development and application of this tool, emerged from education and research in facility management, led to a spin-off consultancy firm Vital Workplace.

**Methods** – Actual measurements of the IEQ conditions, combined with users' perceptions of the IEQ, before and after an office refurbishment, reveals the effectiveness of a refurbishment by analysing the differences between the pre and post-test with multiple statistical analyses.

**Results** – Regarding the IEQ, the ICI reveals not only the actual performance of an office building, also if improved conditions contribute to improved comfort of office workers. In addition, the possible influence of the IEQ on office workers productivity is revealed. This allows facility managers to determine and improve the alignment of environment quality with workers' activities and performance.

**Originality** – The tool combines actual and perceived environmental quality at office buildings.

**Practical or social implications** – Education and research can be used to create spin-offs in facility management. The developed tool can be used to diagnose the current state of the office, a basis for discussion on related improvements, and by doing so, for a cost-benefit analyses of design interventions at organizations. Showing if design impact on users outweigh the costs of real estate, refurbishment, and changes in operations.

**Type of paper** – Research paper.

### KEYWORDS

Facts, health, indoor environment quality, office, perceptions, performance, spin-off.

### INTRODUCTION

Organisations invest a substantial amount of time, money and attention to establish an attractive physical environment (Veldhoen, 2004) and one workstation costs employers 9,000 euros per year (Chang, 2019). For organisations, it is vital that these costs are well spend and will contribute to employee welfare. However, surprisingly little is known about the difference between fact and perception in relation to the indoor environment (IE), which is a system of the indoor air quality (IAQ), thermal conditions, acoustic conditions, and lighting conditions (Frontczak & Wargocki, 2011). In this study the Indoor Comfort Index (ICI) is presented, a tool which measures the actual indoor environmental quality (IEQ) in offices and the perceived IEQ of office workers. The purpose of this tool is to provide information about how well the office building performs and how office workers perceive the quality of this building. Based on this information, employers are able to determine if improvements should be made, or if an intervention is successful. By combining objective with the perceptions of users, the ICI provides a powerful insight into the effectiveness of office management measures and facilitate innovative building management. Based on the outcome of the ICI, organisations can make adjustments and implement improvements in order to provide a healthier indoor environment for office workers, and by doing so, contributing to improved office workers welfare.

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The IEQ influences office workers health and well-being. Exposure to low-quality air, for example, can have serious consequences for human health (Boerstra, Atze, Beuker, Loomans, & Hensen, 2013). Poor indoor environmental conditions can cause building-related health issues, causing a sick building syndrome (SBS). An important characteristic of these health issues, such as sore throats and dry coughs, is that they usually disappear quickly once employees have left the 'sick' building. For employers it is essential to know if their buildings cause SBS related complaints among their office workers, the ICI will provide employers with information about the presence and the amount of complaints. However, further research is required to conclusively establish this as fact, when the ICI is only been used once as an assessment tool. Nevertheless, in the meantime building managers can still use the ICI results to optimise their buildings in order to provide a comfortable place for office workers to work. Office buildings should never be detrimental to employees' health and these buildings should contribute to improved performance and job satisfaction.

In order to determine the comfort level of a building, the quality of the working environment and the extent to which the working environment can be adapted to the wishes of office workers has to be assessed (NEN-EN 16798, 2019). The ICI determines the comfort level of office workers on the basis of seven factors. The first factor is thermal comfort. Thermal comfort of people can be defined as a subjective response, or state of mind, where a person expresses satisfaction with the thermal environment (Olesen & Brager, 2004). While it may be partially influenced by a variety of personal (e.g. clothing and activity), contextual, and cultural factors, a person's sense of thermal comfort is primarily a result of the body's heat exchange with the environment. In the context of an office building, seated office workers may also be exposed to local discomfort (NEN-EN-ISO 7730, 2005), and individual differences should be taken into account (Brink & Mobach, 2016). The second factor is indoor air quality (IAQ). Aspects that play a role are how fresh air is supplied and the ventilation rate within the building (NEN-EN 16798, 2019). The third factor is acoustic comfort. Acoustic comfort is determined by the noise that can be heard by employees at their workplace. Noise can originate from noise sources from as well as outside as inside the building (NEN-EN 16798, 2019). The fourth factor is visual comfort. Aspects which determine visual comfort are the perception of light in the building and the amount of artificial and daylight in relation to the necessary light to perform well (NEN-EN 16798, 2019). The fifth factor is view. View can play a role in the way an individual office worker experiences comfort. Aspects that play a role here are what can be seen by office workers from their workplace. The sixth factor is privacy. This factor is not explicitly mentioned in the NEN-EN 16798 (2019). Nevertheless, research by Newsham, Veitch, and Charles(2008), for example, shows that the sound experience is strongly related to the employees' sense of privacy. In fact, they claim that these two factors combined form a scale. Boerstra, van Dijken, Marinus, Hulsman, and Snepvangers (2018) also link sound perception to the feeling of privacy. The ICI includes privacy as a separate factor in order to investigate possible relations between this factor and other factors. The seventh, and last factor, is individual controllability. The ICI analyses the extent to which users of the office building- per person or per room- can influence light, air, temperature and noise to their personal needs.

## DESIGN, PARTICIPANTS, PROCEDURES AND ANALYSES

The ICI was originally developed, a number of years ago, as an educational tool within the 'Healthy and sustainable buildings' (HSB) course for first-year students of Facility Management at Hanze University of Applied Sciences (UAS). In order to give first-year students an insight in the IEQ an office building, groups of students were given the assignment to measure the air temperature, indoor humidity, CO<sub>2</sub> concentration, sound pressure level, and illuminance levels. Based on this information, the students gained insights in the actual IEQ of a building. This measurement method was later supplemented with office workers perceptions in relation to the IEQ, rating of the IEQ and the perceived influence of the actual IEQ on their productivity.

The ICI method consist of two parts. The first part involves direct observations and equipment-based measurements, resulting in a set of independent variables. The physical measurements consisted of air temperature, relative humidity, carbon dioxide concentration, ambient sound pressure, and illuminance level. Appendix 1 presents the measured physical indoor environmental parameters, the applied measuring equipment and the accuracy of this equipment.

The second part is a perception study, when office workers are interviewed at their workplace. The personal characteristics and the perceived IEQ is collected with a self-composed questionnaire. Table 2 presents the topics covered in this questionnaire. In addition, office workers are asked to rate the actual IEQ on a scale from 1 (very poor) to 10 (excellent) and are asked if the actual IEQ negatively influence their productivity on a 5-point-Likert scale. This results in a set of dependent variables.

In order to obtain reliable measurements, a representative sample of the population must be interviewed. Longitudinal measurements boost reliability and validity, enabling more accurate conclusions to be drawn in relation to actual performance of the office building and level of comfort of office workers. Both cross-sectional and longitudinal measurements will increase the knowledge about the actual performance en level of comfort of an office building over a period of time.

In this study the findings are presented of the actual performance of an office building, located in the middle of the Netherlands, and the perceived level of comfort of office workers before and after a complete office refurbishment. Junior researchers and a supervisor of the School of Facility Management of the Hanze UAS Groningen, The Netherlands, collected data of workstations and their occupants in the June 2016 and in June 2019. First, analysed the internal validity of the PIEQ was analysed. Therefore, seven scales for the PIEQ were composed, i.e. indoor air quality, warm thermal comfort sensation, cold thermal comfort sensation, acoustic comfort, visual comfort, view, and privacy. Based on the response of 2016, conducted a Cronbach's alpha was conducted to test internal consistency. This analysis showed that all statements for perceived comfort contributed to the reliability of the composed scales. Table 2 shows the seven perception scales for the IEQ, the topics which were covered by the statements and the alpha of the composed scale. Because all alphas were higher than 0.70, perception scales for all six categories were composed. Furthermore, the actual IEQ and the perceived IEQ of 2019 were compared with the conditions of 2016 and independent T-tests (two-tailed) were performed in order to determine if the differences between the observed values was significant. To determine the influence of the PIEQ on the perceived productivity, a multiple linear regression analyses was performed. All statistical analyses were performed with IBM SPSS Statistics version 25.

**Table 2** Perceived Indoor Environmental Quality categories, Topics, and Cronbach's Alpha's

Category	Topics covered	$\alpha$
Perceived indoor air quality	Odour intensity and character; ventilation; moisture	0.83
Thermal comfort- warm	Thermal sensation; warm body parts; radiation	0.80
Thermal comfort- cold	Thermal sensation; cold body parts; draught; radiation	0.81
Acoustic comfort	Noise from within and outside the office; noise disturbance	0.90
Visual comfort	Reflections; glare; contrast; colour sensations; (day)light	0.86
View	Quality of view	0.83
Privacy	Need for more quit circumstances	0.89

## RESULTS

We collected in 2016 data of 344 workstations and in 2019 data of 59 workstations and their occupants. Table 3 presents the demographic characteristics of the respondents in 2016 and 2019. During the pre-test in 2016, data were collected from all workplaces and their occupants, which were spread across the seven floors of the office building. During the post-test in 2019, the data were collected of the workplaces and their occupants on the first and second floor, because only on these floors the refurbishment was completed. This explains the difference in number of respondents in 2016 and 2019, 11 respondents participated as well as in 2016 as in 2019. These respondents, who worked in 2019 on the first and second floor, worked on different floors in 2019.

**Table 3** Demographic characteristics of respondents

	2016	2019
Number of respondents (n)	344	57
Mean age (s.d.)	43 (10.0)	39 (10.1)
Male	47%	28%
Female	54%	72%

Furthermore, the actual indoor environmental conditions of 2019 were compared with the conditions of 2016 and analysed if the differences between two observed values were significant. Table 3 presents the actual indoor environmental conditions of the two periods, the calculated differences and the significance level of these differences.

**Table 4** Actual indoor environmental conditions in 2016 and 2019

	2016 (n=344)		2019 (n=57)		Difference 2019-2016	
	M	SD	M	SD	M	SD
T <sub>out</sub>	18.0	2.3	15.2	1.2	-2.8	-1.1
T <sub>a</sub>	23.8	1.1	23.7	0.5	-0.1	-0.6
T <sub>a</sub> <sup>fl</sup>	23.7	1.1	23.7	0.5	0	-0.6
RH <sub>i</sub>	62.7	4.6	47.8	4.6	-14.9	0
RH <sub>o</sub>	78.4	13.1	76.5	7.0	-1.9	-6.1
CO <sub>2</sub>	591.0	86.2	551.7	47.5	-39.3***	-38.7
BGN <sub>av</sub>	51.8	7.5	39.5	5.4	-12.3***	-2.1
E <sub>amb</sub>	625.1	338.8	698.6	402.4	73.5	63.6
View	2.5	0.9	2.9	0.4	0.3	-0.5
***p≤ 0.001						

Finally, the average perception scores was calculated for all categories. The PIEQ of 2019 was compared with the PIEQ of 2016 and analysed the differences between two observed values. Table 4 presents the PIEQ of the two periods of all seven categories, the calculated differences and the significance level of these differences.

**Table 5** Perception scores of the indoor environmental conditions in 2016 and 2019

Category	2016 (n=344)		2019 (n=57)		Difference 2019-2016	
	M <sup>1</sup>	SD	M <sup>1</sup>	SD	M1	SD
Perceived indoor air quality	3.0	0.8	3.6	0.8	0.6***	0.0
Thermal comfort – warm <sup>2</sup>	2.6	0.9	2.2	0.8	-0.4**	-0.1
Thermal comfort – cold <sup>3</sup>	1.8	0.8	1.9	0.8	0.1**	0.0
Acoustic comfort	3.8	0.7	3.9	0.7	0.1	0.0
Visual comfort	4.0	0.6	4.4	0.6	0.4	0.0
View	3.2	0.9	2.8	0.8	-0.4**	-0.1
Privacy	3.5	0.9	3.5	1.0	0.0	0.1

<sup>1</sup> Lowest score is 1 (very poor) and the highest score is 5 (very good)

<sup>2</sup> A low mean score (1) means that the respondents do not experience warm thermal conditions, a high mean score (5) means that the respondents experience very warm thermal conditions

<sup>3</sup> A low mean score (1) means that the respondents do not experience cold thermal conditions, a high mean score (5) means that the respondents experience very cold thermal conditions

\*\*p≤ 0.01 \*\*\*p≤ 0.001

The respondents rated the perceived IEQ in 2016 with a score of 5.8 and in 2019 with a score of 7.0 (two-tailed, p<0.001). The respondents rated the negative influence of the actual IEQ on their productivity in 2016 with a score of 2.95 and in 2019 this score was 2.32 (two-tailed, p<0.001). A multiple linear regression analyses was performed to determine which of PIEQ conditions contribute to the overall influence on office workers productivity. The contribution of perceived influence of IAQ and thermal com-

fort contributed to the overall model ( $p < 0.001$ ) significantly, with respectively a beta of 0.31 ( $p < 0.001$ ) and 0.43 ( $p < 0.001$ ) in 2016 and with respectively a beta of 0.39 ( $p < 0.001$ ) and 0.49 ( $p < 0.001$ ) in 2019

## DISCUSSION AND CONCLUSIONS

Only 11 respondents participated in the pre and post-tests. An independent T-test (two-tailed) was chosen due to size differences of the populations in the pre and post-tests. The demographic characteristics of the two populations are different and might explain the significant difference in warm thermal sensation in the post-test, due to the fact that relatively more female workers participated in the post-test. Males in general are feeling hotter and react more rapidly to changes in temperature (Wyon, Andersen, & Lundqvist, 1972). Based on the measured variables, the actual IEQ differs only significantly regarding the IAQ, background noise level, and view. Although the observed CO<sub>2</sub> concentration is relatively low in as well as 2016 as 2019 based on current guidelines (NEN-EN 16798, 2019), the improved conditions in 2019 led also to a higher perceived IAQ. Surprisingly, the significant reduction of background noise only led to a minor, not significant, improvement of the perceived acoustic comfort. This might be explained by the more open plan office design which was implemented in 2019. Noise is the most frequent reason for complaints about environmental conditions in the workplace, specifically in open plan offices (Lee & Aletta, 2019). Although the actual quality of view increased, the perceived quality of view declined significantly and cannot be explained. Overall, the perceived indoor environmental quality improved after the refurbishment. Respondents rated the overall indoor environmental quality 13% higher. Therefore, it is concluded that, based on the outcome of the ICI tool, that the actual IEQ only improved only little after refurbishment. However, the perceived thermal comfort and IAQ improved significantly and reduced perceived productivity loss of the office workers.

## THE SPIN-OFF

Evidently, improvements offices are urgent, but how can research help? After all, the challenge to such problems is to provide decision makers, designers, and users with evidence about a current situation, and at the same time inspire them to make the right design interventions for improvement. Vital WorkSpace, a spin-off firm of the Hanze UAS Groningen, offers application of the ICI tool to all companies. This firm was founded by a member of the Hanze research group Facility Management (FM) of the Hanze UAS and will be supported by the research group and all collected data will remain accessible for research and innovation purposes. Validated instruments were developed by the research group allowing solid practical applications. Focal points are workplace quality and user perceptions. Results enable organisations to advance workspace quality. Vital WorkSpace has already acquired a number of regular clients providing them with information about actual and perceived working conditions. Moreover, the spin-off provides organisations with evidence about the effectiveness of office refurbishments, for instance, with longitudinal comparative case study designs, as presented in this study. By doing so, it compares changes in judgements of fact and value judgements, such as worker experiences. This creates a basis for a cost-benefit analyses of design interventions: does design impact on users outweigh the costs of real estate, refurbishment, and changes in operations?

## ENTREPRENEURSHIP

The ICI already provided multiple scientific contributions, for instance, on the quality and satisfaction of thermal comfort in Dutch offices (Brink & Mobach, 2016). Together with doctoral candidates and student researchers, Vital WorkSpace will remain to contribute to research and the research group FM will continue to deliver high-quality measurement tools, developed by the Research Group FM, Research Centre on Built Environment, and Centre of Expertise for Entrepreneurship of the Hanze UAS. The start-up was established with the aid of a grant from the National Taskforce for Applied Research (SiA), which is part of the Netherlands Organisation for Scientific Research (NWO).

## REFERENCES

- Boerstra, A. C., van Dijken, F., Marinus, E., Hulsman, L. P., & Snepvangers, C. A. M. (2018). *Binnenmilieu (AI-24) Thermisch binnenklimaat, luchtkwaliteit, geluid, licht en uitzicht.* ( ). Houten: SDU.
- Boerstra, A., Beuker, T., Loomans, M., & Hensen, J. (2013). Impact of available and perceived control on comfort and health in european offices. *Architectural Science Review*, 56(1), 30-41.



- Brink, H. H., & Mobach, M. M. (2016). 6.2 quality and satisfaction of thermal comfort in dutch offices. *Published 2016*, , 162.
- Chang, S. J. (2019). Huisvestings- en facilitaire kengetallen 2019. Retrieved from <https://www.twynstragudde.nl/inzichten/huisvestings-en-facilitaire-kengetallen-2019>
- Frontczak, M., & Wargocki, P. (2011). Literature survey on how different factors influence human comfort in indoor environments. *Building and Environment*, 46(4), 922-937. doi:10.1016/j.buildenv.2010.10.021
- Lee, Y., & Aletta, F. (2019). Acoustical planning for workplace health and well-being: A case study in four open-plan offices. *Building Acoustics*, 26(3), 207-220.
- NEN-EN 16798. (2019). *Energy performance of buildings - ventilation for buildings - part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics - module M1-6*. ( No. ICS 91.120.10; 91.140.01). Brussels: European Committee For Standardization.
- NEN-EN-ISO 7730. (2005). *Ergonomics of the thermal environment – analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria* . ( No. ICS 13.180). Brussels: European Committee For Standardization.
- Newsham, G. R., Veitch, J. A., & Charles, K. E. (2008). Risk factors for dissatisfaction with the indoor environment in open-plan offices: An analysis of COPE field study data. *Indoor Air*, 18(4), 271-282.
- Olesen, B. W., & Brager, G. S. (2004). A better way to predict comfort: The new ASHRAE standard 55-2004. *ASHRAE Journal*,
- Veldhoen, E. (2004). *The art of working* Sdu Uitgevers.
- Wyon, D. P., Andersen, I., & Lundqvist, G. R. (1972). Spontaneous magnitude estimation of thermal discomfort during changes in the ambient temperature. *Epidemiology & Infection*, 70(2), 203-221.

**APPENDIX 1:****INDOOR ENVIRONMENTAL PARAMETERS, SYMBOLS AND DESCRIPTION OF MEASURING**

Variable	Symbol	Description Of Measuring
Outdoor air temperature	$T_{out}$	The outside temperature and the outside humidity was derived from a reliable open source, <a href="http://www.weerplaza.nl">www.weerplaza.nl</a> , at the moment the occupant was questioned
Indoor air temperature at desktop height	$T_a$	Air temperature in degrees Celcius (°C) and is measured with an TESTO 610 temperature and humidity sensor at desktop height (average 0.7m), accuracy $\pm 0.5$ °C @ -10 to +50 °C
Indoor air temperature at floor	$T_{afl}$	Air temperature in degrees Celcius (°C) and is measured with an TESTO 610 temperature and humidity sensor at desktop height (average 0.7m), accuracy $\pm 0.5$ °C @ -10 to +50 °C
Indoor relative humidity	$RH_i$	Indoor relative humidity in percentage (%) and is measured with a TESTO 610 temperature and humidity sensor at desktop height (average 0.7m), accuracy $\pm 2.5$ % $RH_i$ @ 5 to 95 % $RH_i$
Background noise	BGN	Average sound pressure level in dB(A) over a period of 45 seconds and is measured with a Velleman DEM201, accuracy +/- 1.4 dB 94 dB @ 1 kHz
Carbon dioxide concentration	$CO_2$	Parts per million carbon dioxide concentration (ppm $CO_2$ ) is measured with a Atal ENV-MB350NV carbon dioxide sensor on the desktop, accuracy $\pm 30$ ppm + 5% of the actual reading
Ambient illuminance	$E_{amb}$	Illuminance level in Lux and is measured with a VOLT CRAFT MS-1300, accuracy $\pm 5\%$ + 10 digits @ < 10.000 lux

## Breastfeeding Facilities: FM Can Make a Change!

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### ABSTRACT

Breastfeeding has important long-term health consequences, not only for infants, but also for mothers. Researchers have calculated that scaling up breastfeeding could annually prevent 823,000 child deaths and 20,000 breast cancer deaths worldwide. Because of the important effects of breastfeeding, the World Health Organization advises mothers to breastfeed for minimally 2 years. However, breastfeeding rates are low, especially in the western parts of the world. One of the most important reasons to discontinue breastfeeding is the often-difficult combination of breastfeeding and work. Research shows that many mothers don't have access to a suitable space to express milk at work. For FM professionals it is crucial to realize that the availability of breastfeeding facilities is important for organizations too. Breastfeeding improves the health and well-being of infants and mothers, which leads to reduced sick leave and health care costs. Moreover, breastfeeding support at work can lead to higher job satisfaction, a better work-life balance, and can reduce staff turnover. Therefore, offering good breastfeeding facilities creates a win-win situation, benefitting mothers, babies, and organizations. Facility managers are in a unique position to secure a healthier work environment that makes combining work and breastfeeding easy and feasible. FM can make a change!

**Type of paper** – Position paper.

### KEYWORDS

Breastfeeding, facilities, gender, space, work.

### HEALTHY WORKPLACES FOR WOMEN

In recent years, facility management (FM) has made substantial progress in creating healthier workplaces. Indeed, facility managers and FM scientists have paid more attention to preventive measures to boost workers' health and wellbeing (i.e., offering healthy food choices, exercise programs, a healthy indoor climate, and stress-relief and relaxation programs). Such actions are considered to be beneficial not only to employees, but also to organizations as a whole (for instance, because of increased productivity). However, one topic that has frequently been neglected concerns measures that could be taken to facilitate the labor participation of women. The topic is highly relevant, not only to respect diversity and stimulate inclusiveness, but also to foster a healthier workplace. Realizing breastfeeding facilities may be the best example in this context. Good breastfeeding facilities are still often lacking, even though, in the past decades, labor participation of women has increased, and more increases are expected.

### IMPACT OF BREASTFEEDING ON WORKERS' HEALTH AND WELLBEING

Breastfeeding has important long-term health consequences, not only for infants, but also for mothers. In a 2016 meta-analysis (Victoria et al., 2016), it was shown that for infants, breastfeeding protects against infections (e.g., gut, respiratory, middle ear), SIDS, childhood leukemia, dental malocclusions, overweight and, diabetes. For mothers, breastfeeding protects against breast cancer, ovarian cancer and diabetes and improves birth spacing. In addition, recent research shows possible protection against high blood pressure, heart disease, and an early onset of menopause (Kirkegaard et al., 2018; Langton et al., 2020; Peters et al., 2017). Researchers have calculated that scaling up breastfeeding to near-universal levels could annually prevent 823,000 child deaths worldwide and

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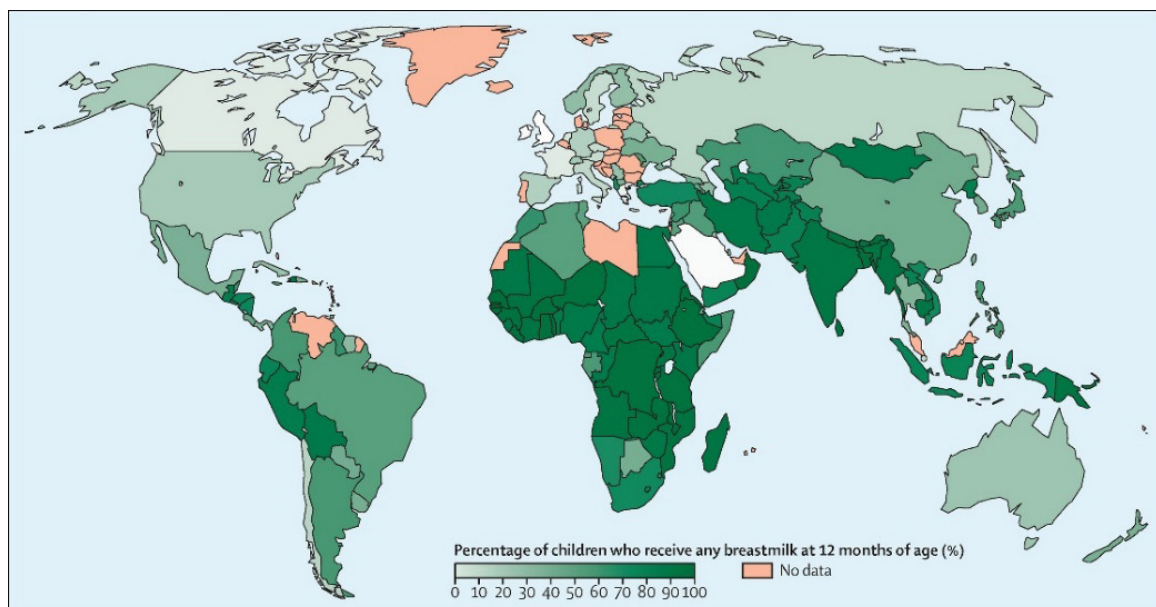
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20,000 breast cancer deaths worldwide (Victora et al., 2016). In addition, breastfeeding has effects on an array of psychological outcomes for mother and child. Breastfeeding impacts children's brain, cognitive, and socio-emotional development, influences mothers' mood, affect, stress, and maternal care, and can contribute to positive mother-infant relationships (Krol & Grossmann, 2018; Liu, Leung, & Yang, 2014; Peñacoba & Catala, 2019; Weaver, Schofield, & Papp, 2018). Clearly, this host of consequences indicates that increased attention and care from the FM domain is warranted.

### LOW BREASTFEEDING RATES

Because of the important effects of breastfeeding on health and well-being, the World Health Organization advises mothers to breastfeed for minimally 2 years. (World Health Organization, 1995). It is advised to breastfeed exclusively (so without any other foods or drinks) for the first six months, and then continue for up to 2 years of age or longer in combination with other foods and drinks, for as long as mother and child want to. However, breastfeeding rates are low in most countries of the world (Victora et al., 2016). The percentage of children that still receive any breast milk at 12 months is already low in most countries of the world, and especially in the western parts of the world (see figure 2). In the Netherlands, 80% of mothers start with breastfeeding, but only 39% is still breastfeeding exclusively at 6 months (Peeters, Lanting, & Van Wouwe, 2015). These mothers often stop breastfeeding because they experience difficulties with the breastfeeding process. Specifically, one of the most important reasons to discontinue breastfeeding is the often difficult combination of breastfeeding and work (Odom, Li, Scanlon, Perrine, & Grummer-Strawn, 2013; Rollins et al., 2016)



**Figure 1** Percentage of children who receive any breastmilk at 12 months of age worldwide (Victora et al., 2016)

### LACK OF ADEQUATE BREASTFEEDING FACILITIES

When a mother is breastfeeding, she needs to express breast milk regularly during a workday (usually two or three times per day). This is important to avoid a build-up of milk that can lead to medical problems and to keep up milk production to be able to continue breastfeeding. In order to express breast milk, a woman needs time and a suitable space to do so. Legislation in most countries of the world already stipulates paid breastfeeding breaks; however, provisions on nursing facilities are present in the legislation of only one third of the countries (International Labour Organization, 2014). Moreover, such provisions are no guarantee that nursing facilities will actually be present. For example, in the Netherlands an employer should provide a suitable, lockable, and private space for breastfeeding by law. However, research shows that 32% of Dutch workers who breastfeed do not have access to a lactation room at all (Commissie Gelijke Behandeling, 2012) and 24% have access to a lactation room that cannot be locked (Inspectie Sociale Zaken en Werkgelegenheid, 2015). These percentages are similar in other countries. For example, 55% of US nursing mothers don't have access to a private space to express milk

(Kozhimannil, Jou, Gjerdingen, & McGovern, 2016). This means that many mothers have to either stop breastfeeding prematurely, or express milk in spaces that were not designed for this purpose and that are often not suitable and hygienic, for example, storage closets, empty conference rooms, or even toilets (see Figure 2).



**Figure 2** Photograph from the series ‘Melk in de meterkast’ about lactation rooms of 23 Dutch women (Floor Fortunati, 2019)

### THE POWER OF FM: WE CAN MAKE A CHANGE!

For professionals in the field of FM it is important to realize that a lack of adequate breastfeeding facilities does not only have a negative impact on mothers and infants, but also on organizations. Indeed, breastfeeding improves the health and well-being of infants and mothers, which leads to reduced sick leave and health care costs. Moreover, breastfeeding support at work can lead to higher job satisfaction, a better work-life balance (Jantzer, Anderson, & Kuehl, 2018), and it can even reduce staff turnover (Ortiz, McGilligan, & Kelly, 2004). This means that offering good breastfeeding facilities creates a win-win situation, benefitting mothers (as workers), baby’s (as new generations of healthier workers), and organizations (health, productivity, corporate image). So, FM can play a key role in advancing health for organizations and societies. A first step in creating good breastfeeding facilities is naturally to make sure that the existing guidelines are followed and that every breastfeeding mother has a suitable, lockable, private space for breastfeeding. Furthermore, a new study indicates that not only functional features, but also psychological features, such as aesthetics and possibilities for relaxation and recreation, play an important role in creating good breastfeeding facilities (van Dellen, Wisse, Mobach, Casper, & Dijkstra, in preparation). In Groningen, other studies are currently carried out on the effects of design features that promote relaxation, and the possibility to employ mindfulness as a tool for breastfeeding mothers to improve breastfeeding outcomes. As a final thought, it is important to underscore that facility managers are in a unique position to guard the interests of the whole workforce, so also of female employees, by securing a healthier work environment that makes the combination of work and breastfeeding easy and feasible. The benefits are many, start now. FM can make a change!

### REFERENCES

- Commissie Gelijke Behandeling. (2012). *Hoe is het bevallen? Onderzoek naar discriminatie van zwangere vrouwen en moeders met jonge kinderen op het werk.*
- Inspectie Sociale Zaken en Werkgelegenheid. (2015). *Arbo in bedrijf 2014. Een onderzoek naar de naleving van arboverplichtingen, blootstelling aan arbeidsrisico’s en genomen maatregelen in 2014.*
- International Labour Organization. (2014). *Maternity and paternity at work: Law and practice across the world.*

- Jantzer, A. M., Anderson, J., & Kuehl, R. A. (2018). Breastfeeding support in the workplace: The relationships among breastfeeding support, work–life balance, and job satisfaction. *Journal of Human Lactation*, 34(2), 379-385.
- Kirkegaard, H., Bliddal, M., Størvring, H., Rasmussen, K. M., Gunderson, E. P., Køber, L., . . . Nohr, E. A. (2018). Breastfeeding and later maternal risk of hypertension and cardiovascular disease—The role of overall and abdominal obesity. *Preventive Medicine*, 114, 140-148.
- Kozhimannil, K. B., Jou, J., Gjerdingen, D. K., & McGovern, P. M. (2016). Access to workplace accommodations to support breastfeeding after passage of the affordable care act. *Women's Health Issues*, 26(1), 6-13.
- Krol, K. M., & Grossmann, T. (2018). Psychological effects of breastfeeding on children and mothers. *Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz*, 61(8), 977-985.
- Langton, C. R., Whitcomb, B. W., Purdue-Smithe, A. C., Sievert, L. L., Hankinson, S. E., Manson, J. E., . . . Bertone-Johnson, E. R. (2020). Association of parity and breastfeeding with risk of early natural menopause. *JAMA Network Open*, 3(1), e1919615.
- Liu, J., Leung, P., & Yang, A. (2014). Breastfeeding and active bonding protects against children's internalizing behavior problems. *Nutrients*, 6(1), 76-89.
- Odom, E. C., Li, R., Scanlon, K. S., Perrine, C. G., & Grummer-Strawn, L. (2013). Reasons for earlier than desired cessation of breastfeeding. *Pediatrics*, 131(3), e726-e732.
- Ortiz, J., McGilligan, K., & Kelly, P. (2004). Duration of breast milk expression among working mothers enrolled in an employer-sponsored lactation program. *Pediatric Nursing*, 30(2), 111-119.
- Peeters, D., Lanting, C. I., & Van Wouwe, J. P. (2015). *Peiling melkvoeding van zuigelingen 2015* Leiden: TNO.
- Peñacoba, C., & Catala, P. (2019). Associations between breastfeeding and Mother–Infant relationships: A systematic review. *Breastfeeding Medicine*, 14(9), 616-629.
- Peters, S. A., Yang, L., Guo, Y., Chen, Y., Bian, Z., Du, J., . . . Woodward, M. (2017). Breastfeeding and the risk of maternal cardiovascular disease: A prospective study of 300 000 chinese women. *Journal of the American Heart Association*, 6(6), e006081.
- Rollins, N. C., Bhandari, N., Hajeebhoy, N., Horton, S., Lutter, C. K., Martines, J. C., . . . Group, The Lancet Breastfeeding Series. (2016). Why invest, and what it will take to improve breastfeeding practices? *The Lancet*, 387(10017), 491-504.
- van Dellen, S. A., Wisse, B., Mobach, M. P., Casper, A., & Dijkstra, A. (in preparation). *What a room! the impact of lactation room quality on breastfeeding mothers*. Unpublished manuscript.
- Victora, C. G., Bahl, R., Barros, A. J., França, G. V., Horton, S., Krasevec, J., . . . Rollins, N. C. (2016). Breastfeeding in the 21st century: Epidemiology, mechanisms, and lifelong effect. *The Lancet*, 387(10017), 475-490.
- Weaver, J. M., Schofield, T. J., & Papp, L. M. (2018). Breastfeeding duration predicts greater maternal sensitivity over the next decade. *Developmental Psychology*, 54(2), 220.
- World Health Organization, (. (1995). The world health organization's infant-feeding recommendation. *WHO Weekly Epidemiological Record*, 17, 117-220.

# The Dangers of Urban Decline and the Role of Facility Management in Reducing Associated Safety and Health Risks

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## ABSTRACT

**Background and aim** – This paper studies urban decline, the process in which the built environment suddenly or gradually loses its practical, technical and economic functionality, resulting in it being abandoned by its legitimate occupants and neglected by its owners for an extended period of time. Recent European examples of urban decline as well as five German examples were studied. This is followed by a reflection on the risks for public safety and public health that these examples show and the possible role of facility managers in diminishing these risks.

**Methods / Methodology** – Data were collected by means of desk research and direct observations

**Results** – At all locations public safety and public health risks were considerable. Direct observations at five German locations show extensive urban decline.

**Originality** – Identifying safety and health risks in abandoned buildings and connecting these issues to the facility management profession offers a new perspective on dealing with urban decay.

**Practical or social implications** – Abandoned buildings that are easily accessible to the public generate considerable risks for public safety and health. This paper calls for a debate about how to deal with these risks. Part of the debate should be whether or not such situations should be allowed to continue. Moreover, this paper suggests a prominent role for the facility management profession in order to deal with these safety and health issues.

**Type of paper** – Research paper.

## KEYWORDS

Abandoned buildings, city decay, facility management, healthy cities, public health, public safety, urban decline.

## INTRODUCTION

Cities rise, cities fall. This has happened since ancient times and is still happening today. Troy, Babylon, Persepolis, and Pompeii are iconic examples of once thriving cities that fell into an irreparable condition and have now been reduced to ruins. In some cases, it is easy to establish what exactly led to their downfall, while in other cases this is impossible. For Pompeii it was clear that the cause was a volcanic eruption. But for Troy there are several theories stating that a war, an earthquake, or a massive fire has led to its downfall (Maher, 2011). Regardless of the exact causes, all four of the aforementioned historic cities were subject to a process that is called ‘urban decline’ or ‘urban decay’. Danish scholar Hans Skifter Andersen defines ‘urban decay’ as:

*“...a result of the interaction between social, economic and physical changes in cities...” [leading to] “...complicated mechanisms that draw the areas into a downward spiral from which they rarely recover unaided.” (Andersen, 2003).*

However, with his definition Anderson neglects disasters and other external causes such as the ones that hit Pompeii, Nagasaki, and Chernobyl. Buildings in these cities may be abandoned for long periods, perhaps even forever, depending on the capabilities to build trust, to carry a promise, and restart human life. Moreover, some of the iconic historical examples from above have witnessed repeated cycles of rise

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and fall. Eventually leading to decline that now has lasted for centuries. Although the aforementioned historic examples are declined far beyond repair, some of them have aesthetic appearance as such. Their remains attract tourists from all over the world. Their function has shifted from inhabitants to tourists. In other cases, policies and measures can be put into place to reverse processes of urban decline (Grogan, 2002) and revive the city.

As there are so many well-known examples of declined and abandoned cities from ancient times, one might think that urban decline is a phenomenon that is not prominently present in today's world. However, recent history tells us otherwise, as the twentieth and twenty-first century also show a multitude of declined and even totally destroyed and abandoned urban areas. In this context, this paper describes recent examples of urban decline in various countries and subsequently scrutinizes five German sites by means of location visits and direct observations. This is followed by a reflection on the risks for public safety and public health that these examples show.

For this specific purpose, studying urban decline in a contemporary environment, urban decline is defined as:

*The process in which the built environment suddenly or gradually loses its practical, technical, and economic functionality, resulting in it being abandoned by its legitimate occupants and being neglected by its owners for an extended period of time.*

The focus on urban decline should be seen in the broader light of our research into healthy cities, which is one of the main research themes of our research group. Hancock and Duhl (1988), who are the initiators of the UN Healthy Cities programme, mention eleven qualities that a healthy city should have, the three qualities that are most relevant in the context of city decline are: 1) a clean, safe, high-quality physical environment; 2) an encouragement of connectedness with the past, heritage, and other groups and individuals; and 3) a high positive health status and low disease status for all.

## METHODS

Two sorts of data have been collected for the micro-case descriptions in this paper. First, this paper uses desk research to study five cities suffering from urban decline in various countries around the globe. These cases were selected in interaction with students, appeared in iconic movies, and/or described in the media. Second, five German cities were scrutinized with location visits and direct observations. These cases were a convenience sample, ease of access, proximity, and recent history being the main reasons for them being selected. Be reminded that the former German Democratic Republic (GDR), experienced a major regime change in 1989. With the Berlin wall coming down, the GDR also fell, generating thousands of vacant buildings (Richter, 2015). Moreover, the German cases were also chosen to demonstrate the existence of extensive urban decline in the developed world.

Ten German locations were pre-selected with Google Street View. Five locations were excluded because these were inaccessible due to legal or physical reasons. The remaining five locations were visited. The objective of this first visit was to establish their actual accessibility and their risks regarding public safety and public health. No fence or wall was climbed and no door or gate was forced or even opened to access these locations. All five sites were easily accessible for the public. However, the exact locations of the cases will remain undisclosed in order to prevent urban decline 'tourism'.

## RESULTS

### Desk research

The desk research of this paper revealed five notable examples of contemporary urban decline in the USA, (former) Yugoslavia, Ukraine, China, and France. Examples are described to explore the reasons of decline and the current state of the studied cities.

The Rust Belt is a region in the Midwest of the United States that fell victim to a structural economic downfall starting in the 1970's and continuing till present day (Alder, 2014). Earlier, the economy of the Rust Belt grew exponentially when the major American car manufacturers Ford, Chrysler, and General



Motors decided to locate their plants and headquarters in and around Detroit. It caused the population and the economy of the Rust Belt to explode, with Detroit at the heart of these developments. But with the subsequent rise and influence of German, Japanese, South-Korean, and Chinese car industries, the Detroit car industry failed to compete on a global scale. Thousands of jobs were lost and the population of Detroit shrank. Tens of thousands of commercial and residential buildings were abandoned. Many of them being collapsed, burnt out, or demolished now (The Guardian, 2013). Some parts of the city have been taken over by gangs and abandoned buildings are used for criminal activities (Terry, 2019). These developments have made Detroit a modern 'icon' of urban decline. Up to a point where the decline of Detroit forms the major backdrop for prominent Hollywood movies, such as Robocop (1987), 8 mile (2002) and It follows (2014). This clearly shows that complete social, economic, and physical collapse of cities is not just a thing of the past.

After the fall of the Soviet Union in 1991, many former communist states experienced peaceful transitions into democracies with a market economy. But former Yugoslavia was a complex construct of ethnicities, religions, political movements, and paramilitary organizations that were tied together by Tito and held together by the strict leadership of the communist regime. In 1991, former Yugoslavia broke up into 5 countries, leading to the Yugoslav wars (Anderson, 1995). A very bloody series of conflicts took place, resulting in an estimated death toll of 130,000-140,000. Dozens of major cities were partly destroyed. Cities like Belgrade, Sarajevo, and Zagreb suffered from major destruction. Many buildings in the centres of these cities are still abandoned today.

Pripyat is located in the Northern Ukraine at a 2 kilometres distance from nuclear reactor number 4 in Chernobyl that exploded on April 26<sup>th</sup>, 1986. Pripyat was evacuated the day after the explosion and has been abandoned till present day. After 34 years of neglect, Pripyat's buildings have collapsed, wild animals like boars inhabit the city, and highly contaminated items and materials are still lying in and around buildings (Dobraszczyk, 2010). Although Pripyat is part of a forbidden exclusion zone, more and more tourists and adventure seekers manage to reach the town and stay there for a while. The situation in Pripyat is in some ways comparable to the contaminated exclusion zone surrounding Fukushima in Japan.

For the past decade, the Chinese government has initiated a building boom that has never been seen before in world history. The objective was to bring people from rural areas to the cities in order to work in mostly production facilities. However, this internal mass migration is structurally lagging behind the building process, having left millions of apartments in China unoccupied for years now and the emergence of so-called 'ghost cities' (Mingye, 2017). The same goes for many shopping centres and offices in these areas. In many cases there is an additional problem because of rushed construction methods and low-quality building materials. This has resulted in millions of empty buildings that are deteriorating rapidly.

After the second World War most of the French colonies became independent. Many people from those former colonies, especially people from African nations, settled in France. In order to deal with this sudden influx of immigrants, and for other social-economic reasons, France built 'banlieues' (suburbs) at the edges of major cities like Paris, Lyon and Marseille. Some of these banlieues transformed into problematic areas, giving the word 'banlieue' a bad name (Horvath, 2014). The media reported clashes between immigrants and natives, rising crime levels, poverty, drug trafficking, and prostitution. During the past decade, some banlieues have been repeatedly in the news because of riots and civil unrest. Reason for which they are labelled by the media as 'no-go areas'. This has led to major urban decline in some of the largest banlieues of the country.

Every case of the above-mentioned examples of urban decline appears to have its own specific set of underlying causes and catalysts. Therefore, it seems to be impossible to identify a universal cause of urban decline. The variety of causes of urban decline that appear from these five examples include global economic competition (American Rust Belt), war (former Yugoslavia), human-induced environmental disaster (Pripyat), overdevelopment (Chinese Ghost Cities), and social unrest (The French Banlieues). This paper continues with direct observations and site visits in Germany.

### Direct observations

After having been selected by means of Google Street View, five contemporary locations were visited in order to make direct observations: Leipzig (site visit in November 2019), Bernau, Wunsdorf Waltstadt, Berlin, and Fürstenberg (all site visits in December 2019).

Leipzig is a major German city with a population of approximately 600,000 residents. It is located in the German state of Saxony. Especially for the past decade, Leipzig is known for its rapid growth in population and economy. Despite being one of the fastest growing cities in Germany, Leipzig shows clear signs of urban decline throughout the city. One of the most notable examples is a stretch of land of about 200 meters wide and 1,000 meters long filled with abandoned buildings. The area contains a group of 10-20 abandoned and decayed buildings. Most of them far beyond repair, completely accessible to the public, including children, and providing an extremely dangerous and hazardous environment at the same time. Dangerous materials were lying around unattended, collapsed buildings were freely accessible, and many of the buildings showed the signs of human defecation. In some of the buildings young people were inside, exploring the building and climbing unstable parts of the construction.

Bernau is a municipality in the German state of Brandenburg. It is located about 20 kilometres north of central Berlin and has a population of about 36,000 residents. It is home to a huge former military complex, both used by the Nazi's and the former communist regime. After being abandoned in 1990, the complex has remained empty and has not seen any significant maintenance or repair. During the site visit, most of the buildings were easily accessible to the public and providing an extremely dangerous and hazardous environment at the same time. Some building parts were close to collapsing, there were holes in floors at unexpected places and in some buildings drugs paraphernalia were lying on the ground.

Wünsdorf-Waltstadt is a municipality about 30 kilometres south of Berlin city centre. Although Wünsdorf is known for its former military facilities, it is also home to many abandoned residential buildings that are scattered around town. In several buildings, roofs looked like they could collapse any moment, severe cracks in walls were visible, floors were covered with dangerous materials like sharp metal objects and broken glass and railings from staircases were missing. Some of the buildings seemed to be inhabited. In some parts of the premises, small groups of men were gathering and consuming alcoholic drinks.

The case in Berlin concerns almost an entire abandoned city with close to a hundred buildings south of the city centre. The streets and surroundings of the buildings were fully overgrown with bushes and branches of trees, making strolling around the area difficult and in some places dangerous. The buildings contained collapsed floors and roofs and there were objects that looked like chemical storing units. Some of the buildings were apartment buildings with up to 10 floors. Some of the roofs were freely accessible and there were no railings or fences to prevent people from falling down.

The Fürstenberg location concerns a former military facility. Some parts of the premises were used as a dumpster for all kinds of equipment and chemical waste. Some buildings appeared to be close to collapse. Dark and apparently flooded basements were accessible and piles of materials looking like asbestos were stacked in open air.

These five locations have in common that an important cause for the decline of the respective places appears to be obsolescence of buildings after the termination of the communist regime. The situations as assessed, imply significant risks to public safety and public health, such as getting injured by collapsing constructions; sinking through unstable roofs and floors; falling into holes in the ground; falling from roofs or staircases, or into elevator shafts; getting stuck or drowning in flooded basements; getting injured because of sharp items and other dangerous objects like shattered glass; getting poisoned by hazardous materials such as asbestos, possibly resulting in disease; getting infected with germs that are spread by mould, vermin, dead animals and defecation; falling on slippery floors; tripping over objects lying on the floor; potentially being attacked by animals such as rats, swines, wolves, and wasps; and being harassed or attacked by people.

Nowhere at any of the visited sites, the researchers observed visible signs of facility management related activities, which could have contributed to reducing safety and health risks. For example, the researchers did not observe any security or supervision personnel or their vehicles, surveillance cameras, functioning lighting, recently applied notices, fencing, locking or boarding-up, or any signs of building maintenance, greenery management, repair work, road work, waste management or cleaning and clean-up activities. Nor were there any visible signs of regeneration or regulated alternative use of the sites. It should also be noted that online research prior to the site visits did not reveal any official warnings against visiting and entering these sites. Local authorities do not appear to actively, or at least effectively, engage in public communications activities in order to discourage site visits.

## DISCUSSION

This explorative research clearly confirms the existence of major examples of contemporary urban decline. The desk research showed that causes of urban decline varied from global economic competition to war, human-induced environmental disaster, overdevelopment, and social unrest. The site visits and direct observations showed that even in a highly developed country like Germany urban decay is vividly present. Scattered around several German states, examples of groups of abandoned buildings have been found that were both very hazardous and easily accessible to the public at the same time.

As these risks for public safety and public health are considerable, a relevant question that arises is how situations like the cases presented above should be dealt with. At the time of the visits, notwithstanding the risks it was remarkable that in none of these locations there was visible presence of security, police, local authorities, owners, or caretakers. No one seemed to take any responsibility or control of the situation.

Therefore, this paper calls for a debate about how to handle situations and locations like the ones described. Part of the debate should be whether situations like these should be allowed to continue. This paper would suggest a more prominent role for the facility management profession in order to deal with the various safety and health issues. Although facility management is a discipline that basically focusses on supporting processes in functioning buildings, this paper would like to make a case for letting facility managers also support processes concerning non-functioning buildings.

Instead of the usual activities that would normally be applied in the context of functioning buildings, facility managers could now focus on a specific set of activities that would better suit a situation of urban decline, in order to contribute to reducing health and safety risks in and around abandoned buildings. Such a set could consist of for example risk assessment, security management, supervision, communications management, applying lighting, notices and signage, fencing, locking, boarding-up, building maintenance, greenery management, repair work, road work, waste management, cleaning and clean-up activities.

Architects design buildings and contractors erect buildings, but facility managers understand the use of buildings during their entire lifecycle. Why not extend the portfolio of the facility manager into the non-functional era of a building's existence? The observations that have been made for this paper show that that part of a building's lifecycle could take years, if not decades and deserves more attention than which is currently provided.

## REFERENCES

- Alder, S., Lagakos, D., & Ohanian, L. (2014). *Competitive pressure and the decline of the rustbelt: a macroeconomic analysis*. Cambridge: National Bureau of Economic Research.
- Andersen, H. S. (2003). *Urban Sores: On the Interaction Between Segregation, Urban Decay, and Deprived Neighbourhoods*. Routledge.
- Anderson, D. (1995). *The Collapse of Yugoslavia: Background and Summary*. Parliamentary Research Service.
- Dobraszczyk, P. (2010). Petrified Ruin – Chernobyl, Pripjat and the death of the city. *City*, 14 (4), 370-389.
- Grogan, P. S. & Proscio, T. (2002). *Comeback Cities: A Blueprint for Urban Neighbourhood Revival*. Boulder: Westview Press.

- Hancock, T., & Duhl, L. (1988). *Promoting health in the urban context*. WHO Healthy Cities Papers, No. 1. Copenhagen: FADL Publishers.
- Horvath, C. (2014). Exploring the Banlieue. *Francosphères*, 3 (2).
- Maher, M. (2011). Fall of Troy VII: New Archaeological Interpretations and Considerations. *Totem: The University of Western Ontario Journal of Anthropology*, 11 (1).
- Mingye, L. (2017). Evolution of Chinese Ghost Cities. *China perspectives*, 1, 69-78.
- Richter, C. (2015). The abandoned buildings of the Eastern Bloc. Retrieved from: [www.bbc.com/news/magazine-34575019](http://www.bbc.com/news/magazine-34575019)
- Terry, N. (2019). Residents around Detroit's 'Red Zone' want better for community. Retrieved from: [eu.detroitnews.com/story/story-series/death-by-instagram/2018/04/27/detroit-gang-wars-residents-want-better-community/556655002/](http://eu.detroitnews.com/story/story-series/death-by-instagram/2018/04/27/detroit-gang-wars-residents-want-better-community/556655002/)
- The Guardian (2013). Detroit: a city in decline - in pictures. Retrieved from: [www.theguardian.com/world/gallery/2013/jul/19/detroit-goes-bankrupt-in-pictures](http://www.theguardian.com/world/gallery/2013/jul/19/detroit-goes-bankrupt-in-pictures)

# Enabling Older People to Live Independently: A Shared Responsibility of Citizens and Municipality

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## ABSTRACT

**Background and aim** – This paper studies concepts for assisted living for independently living older people. This is an important issue, as the number of independently living over-75s increases rapidly, and their needs and wishes are more explicit and diverse than before. This paper aims to explore the difficulties that emerge with respect to connecting to these needs and wishes. It scrutinizes two Dutch initiatives related to assisted living.

**Methods / Methodology** – Data were collected by means of desk research, conversations and discussions.

**Results** – A service flat is a more traditional form of a facility for assisted living. Here, older people live independently in their own apartment, while receiving services. However, difficulties can be experienced in connecting with the needs and desires of the elderly. Recently, other new concepts for assisted living have arisen, such as the Knarrenhof, which is aimed at a mix of richer and less affluent (future) elderly and which consists of groups of houses around court yards. Difficulties that such an initiatives can experience relate to the collaboration between private initiators and the municipality, and between various municipal departments.

**Practical or social implications** – What is needed is an integral approach by the different municipal departments, which is based on a social cost-benefit analysis, and in which the municipality connects as much as possible with private initiatives. For the realization of facilities for assisted living is a shared responsibility of citizens and the municipality.

**Type of paper** – Research paper.

## KEYWORDS

Assisted living, independent living, citizens' initiative, role of the municipality, healthy cities.

## INTRODUCTION

This paper studies concepts for assisted living that aim at independently living older people in the Netherlands. It contains an exploration of difficulties with respect to connecting to the needs and desires of these elderly. This is an important issue, as the number of independently living elderly increases rapidly, and their needs and wishes are more explicit and diverse than before. As each country has its own context, the Dutch situation is taken as an example. However, as the Dutch situation also corresponds to a greater or lesser extent to the context of other European countries, so do the insights this exploration generates.

In the Netherlands, there is a growing number of frail elderly living independently, where frailty can be defined as “a process of accumulation of physical, mental and/or social deficits in functioning” (Van Campen, 2011). In general, frailty increases with age. In 2019, there were more than 1.2 million over-75s living independently and this number is expected to rise to more than 2 million in 2030. Furthermore, the age until which they keep on living independently is also rising, just as the amount of support and care that these people need (De Klerk et al, 2019). To enable people to grow old independently, they need suitable houses with essential services nearby; advice, support and facilities that help them implement their own solutions; and a network of formal and informal care (De Kam, 2013). Factors

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influencing whether frail people can live independently include income, accessibility of their house and living environment, availability of a supporting social network, opportunities for social contacts and participation; and informal care. Frail people need accessible houses; a safe living environment stimulating social contacts and participation; support from social networks; and services (e.g. shops and healthcare) at walking distance or being delivered at home (Rossum et al., 2014). Until recently, these conditions were provided by publicly financed care homes. The elderly who lived in a care home had their own room, with everything being arranged for them, including meals and laundry services. These care homes also offered the option to participate in all kinds of activities, such as coffee meetings, handicrafts and choir rehearsals. Beside these care homes, there were also nursing homes for people who needed intensive nursing that could not be offered at home or in a care home.

Since the 1960's several private initiatives have also been taken in order to realize other assisted living facilities for the elderly alongside care homes, as part of the elderly did not want to live in a care home. These new facilities mainly aimed at middle class seniors. A more traditional form of such a facility is the service flat, where older people live independently in their own apartment, while receiving services such as meals, cleaning and technical support. In the Netherlands there are approximately 360 service flats. These flats also contain central rooms, where inhabitants can organize activities together. All services used to be included in the price and obligatory for all inhabitants. However, today's elderly are more empowered than those of some decades ago, and their needs and desires have changed (De Klerk et al., 2019). For this reason, there is a decreasing interest in service flats and other initiatives labeled for seniors among today's vital elderly. Moreover, these elderly have a very critical attitude towards the price-quality ratio and the supplementary facilities that service flats offer. As a result, various service flats with high service cost and outdated apartments have recently been confronted with vacancy (Nouws, 2015). It is only after health problems have become manifest that many elderly nowadays consider moving into assisted living facilities such as service flats.

Alongside the more traditional facilities such as service flats, various other new concepts for assisted living have arisen recently, such as for instance houses in which several generations live together. The closedown of the care homes in the Netherlands gave extra momentum to the development of these new concepts. This closedown was induced by the sharp rise of healthcare costs, an important cause being the increasing number of elderly. In order to diminish these costs, since 2015 a policy has been implemented in the Netherlands aiming at facilitating the elderly to live independently as long as possible, instead of in care homes. These elderly are expected to arrange the support they need as much as possible by themselves, with help from their social network. Only if there is no other option should they get additional care from healthcare support. This has resulted in a decrease of the over-80s living in institutions from 63% in 1980 (Den Draak et al., 2016; Garssen en Harmsen, 2011) to about 11% (De Klerk et al., 2019). This policy was a part of a wider set of policies of the Dutch national government aimed at stimulating the so-called "do-democracy" (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2013), in which citizens co-decide and tackle social issues themselves. This do-democracy was the result of a process of decentralization and deregulation of social policies that commenced in the 1980s (Heeg, Klagge & Ossenbrügge, 2003). This resulted in municipalities retrenching from parts of the social policy domain, the underlying expectation being that this would stimulate private initiative.

Often these new concepts for assisted living have been initiated by relatively rich and highly educated (future) seniors, who have taken the initiative with a group of like-minded others to, for instance, have a house, or a group of houses, constructed or adapted for them to live in together. However, for less affluent people this is no option. Furthermore, there are also private initiatives aimed at a mix of richer and less affluent (future) elderly. An example of such an initiative is the concept of the Knarrenhof. ("Knar" means "old person" in Dutch.) A Knarrenhof consists of groups of houses around court yards ("hof" in Dutch), these houses being a mix of owner-occupied and rental properties (<https://knarrenhof.nl/>). All seniors who move into a Knarrenhof agree to socially support each other. Notwithstanding these new initiatives, until now the number of private initiatives has been limited (RIVM, 2018) and there are still insufficient facilities for assisted living that connect to the needs and desires of older people.

The research that underlies this paper is the first step of an investigation into how concepts for assisted

living can be realised that connect to the needs and desires of independently living older people. This research into assisted living concepts fits in with our research group's broader research theme healthy cities. According to Hancock and Duhl (1988), who are the initiators of the UN Healthy Cities programme, qualities of a healthy city are: 1) a clean, safe, high-quality physical environment; 2) a stable and sustainable ecosystem; 3) a strong, mutually supportive and non-exploitive community; 4) public participation in and control over the decisions affecting one's life, health and well-being; 5) meeting the basic needs for all; 6) access to a wide variety of experiences and resources and possibilities of multiple contacts, interaction and communication; 7) a diverse, vital and innovative economy; 8) encouragement of connectedness with the past, heritage, and other groups and individuals; 9) a city form compatible with and enhancing the above; 10) an optimum level of appropriate public-health and sick-care services for all; and 11) high positive health status and low disease status. Hence concepts for assisted living that connect to the needs and desires of older people should be an important aspect of a healthy city.

The knowledge that this exploration generates is aimed to facilitate the realization of such concepts. The central research question of this paper is: "Which difficulties emerge when realizing assisted living concepts for independently living elderly that connect to their needs and desires?" In order to answer this question, this paper scrutinizes two initiatives with respect to assisted living: The Vondelflat, which is a service flat, and the Knarrenhof.

## METHODS

Websites and newspaper articles were consulted, followed by conversations with a member of the supervisory board of both initiatives. Furthermore, several discussions, with members of our research centre as well as with external partners, took place on desirable characteristics of facilities for assisted living, as well as on opportunities and challenges with respect to their realisation. Our decision to scrutinize both a service flat initiated in the 1960s and a recent initiative was made on purpose, while our choice for the Vondelflat and the Knarrenhof can be considered as a convenience sample, contact persons of both initiatives being part of our research group's network.

## RESULTS

### The Vondelflat in Groningen

The Vondelflat in Groningen is a service flat that was built in the 1960's as a private initiative. From the start, all inhabitants rented their own apartment and there were also rooms for general use. Moreover, the management of the flat provided for domestic services and also for warm meals, for which service costs had to be paid. Since the start, these meals had been prepared in the kitchen of the flat. However, in 2016 the preparation of meals was outsourced to a big catering business, because of financial reasons. This caterer cooked the food within its own organization, after which it was transported to the Vondelflat. Here, the food was divided into portions, warmed up and served to the inhabitants. As the elderly judged the quality of the meals as insufficient, a number of them decided to order their meals somewhere else. However, according to the management, these meals formed a compulsory part of the concept of the service flat, for which the inhabitants had to pay, whether they made use of it or not. As several elderly persisted in their refusal to pay, the management took them to court. This caused indignant reactions throughout the country and attention from the media (see e.g., Van der Laan, 2017a). Subsequently, the rules were changed, so that from that moment the elderly could decide for themselves where to order their meals.

In the meantime, the Vondelflat had to deal with increasing vacancy, as the building had become outdated. For this reason, in 2013 the management decided to not only rent apartments to older people, but also to other groups of people who had difficulties in finding suitable housing, including young people and singles. Furthermore, a start was made to develop plans for a new building. At the time of our research, these plans were finished and the construction of two new buildings was about to start, at a nearby location. The initial idea was to move the elderly living in the Vondelflat to one of the new buildings. However, these elderly appeared not to be willing to move. As moreover most of them were already very old, it was decided to let them live in the old building.

The design for the new buildings took account of new insights into needs and desires of old people.

However, this turned out to be only general insights, as no elderly, nor any organization representing them, had been involved in the design. At the moment of our research a start had just been made with contacting elderly from the neighbourhood who might be interested in living in one of the new buildings. Meanwhile, two organisations providing care for frail people had indicated that they were interested in renting one of the buildings. However, this offer had been refused, as the establishment of an healthcare organization in one building was supposed to negatively influence the options for renting out the other space.

This example illustrates the difficulties that a private initiative such as this serviceflat has in connecting with the needs and desires of older people.

### **The Knarrenhof in Zwolle**

In 2018 the first Knarrenhof was realized in the city of Zwolle. Meanwhile, it has become a popular concept that also attracts media attention (see e.g. Van Dinther, 2020), as it aims at a mix of property owners and renters instead of only at affluent people, with all inhabitants agreeing to socially support each other. Inhabitants are enthusiastic and elderly in other places are also interested in living in a Knarrenhof. Therefore, the Knarrenhof foundation has been established with the aim of rolling out this concept in other places. However, this does not go without a struggle. On one hand, a lot of enthusiasm exists concerning the concept of the Knarrenhof, as it seamlessly fits in with the policy of the Dutch government. The Knarrenhof enables seniors to live independently as long as possible while stimulating that the necessary support be provided as much as possible by their social network, and as little as possible by professional caregivers.

On the other hand however, the Knarrenhof foundation faces several considerable difficulties with respect to the realization of other Knarrenhofs. One important problem is the price of land. Locations that are deemed suitable for a Knarrenhof are mainly located in the middle of a city, close to facilities such as shops and easily accessible by public transport. However, because of these characteristics the price of land is high, which is often too high for the Knarrenhof foundation, as it is aimed at realizing a mix of cheap and expensive houses. A second problem concerns the contacts with the various municipal departments that have to be involved for a new Knarrenhof to be realized. The representatives of the Knarrenhof foundation have experienced that they were sent from pillar to post, which makes the process of realizing a new Knarrenhof longlasting and full of frustrations. In order to break through this situation, the initiators needed endless patience, strong social networks, and knowing who to go to.

Finally, a third difficulty is related to getting a bridging loan, which is needed as the Knarrenhof foundation has insufficient funds to prefinance a new Knarrenhof. After a long process of deliberations, in 2019 a regulation was implemented and funds were made available in order to enable social initiatives like the Knarrenhof foundation to get a bridging loan. However, the process of applying for such a loan is treacly and not transparent, reason for which the available funds have hardly been appealed to until now. The main reason why the Knarrenhof foundation in the beginning of 2020 had still not succeeded in getting a bridging loan was because the executives of the regulation considered the Knarrenhof to be a commercial project developer instead of a social initiative.

This example illustrates the difficulties that a private initiative such as the Knarrenhof can experience, notwithstanding the fact that it connects well to the needs and desires of older people. These difficulties relate to the collaboration between the private initiators and the municipality, and between various municipal departments.

### **DISCUSSION**

Both national and local government policies have been instated that aim at citizens living independently as long as possible when they grow older. Furthermore, these elderly are supposed to arrange the support they need as much as possible by themselves, with help from their social network. Hence citizens are expected to take the initiative. Driven by these government policies including the closing down of care homes, as well as by dissatisfaction with more traditional assisted living facilities such as service flats, various recent private initiatives have indeed been established with respect to realizing



facilities for assisted living that connect to the needs and desires of older people. However, our analysis of the Knarrenhof illustrates that notwithstanding the fact that these private initiatives are in accordance with national and local government policies, the initiators are hindered by regulations and municipal departments who do not collaborate, instead of being facilitated by the municipality. Actually, there is a mismatch between the local government and citizens who want to take the initiative, or a friction in “the market for citizenship” (Boutellier & Klein, p. 11). If municipalities consider it important that citizens take responsibility and initiative, they should facilitate private initiatives instead of hindering these initiatives by obstructive regulations or lack of collaboration between different departments.

This current practice is counterproductive, in the first place because it causes much frustration for citizens who take the initiative to realise facilities for assisted living. As far from every citizen – old or young – is able to take the initiative and to arrange their own support, as many do not have the necessary skills and networks (De Klerk et al., 2019; Nijkamp, Burgers & Kuiper, 2017), it should be realized that it is very important to prevent those who do take the initiative from becoming frustrated. Furthermore, in the second place, this is also counterproductive for economic reasons. On the one hand, the real estate department of a municipality may earn less when selling land to, for instance, the Knarrenhof foundation. However, on the other hand, the municipal department for health and social care might save considerably on expenses related to home adaptations and on support and care for the elderly who live in a Knarrenhof. What is needed is an integral approach by the different municipal departments, which is based on a social cost-benefit analysis, and in which the municipality connects as much as possible with private initiatives. For the realization of facilities for assisted living, which enable older people to live independently, is a shared responsibility of citizens and the municipality.

## REFERENCES

- Boutellier, J. & Klein, M. (2014). *Praktijken van sociale verantwoordelijkheid. Over de inzet van burgers in een ‘participatiesamenleving’* [Practices of social responsibility. On the deployment of citizens in a ‘participation society’]. Utrecht: Verwey-Jonker Instituut.
- De Kam, G. de, (2013). *Kwetsbaar en zelfstandig. Een onderzoek naar de effecten van woonservicegebieden voor ouderen*. Nijmegen: Hogeschool van Arnhem en Nijmegen, Radboud Universiteit Nijmegen, Universitair Medisch Centrum Groningen en Stuurgroep Experimenten Volkshuisvesting.
- De Klerk, M., Verbeek-Oudijk, D., Plaisier, I., & Den Draak, M. (2019). *Zorgen voor thuiswonende ouderen. Kennissynthese over de zorg voor zelfstandig wonende 75-plussers, knelpunten en toekomstige ontwikkelingen*. Den Haag: Sociaal en Cultureel Planbureau.
- Den Draak, M., Marangos, A.M., Plaisier, I., & De Klerk, M. (2016). *Wel thuis? Literatuurstudie naar factoren die zelfstandig wonen van mensen met beperkingen beïnvloeden*. Den Haag: Sociaal en Cultureel Planbureau.
- Garssen, J. & Harmsen, C. (2011). *Ouderen wonen steeds langer zelfstandig*. Retrieved 16 March 2020 from <https://www.cbs.nl/nl-nl/nieuws/2011/28/ouderen-wonen-steeds-langer-zelfstandig>.
- Hancock, T. & Duhl, L. (1988). *Promoting health in the urban context. WHO Healthy Cities Papers, No. 1*. Copenhagen: FADL Publishers.
- Heeg, S., Klagge, B., & Ossenbrügge, J. (2003). Metropolitan cooperation in Europe: Theoretical issues and perspectives for urban networking. *European Planning Studies*, 11, 139–153.
- Ministerie van Binnenlandse Zaken en Koninkrijksrelaties (2013). *De doe-democratie. Kabinetsnota ter stimulering van een vitale samenleving*. Den Haag: Ministerie van Binnenlandse Zaken en Koninkrijksrelaties.
- Nijkamp, J., Burgers, J., & Kuiper, C (2017). The Munchausen paradigm for deprived neighbourhoods: Pulling yourself out of the swamp of deprivation. *Journal of Social Intervention: Theory and Practice*, 26 (2), 27-42.
- Nouws, H. (2015). *Verhuurbaarheid seniorenwoningen*. Amersfoort: Research en advies in wonen en zorg.
- RIVM (2018). *Volksgesondheid Toekomst Verkenning 2018. Kwetsbare ouderen*. Retrieved 16 March 2020 from <https://www.vtv2018.nl/kwetsbare-ouderen>.
- Rossum, F. van, Leidelmeijer, K., Wever, T., & Ham, M. van den (2014). *Randvoorwaarden voor extramuraal wonen bij ZZP's VV 01 t/m 04*. Amsterdam: RIGO.
- Van Campen, C. (2011). *Kwetsbare ouderen*. Den Haag: Sociaal Cultureel Planbureau.

- Van der Laan, M. (2017a, June 21). Maaltijdrel Vondelflat Groningen: directie sleept bewoners voor de rechter. *Dagblad van het Noorden*.
- Van Dinther, M. (2020, January 15). *Ouderen zijn gelukkig in Zwols 'knarrendorpje'. Waarom durven veel gemeenten er dan niet aan?* [Seniors are happy in 'knarren village' in Zwolle. Why do many municipalities not dare to implement this concept?]. *De Volkskrant*.
- Van Klaver, S, Van Triest, N., & Senior. P. (2018). *Langer thuis: een verkenning. Behoeften en toekomst woonzorg voor kwetsbare senioren*. Den Haag: Platform 31 en Aedes-Actiz Kenniscentrum Wonen-Zorg.

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**THEME 4:**  
**FACILITY DESIGN IN THE CONTEXT OF SOCIETY**

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Contributions by *Facility Design*,  
Research Centre for Built Environment NoorderRuimte  
Hanze UAS

**Professionalization of Municipal Real Estate Management: An Analysis of Dutch Literature**

*Annette van den Beemt-Tjeerdsma, Erwin van der Krabben, and Mark P. Mobach*

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**Influencing Automatic Behaviours to Reduce Waste at Facility Operations**

*Rachel Kuijlenburg, Kim A. Poldner, and Mark P. Mobach*

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**Cleaning with Services and Spaces: Effects of Seating Materials and Architectural Clutter  
on Perceived Cleanliness**

*Martijn C. Vos, Mirjam Galetzka, Mark P. Mobach, Mark van Hagen, and Ad T.H. Pruyn*

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# Professionalization of Municipal Real Estate Management: An Analysis of Dutch Literature

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## ABSTRACT

**Background and aim** – The aim of this paper is to look at the professionalization of municipal real estate management (MREM) from an organizational design perspective.

**Methods / Methodology** – Analysis of current and recent MREM-literature in a Dutch context on organizational design.

**Results** – It appears that organizational design is implicitly or explicitly concluded as being interesting and relevant, but no research was performed on this topic. In general, it seems MREM could be significantly better organized creating higher value of its real estate for society.

**Practical or social implications** – The finding that organizational design is an interesting yet underexposed parameter contributes to an awareness at real estate professionals. A better organization of MREM will not only increase professionalism, but also create higher value for local authorities and society. Moreover, possibilities for future research have been identified. Ultimately, new research and more best case practices can advance the management of real estate at local governments.

**Type of paper** – Research paper.

## KEYWORDS

Municipal real estate management, organization design, professionalization, public management, local authorities

## INTRODUCTION

Public administration in the Netherlands has four tiers: central government, the provinces, the municipalities, and the water authorities. Municipalities are the third in the Dutch public administration line and only do tasks that directly affect local residents. There are 355 municipalities in the Netherlands and these have autonomous powers to decide on issues concerning implementing national and municipal policies (Government of the Netherlands, 2020; Centraal Bureau voor de Statistiek, 2020).

Municipality's main policy priorities are set by municipal councils, which are representatives of the local residents. The municipal executive is responsible for implementing these policies effectively. In order to do so, facilities are needed to support the core business of authorities. One of these facilities is real estate. So, the main reason for authorities to own and manage real estate is to support them in performing their primary tasks for society (Evers, van der Schaaf, & DeWulf, 2002).

From this perspective, real estate as a facilitator for effective policies, three studies (van den Beemt & Veuger, 2016; van den Beemt & Veuger, 2017; Marona & van den Beemt, 2018) were performed by Van den Beemt on municipal real estate management (MREM) in the Netherlands. Results of these three studies will be presented and scrutinized. The study is organized at two main questions: Does Dutch real estate support local authorities in their primary task for society? And what is the role of the real estate professional in this respect? Implications of these questions will be discussed, allowing us to identify possible best case practices as well as blind spots at MREM.

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## CONCISE LITERATURE STUDY

Three Dutch studies will be presented and discussed. The first study (van den Beemt & Veuger, 2016) is about how the profession of corporate real estate management can add value to the less developed discipline of MREM. Secondly, the study about real estate value (van den Beemt & Veuger, 2017) deals with the relationship between assessed values and transaction prices of sold municipal real estate. The most recent study (Marona & van den Beemt, 2018) is an international study. It studied concepts developed in the profession of public management, and applied in Polish and Dutch MREM. All three studies are part of a PhD study concerning the professionalization of municipal real estate management by Van den Beemt.

### Added value of corporate real estate management

The results of this study are based on a questionnaire, that was held from 2008 until 2016. Both trends and status quo of Dutch MREM were investigated yearly. As part of this questionnaire, municipalities were asked to provide well-argued examples of best case practices. Respondents specifically mentioned the way in which these front runners organized their real estate management. Therefore, these targeted municipalities were invited to open up. They were asked to describe their organization by means of three main topics of corporate real estate management (CREM): organization structure, operations (implementation and results) and direction (strategy and plans) (Hoendervanger, van der Voordt, & Wijnja, 2012). A cross-case analysis with a variable-oriented approach was applied (Miles, Huberman, & Saldaña, 2014)

Results of this study show that municipalities aim to align real estate, policies, and needs of citizens/tenants in order to effectively and efficiently manage their real estate portfolio. They want to achieve this by organization design. However, there are some difficulties in designing their organizations. First, there is role ambiguity. There is a large variety in the tasks that real estate professionals perform. There is clear role description. Second, organizational structures are unclear and there seems to be no one size fits all solution for organizing MREM. So, here too the varieties are substantial. However, the best case practices show consistency with respect to factors: communication, cooperation, culture, and support from top management. Short lines of communication and good cooperation between departments allows MREM to act consistently and to be flexible and creative. Moreover, a good organization culture and support from both management and the board (Mayor and Councillors) also play an important role in many of the success stories. Hence, it was concluded that learning capacity and an enabling organizational culture are essential in developing MREM.

An important insight from this study was that municipalities make strategic and organizational changes aiming for better results in both the real estate portfolio itself as well as improving the municipal organization. Moreover, the way in which MREM can learn and benefit from CREM to further professionalize is mainly about the perspective on real estate and consequently how to manage this.

### Valuation of municipal real estate

This study's results came from 44 files that contain real estate data for executing the Dutch Real Estate Assessment Act (DREA). This act regulates that nearly all real estate in the Netherlands will be appraised by the local government (municipality) each year. The assessed (DREA) value is used for taxes and other official purposes like budgeting and considerations for disposal. After applying several selection criteria, 365 municipal real estate transactions were studied.

It appeared that the sum of the assessed value represents 40.8 percent of the sum of the transaction prices. Practically, this means that 59.2 percent of the price paid on the market was added by market forces. This does not only hold for the sum: it also appears that on an object level too, the market assigns a greater value to the object than the assessed value. Hence, this study showed that the annual DREA valuation offers no valuation foundation to determine the market value of municipal real estate.

The main insight from this study is that important decisions like budgeting and disposal have to be based on values that might not be congruent with the real-life market situation. This study aimed at researching the relationship between assessed values and transaction prices of municipal real estate

sold. Based on this study, it could be concluded that this relationship is not very strong. Findings also seem to imply that municipalities lack an organizational principle, allowing them to assess the value of their real estate validly.

### Public management and good governance

For this study, two public management approaches were operationalized to be studied: seven New Public Management (NPM) standards and five Good Governance (GG) principles. Surveys were sent to real estate professionals of all 304 Polish municipalities belonging to all metropolitan areas in Poland (response rate: 38%) and all 380 Dutch municipalities (response rate: 22%) to assess the level of implementation of the principles of GG and NPM in real estate management practices. Both data were combined; with this one uniform dataset statistical analyses were made.

The analyses showed that the concepts of NPM and GG were only partially applied: as a collection of instruments instead of as a whole. So, most municipalities only choose some parts of the concepts and apply it to their MREM. Results show that GG standards in Polish MREM are used a little more broadly than in The Netherlands. Results also suggest that concept compliance was more frequent in larger municipalities. However, this was only statistically significant for Poland.

The main insight from this study is that, although in 1991 already NPM was *'[...]over the past 15 years [is] one of the most striking international trends in public administration'* (Hood, 1991), it is still not fully implemented in Dutch MREM. Purpose of this research was to present the role of NPM and GG in Polish and Dutch MREM. This role cannot be described on the overall NPM and GG level; only on their different indicators.

### DISCUSSION

The aim of this paper is to show what needs to be done in light of the professionalization of MREM and organizational design. A profession is a self-regulated occupational group that has a body of knowledge and recognized role in serving society professions are self-regulated, accountable, and under continual scrutiny and development. They are guided by a code of ethical conduct that is the foundation for practice decisions and actions. Membership of the profession requires completion of an appropriate (commonly degree-based) intensive educational program (Higgs, McAllister, & Whiteford, 2009). Based on our current concise analysis there are some open ends that are interesting for future research.

The first study (van den Beemt & Veuger, 2016) concludes on role ambiguity, but does not elaborate on that. From organization design theories it is known that this means there is a lack of the necessary information available to a given organizational position (Kahn, Wolfe, Quinn, Snoek, & Rosenthal, 1964). Tasks or authority are not clearly defined (Jones, 2007). Moreover, there seems to be a lack of standardization in role descriptions; one of the design parameters of organization structure. A considerable number of empirical studies on role stress shows that high levels of role ambiguity has a negative effect on both the individual and the organization (Nicholson Jr. & Goh, 1983; Kahn, Wolfe, Quinn, Snoek, & Rosenthal, 1964). Knowing the scope of the position makes it easier to take responsibility for actions and interact with each other (Jones, 2007). However, since it was concluded that organization interventions affect MREM, role ambiguity should be subject to further research on studying the professionalization of MREM. This also holds for the second open end of that study: unclear organization structures and the implication that there seems to be no standard structure for MREM. Organization structure affects managerial decision behavior in various ways (Blankenship & Miles, 1968) and it can help with developing the coordination abilities at MREM that support strategy (Jones, 2007).

The second study (van den Beemt & Veuger, 2017) shows that decision making happens based on information that might not be very accurate. Since data-driven decisions tend to be better decisions (McAfee, Brynjolfsson, Davenport, Patil, & Barton, 2012) this could be subject for further research. Again, could this be standardized, and done more validly? In this context, be reminded that decision making relates to organizational structure because it is the structure on which decision-makers rely and on which the allocation of information and resources is based. Organizational structure can be seen as

an instrument to improve its learning ability to adjust to new situations and to enhance decision making (Jones, 2007).

The third and last study (Marona & van den Beemt, 2018) shows that the implementation of NPM can be refined and improved. Since NPM is a crucial driving force for efficient and effective public asset management (Lu, 2011), this would be worth qualitative, deeper grounded research in order to identify possibilities for enhancing MREM, to make it more efficient and effective.

## CONCLUSION

In conclusion, based on the above studies organization design seems to be an interesting parameter yet not further researched. And the development of this property may of vital importance for municipalities. In line with Jones (2007) we argue:

*“The consequence of poor organizational design or lack of attention to organizational design is the decline of the organization”* (Jones, 2007).

In general, MREM could be significantly better organized creating higher value of its real estate for society. The finding that organizational design is an interesting yet underexposed parameter contributes to an awareness at real estate professionals. A better organization of MREM will not only increase professionalism, but also create higher value for local authorities and society. In this context, the variety of approaches in different municipal practices is extremely large; a clear coordinating mechanism like standardization seems to be lacking. However, this needs further study. Possibilities for future research have also been identified. Ultimately, new research and more best case practices can advance the management of real estate at local governments. Further research on organizational design in MREM, by any means, can be regarded as a building block in the professionalization of MREM. By doing so, this will help local authorities to optimize the support of their real estate for an effective implementation of local policies.

## REFERENCES

- Blankenship, L., & Miles, R. (1968). Organizational Structure and Managerial Decision Behavior. *Administrative Science Quarterly*, 13(1), 106-120. doi:10.2307/2391263
- Centraal Bureau voor de Statistiek. (2020, 03 21). *Gemeentelijke indeling op 1 januari 2020*. Opgehaald van Gemeentelijke indeling op 1 januari 2020: <https://www.cbs.nl/nl-nl/onze-diensten/methoden/classificaties/overig/gemeentelijke-indelingen-per-jaar/indeling%20per%20jaar/gemeentelijke-indeling-op-1-januari-2020>
- Evers, F., van der Schaaf, P., & DeWulf, G. (2002). *Public Real Estate: Successful Management Strategies*. Delft, The Netherlands: DUP Science.
- Government of the Netherlands. (2020, 03 21). *Government and democracy*. Opgehaald van Government and democracy: <https://www.government.nl/topics>
- Higgs, J., McAllister, L., & Whiteford, G. (2009). The Practice and Praxis of Professional Decision-Making. *Understanding and Researching Professional Practice*(8), 101-120. doi:10.1163/9789087907327\_008
- Hoendervanger, J., van der Voordt, T., & Wijnja, J. (2012). *Huisvestingsmanagement: Van Strategie tot Exploitatie (Housing Management: From Strategy to Operations)*. Groningen/Houten: Noordhoff Uitgevers.
- Hood, C. (1991). A Public Management For All Seasons? *Public Administration*, 69(1), 3-19. doi:10.1111/j.1467-9299.1991.tb00779.x
- Jones, G. (2007). *Organizational Theory, Design, and Change*. Upper Saddle River, New Jersey, 07458: Pearson Education, Inc.
- Kahn, R., Wolfe, D., Quinn, R., Snoek, J., & Rosenthal, R. (1964). *Organizational Stress*. New York: Wiley.
- Lu, Y. (2011). New Public Management reforms in public asset management as the state governments of the United States. *Proceedings of the International Conference on Public Administration*. Sichuan, China.
- Marona, B., & van den Beemt, A. (2018). Impact Of Public Managemet Approaches on Municipal Real Estate Management in Poland and The Netherlands. *Sustainability*, 10(11), 4291. doi:10.3390/su10114291
- McAfee, A., Brynjolfsson, E., Davenport, T., Patil, D., & Barton, D. (2012). Big data: the management revolution. *90*(10), 60-68.

- Miles, M., Huberman, A., & Saldaña, J. (2014). *Qualitative Data Analysis: A Methods Sourcebook*. Thousand Oaks, CA.: SAGE Publications.
- Nicholson Jr., P., & Goh, S. (1983). The Relationship of Organizational Structure and Interpersonal Attitudes to Role Conflict and Abiguity in Differten Work Environments. *Academy of Management Journal*, 26(1), 148-155. doi:10.2307/256141
- van den Beemt, A., & Veuger, J. (2016). Towards A More Professional Municipal Real Estate Management. *Journal of Corporate Real Estate*, 18(2), 132-144. doi:10.1108/JCRE-11-2015-0041
- van den Beemt, A., & Veuger, J. (2017). Community Real Estate Market Value Exceeds Assessment Act Value. *Real Estate Finance*, 34(1), 15-22.



# Influencing Automatic Behaviours to Reduce Waste at Facility Operations

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## ABSTRACT

**Background and aim** – Many countries signed the Paris Agreement in order to mitigate global average temperature rise. In this context, Dutch authorities also decided to realize a maximum of 35% residual waste by 2020 for its own operations. So, 65% of the total waste should be recyclable or re-usable and only a maximum of 35% should be not. This current paper explores how changes in automatic behaviours, facility operations and related practice-oriented research can contribute to this aim of the authorities.

**Methods** – Desk research.

**Results** – Three different focal points can potentially contribute to achieving a maximum of 35% residual waste at facility operations. These are interventions at automatic user behaviours, spatial transformations to support more favourable sustainable automatic behaviours, and the design of relevant management systems for facility professionals.

**Originality** – Waste is only an end station of an entire supply chain. Meaningful interventions at different stages can improve the sustainability of facility operations, i.e. at the behaviour and spaces of users and at management systems of professionals. Students in facility management will be involved in all stages.

**Practical or social implications** – The facility management profession has an important role to play in the mitigation of global average temperature rise. However, facility professionals struggle to find efficacious sustainable solutions. Professionals are supported with interventions that have proven effectiveness on reduction of residual waste. These developments result in restraint behaviour and a certain shyness for action. That is why too often sustainability policies are linked to waste separation with the idea that it is tangible and easy to implement. However, this is an oversimplification of reality.

**Type of paper** – Position paper.

## KEYWORDS

Circularity, facility management, operations, procurement, space, sustainability, waste reduction.

## INTRODUCTION

Similar to other countries in the world, The Netherlands pursues the objectives of the Paris Agreement 2016 in order to mitigate global average temperature rise. In 2019, Dutch authorities, business, and not-for-profit organizations agreed to contribute to Paris with energy transition (100% renewable), climate transition (95% CO<sub>2</sub> reduction), and circularity (100% reuse of raw materials in 2050). This means that the landfill / incineration of Dutch waste must be halved from 10 Mton in 2012 to 5 Mton in 2022. In her role model, Dutch central authorities decided to set higher standards and to reduce even more waste. A total of 65% of the waste should be recyclable or re-usable and an absolute maximum of 35% should be not (in 2018 this latter percentage was 62%) (Ministerie van Economische Zaken en Klimaat, 2019). This aim of the authorities and its relation with facility management (FM) is the focus of our current study. How to reduce waste with changes in automatic behaviours and facility operations?

In this context, a Dutch consortium was set up in order to reduce waste, to a maximum of 35% residual waste by 2020. Facility providers of the Custodial Institutions Agency (DJI), Ministry of Security and Justice, FM Haaglanden (FMH), The Ministry of the Interior and Kingdom Relations (BZK), The Hague

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University of Applied Sciences (THUAS), and Hanze University of Applied Sciences Groningen decided to work together on this topic. Starting point was the challenge to embed the sustainability objective in the day-to-day facility operations. Moreover, a challenge to encourage sustainable behaviour of building's occupants was added. After all, research shows that behavioural change is a complex and demanding managerial task (Broeders, Midden, & Ham, 2010). Ingrained patterns and automatic behaviour of people are the weak links for sustainable awareness and an important cause for non-sustainable behaviours.

In this context, the current paper explores how FM and its daily operations can achieve the 35% residual waste standard compared to 2012. The consortium provides us with wonderful opportunities, such as studies in penitentiaries, offices of national authorities, and a university. Field experiments will be conducted, most of them with students. This current paper aims to share the design of one of these studies: tracking waste in penitentiaries, office buildings, and a university.

## RESEARCH QUESTIONS

The general aim of this research is how to enable the reduction of PMC waste (low-density polyethylene plastic, metal, and cartons), getting grip on logistics of waste flows, and to promote more sustainable behaviour. The latter with a focus on buildings occupants such as detainees, civil servants, prison guards, students, and facility employees. The objective is to develop a best practice: prevention of waste rather than 'recycling', 'down cycling', and 'up cycling'. We organized the preparation of our studies around the following questions:

- Can interventions in automatic behaviours contribute to sustainability?
- Can the sustainability of automatic behaviours become more favourable by spatial transformations?
- What systems can support facility professionals in achieving a maximum of 35% residual waste at facility operations?

## RESEARCH DESIGN

This research project is based on the cycle for practice-oriented research and innovation by Van der Donk & Van Lanen (2016). Practice-oriented research is research that is being conducted by professionals from the specific field, by which, on a systematic basic, answers are deduced from the direct surroundings. This approach is aimed at creating better solutions for problems present in day-to-day encounters (Van der Donk & Van Lanen, 2016). The choice for this research methodology is the societal problem of waste in relation to the day-to-day encounter of the facility professional with waste management. Moreover, combine this with desk research, inductive reasoning, and participatory action research with our consortium partners; trying to find solutions that work. A key characteristic of these approaches is that it focuses on finding solutions to problems encountered by professionals in actual practice. Through active collaboration between professionals in the public sector and higher education, the acquired knowledge and research findings end up directly in professional practice. Moreover, it will be applied in the curriculum of universities, for instance, via research groups, lecturers, and instructors.

Within this scope, theoretical and empirical research will be conducted using both quantitative and qualitative methods. We will employ a combination of, for instance, interviews, document analysis, process analysis, spend analysis, shadowing, focus groups. Important focal point are the behaviours of facility professionals and buildings occupants, presuming that appropriate spatial and organizational interventions at these stakeholders can potentially stimulate waste reduction.

## THEORY

In 2020 most Dutch building owners and related facility management professionals have taken steps for waste separation (Ministerie van Infrastructuur en Rijkswaterstaat, 2020). Despite waste management policies and the introduction of waste separation systems, it appears to be very difficult to separate waste correctly. Based on recent sampling and monitoring only 25% of the mono-flow waste output is clean and 75% is contaminated by other flows. Practitioners argue that the 35% residual waste is very difficult to achieve (DJI, 2019). As a result, most targets are currently not met. End users play a crucial role in sorting waste. But how to stimulate building occupants to start separating waste correctly?

### Automatic behaviour

A big trap in 'sustainable thinking and sustainable acting' is the so-called 'cognitive ease' (Broeders, Midden, & Ham, 2010). This means that in general people prefer to respond in such way that requires little cognitive effort and will behave in the easiest way. A deliberate and reasoned processing of information and decision-making is only used if this really cannot be otherwise (Broeders, Midden & Ham, 2010). This is caused by the facts that the human brain, as a result of its evolution, is primarily designed for fully automatic repetition of habitual behaviour. The human brain wants to 'accomplish as much as possible by as little effort as possible'. In addition, it is designed to avoid pain, discomfort, and loss. In many cases, this hinders the motivation to adopt new habits (Woolley & Fishbein, 2017). After all, the chance of failure, and therefore pain, discomfort, and loss are far greater during transformation processes and experimenting with new habits in contrast to automatic behaviour where the outcome is predictable and less risky. These principles were discovered by Daniel Kahneman (1974) based on ground-breaking scientific research of the brain's chemistry where two systems were distinguished that steer our actions. System 1 is fast, intuitive, emotional, and dominant whereby conclusions are drawn (too) quickly without rational considerations; System 2 is slower, deliberative, and more logical. Kahneman's research shows that the majority of our daily behaviour is full of automatism driven by System 1. Therefore, it is necessary to intervene in these 'automatic mental processes' to achieve successfully sustainable behavioural changes (Broeders, Midden, & Ham, 2010).

### Space and behaviour

Apart from internal physiological dynamics, the human brain is also influenced by external factors, such as the physical and social environment that continuously is driving our behaviours and actions (Gibson, 1966; Ulrich, 1991; Mobach 2009). In the 1960s, Gibson formulated the 'affordance theory' demonstrating that a multidisciplinary and integral approach is needed for a successful change of systematic sustainable behaviour. In short, Gibson defines 'affordance' - i.e., an opportunity for action- of the environment as the interaction between space and people. Both are complementary and influence each other. Not only Gibson's 'affordance theory' underscores the importance of an integrally approach of promoting sustainable behaviour as a relationship between people and space, also the anthropology, psychology, sociology, behavioural economics, environmental psychology, philosophy and planning underline this interaction between people and space (Downs & Stea, 1973, 1977; Ittelson, 1973; Moore, 1976; Lefebvre, 1991; Shefrin, 2002; Steg & Buijs, 2004; Van Andel & Hamel, 1981; Bouma et al., 2018). Hence, promoting sustainable behaviours requires research into both the conscious and unconscious actions and the spatial environment in which people are residing.

Individual preferences and behaviours are intertwined with physical spaces. This perspective provides a framework for understanding the relationships between the way people organize themselves and the relationship they have with the spaces around them. Space as a social construction. In this context, Lefebvre (1991) defines space as both physical space and the way in which space is conceived. He argues that space is under constant social construction; therefore, he uses the term 'social space' (Lengkeek, 2002).

In this perspective, people 'produce' space by giving it meaning. This approach also provides insight into the way in which space can be created as a meaningful place so that desired sustainable behaviour can be achieved. The question here is how habitual behaviours, often driven by impulsive behaviour and cognitive ease, can be changed by transformations in the physical and social space. The focus on automatic processes is a useful approach to get a grip on automatism of sustainable behaviours (Gregory & Di Leo, 2003).

### Facility operations

Although the design of the space is mostly initiated by other disciplines (architecture, real estate, interior designers, technical installers, planners, investors, etc.), the facility professional is responsible for maintenance and the operation of the facility service, based on a multidisciplinary approach whereby the integration of 'people', 'place', 'process', and 'technology' should lead to well-being ('prosperity') for building occupants (ISO, 2018). An example is the use of innovative technology for energy saving (sensors that support user behaviour to save energy and water), the 'upcycling' of waste into new

products, and inclusiveness (including workers with disabilities). Therefore, FM has the potential to improve sustainability, sustainable behaviours, and inclusiveness. This means that FM must develop and apply a successful sustainable strategy for its operations.

In 2014, AAFM reported that 21% of the total energy consumption in the Netherlands is credited to the commercial real estate and the 7% of the total CO<sub>2</sub> emissions are caused by the heating and cooling of commercial real estate, with peaks during hot summer days. In these settings, approximately 30% of the water use is for the greenery around the building. Logistics and waste management also provide facility managers with ample opportunities for sustainable improvement of the supply chain.

There are good examples of successful sustainable interventions, such as water saving faucets, light sensors, and smart indoor climate systems. Moreover, socially responsible procurement is also taken very seriously within the Dutch central government. Yet there is still a world to be won. Moreover, a better integration of services and spaces can ensure positive changes in sustainable behaviour of buildings occupants (FMN/Twijnstra Gudde, 2019).

Our expectation is in line with these observations. Substantial steps can still be taken within waste management. For this reason, it is important that research is conducted on the operational phase of a building with associated needs of services in order to retrieve knowledge about daily behavioural patterns of buildings occupants and their footprint. Research will enable facility professionals to improve their protocols, both for facility operations and buildings users, all aiming to promote more sustainable behaviours. For instance, data of spend analyses and of experiences of cleaning services and waste management are generating valuable insights on behaviour of professionals and users. Data on energy and water consumption, but also the procurement of mobile phones, vehicles, catering (with or without disposables), plastics, and waste processing are important topics for our research.

### THREE DIFFERENT STAGES

The entire research project consists of three stages in which students will conduct research within the built and organizational environment with consortium partners. These consists of focal point at automatic behaviour, space and behaviour, and facility operations. Firstly, for the analyses of automatic behaviours, students will investigate building occupants by shadowing. Students will observe the waste behaviour of buildings occupants in their natural environment. This should lead to a clarification of methods of waste separation and identifying bottlenecks within the building. Secondly, in order to better align spaces and behaviour data will be collected with direct observations in buildings, interviews with buildings occupants, and waste counting and weighing by students. For a predetermined period, students will collect waste and measure the various waste streams in two prisons, an office building, and at the university campus. This allows us to improve our understanding of how spaces- physical and social- are interrelated with unfavorable behaviours. Moreover, students will be involved to develop new waste bins and better spatial positioning and orientation of bins. For instance, in line with the automatic behaviours determined in the previous stage. Thirdly, with respect to the facility operations students will conduct spend analysis of the purchases of prisons and the university. Moreover, new protocols will be established to better understand waste flows and waste reduction. This should help facility professionals with waste reduction. These outcomes will also be useful as starting point for a debate among purchasing and procurement officers. After all, the purchasing department is often a starting point for raw materials that will end as waste.

We also carefully select the data from the above stages as an input for better facility management. For instance, data to create a dash board to improve sustainable facility operations and contract management. All these measures have a clear focus on supporting the FM professional to achieve a maximum of 35% of residual waste.

### CONCLUSION

Sustainability is a trend and a 'buzz' word (FMN/Twijnstra Gudde, 2019). However, exploratory research also shows that yet little is known about critical success factors with which facility professionals can stimulate sustainable behaviours and processes. The focus is often on a small number of aspects and

lacks integrated solutions (Twynstra Gudde/FMN, 2019; Gluch & Svensson, 2017; Lohman Rasmussen, Jensen, & Balslev Nielsen 2017).

The facility management profession has an important role to play in the mitigation of global average temperature rise. However, facility professionals struggle to find efficacious sustainable solutions. The enormously broad concept of sustainability does not help to focus operations. Moreover, there is a lack of efficacious protocols and procedures. Also, professionals lack interventions with proven effectiveness on reduction of residual waste. These developments result in restraint behaviour and a certain shyness for action. That is why too often sustainability policies are linked to waste separation with the idea that it is tangible and easy to implement. However, this is an oversimplification of reality. Waste is the end station of an entire supply chain. For this reason this research project will focus on meaningful interventions at both the start and the end of the supply chain: purchase management, waste management, and everything in between that is necessary to improve the sustainability of facility operations.

We can only do so, with better- much more integrated- research, practice, and education. Our future is in the hands of the next generation, our students as a new generation of FM professionals. In line with Greta Thunberg: "We can't save the world by playing the rules, because the rules have to change! Everything needs to change- and it has to start today" (Corbett, 2018). So, let's change!

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## REFERENCES

- Andel, J.A., & Hamel, R. (1981). *Literatuuroverzicht omgevingspsychologie*. Eindhoven: Vakgroep Gedragwetenschappen, Technische Hogeschool.
- Bouma, G., Boonstra, B., & Vanempen, E. (2018). *Gedrag en Ruimte. Bijdragen aan PlanDag 2018*. [www.plandag.net](http://www.plandag.net).
- Broeders, R., Midden, C., & Ham, J. (2010). *Zwerfafval: Met automatisch gemak goor je hetin de afvalbak*. Technische Universiteit Eindhoven . Eindhoven: Technische Universiteit Eindhoven . Retrieved from: [www.kenniswijzerzwerfafval.nl](http://www.kenniswijzerzwerfafval.nl)
- Corbett, J. (2018). 'Teen Climate Activist to Crowd of Thousands: 'We Can't Save the World by Playing by the Rules Because the Rules Have to Change''. *Common Dreams*. 20 October. Retrieved from: [www.commondreams.org](http://www.commondreams.org)
- Dienst Justitiele Inrichtingen. (2018, 12 18). *Inkopen met Impact*. Retrieved from: <https://www.dji.nl/>
- Donk, C. van der, & Lanen, B. van (2016). *Praktijkonderzoek in de school*. Bussum: Coutinho.
- Downs, R.M., & Stea, D. (1977). *Maps in Minds: Reflections on Cognitive Mapping*. New York: Harper & Row.
- Downs, R., & Stea, D. (1973). *Image and Environment: Cognitive Mapping and Spatial Behaviour*. Chicago: Aldine Publishing Company.
- FMN/Twynstra Gudde. (2019). *Duurzaamheid bepaalt de blik van de facility manager*. Amersfoort: FMN en Twynstra & Gudde.
- Gibson, J. J. (1966). *The Senses Considered as Perceptual Systems*. London: Allen and Unwin.
- Gluch, P., & Svensson, I. (2017). On the nexus of changing public facilities management practices: purposive and co-creative actions across multiple levels. *Construction Management and Economics*, 36(5).
- Gregory, G., & Di Leo, M. (2003). Repeated behavior and environmental psychology: The role of personal involvement and habit formation in explaining water consumption. *Journal of Applied Social Psychology*, 33, 1261-1296.
- ISO. (2018). *ISO 41011:2017*. Retrieved from: [www.iso.org/standard/68167.html](http://www.iso.org/standard/68167.html)
- Ittelson, W. (1973). 'Environment Perception and Contemporary Perceptual Theory', in W.H. Ittelson, *Environment and Cognition* (pp. 141- 154). New York: Seminar.
- Kahneman, D. (2011). *Thinking Fast and Slow*. Farrar, Straus and Giroux: New York.
- Lefebvre, H. (1991). *The Production of Space. (translated by Donald Nicholson-Smith)*. Oxford & Oxford & Cambridge: Blackwell.

- Lengkeek, A. (2002). De verbeelding van ruimte. *AGORA*, 18(4), 7-11.
- Lohmann Rasmussen, H., Anker Jensen, P., & Balslev Nielsen, S. (2017). Initiatives to integrate operational knowledge in design: a building client perspective. *Facilities*. doi:<https://doi.org/10.1108/F-02-2017-0021>
- Ministerie van Economische Zaken en Klimaat. (2019). *Klimaatakkoord*. Retrieved from Rijksoverheid: <https://www.klimaatakkoord.nl/>
- Ministerie van Infrastructuur en Rijkswaterstaat. (2020). *Beleidskader LAP3*. Retrieved from <https://lap3.nl/beleidskader/>
- Mobach, M.P. (2009). *Een organisatie van vlees en steen*. Assen: Koninklijke Van Gorcum B.V.
- Moore, G.T. (1976). 'Theory and research on the development of environmental knowing', in G.T. Moore, & R.G. Golledge, *Theories, research, and methods* (pp. 138- 164). Dowden: Hutchinson & Ross.
- Shefrin, H. (2002). Behavioral decision-making, forecasting, game theory, and role play. *International Journal of Forecasting* 18,, 375-382.
- Steg, L., & Buijs, A. (2004). *Psychologie en duurzame ontwikkeling*. Nijmegen: McDonald/SSN.
- Ulrich, R. (1991). . Effects of interior design on wellness: theory and recent scientific research. *Journal of health care interior design*, 79- 109.
- Woolley, K., & Fishbein, A. (2017). Immediate Rewards Predict Adherence to Long-Term Goals. *Personality and Social Psychology Bulletin*, 151-162.

# Cleaning with Services and Spaces: Effects of Seating Materials and Architectural Clutter on Perceived Cleanliness

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## ABSTRACT

**Background and aim** – How do customers determine the cleanliness of their surroundings? Research and practice typically focus on the quality of cleaning services while ignoring the role of other environmental stimuli. The aim of this paper is to explore the effects of seating materials and architectural clutter as determinants of customers' perception of cleanliness.

**Methods / Methodology** – The perception of cleanliness was operationalized using the dimensions: cleaned, fresh, and uncluttered. Effects of seating materials and architectural clutter were examined in three separate experiments in train stations. A field experiment was used to examine the effects of seating materials (N = 544) and a photo experiment evaluated the effects of architectural clutter (N = 220).

**Results** – Smooth seating materials and uncluttered architecture were found to positively influence different dimensions of perceived cleanliness.

**Originality** – This study provides deeper insight into the concept of perceived cleanliness and related dimensions by demonstrating that perceived cleanliness may be influenced by other determinants than cleaning quality only.

**Practical or social implications** – The results may allow facility managers to improve decision making. Instead of solely increasing cleaning frequencies to improve customers' perception of cleanliness, facility managers may decide to invest in replacing or refurbishing seating materials and/or uncluttering architecture.

**Type of paper** – Research paper.

## KEYWORDS

Architectural clutter, cleaning, facility management, perceived cleanliness, seating materials, trains, train stations.

## INTRODUCTION

As one of the key topics in facility management, cleanliness research grew over the last decade. Whereas most of this research typically focusses on the organizational and financial side of cleanliness, we are interested in the customer perspective on cleanliness. More specifically, we will tap into how customers perceive cleanliness and how it may be influenced by properties of services and spaces designs. Customers' perception of cleanliness is determined by the total (holistic) configuration of services and spaces, including cleaning quality (e.g., dust, stains). Although it is without much doubt that customers use environmental stimuli to make sense of service environments, it remains unclear how this works for perceived cleanliness. A systematic exploration and evaluation of how services and spaces influence perceived cleanliness seems appropriate to further the professional and academic field of cleanliness. In this context, we have set up experiments that help unveiling the relationship between services, spaces, and customer perception of cleanliness. The results of these experiments are preliminary and part of a

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larger research project. More extensive discussion of related results will soon be published.

## LITERATURE STUDY

### Dimensions of perceived cleanliness

What is perceived cleanliness? Available definitions and operationalizations mainly focus on how customers perceive the cleanliness of specific interior elements (i.e., windows, bathroom) while ignoring other dimensions, including the aesthetic quality of a service environment (Barber & Scarcelli, 2010). Also, the existing measurement instruments are predominantly intended for specific settings, such as restaurants and hotels (Barber & Scarcelli, 2010; Lockyer, 2003), which complicates generalisability to other service settings. Recently, this void was filled by the introduction of the cleanliness perceptions scale (CPS), this instrument offers a more holistic take on perceived cleanliness by distinguishing three dimensions: cleaned, fresh, and uncluttered (Vos, Galetzka, Mobach, van Hagen, & Pruyn, 2019a). The (1) cleaned dimension focusses on determinants related to the cleaning process (e.g., cleaning quality, visibility cleaning staff), the (2) fresh dimension on the smell of an environment (e.g., pleasant, unpleasant, related to cleanliness or not), and the (3) uncluttered dimension focusses on the architectural clutter in an environment (i.e., organisation, coherence of architectural design). In our two experiments, we measured perceived cleanliness using the CPS.

### Determinants of perceived cleanliness

Since knowledge on determinants of perceived cleanliness is scattered and dominantly accumulated in practice, we used a systematic literature review (Vos, Galetzka, Mobach, van Hagen, Pruyn, 2018a) and a qualitative study (Vos, Galetzka, Mobach, van Hagen, & Pruyn, 2018b) performed in the facilities management industry to select determinants for our experimental studies. Inspired by this previous research, determinants were categorized using Bitner's (1992) environmental dimensions (i.e., ambient conditions, space/function, and signs, symbols, & artefacts). As we wanted to further literature on environmental dimensions of perceived cleanliness, the focus of the study was on the space/function dimension. As such, the effects of seating materials (i.e., upholstery) and architectural clutter were tested in two separated experiments.

#### *Seating materials*

The tactile and visual experience of materials (e.g., dull vs. shiny, cloth vs. leather) has been associated with perceived cleanliness. For instance, researchers demonstrated that people sitting at a table with a shiny (vs. dull) table top had more positive perceptions of cleanliness and showed more cleaning behaviour (Broeders, Lakens, Midden, & Ham, 2011). In an explorative study, scholars found that rail passengers generally prefer smooth materials, such as leather and vinyl over less smooth materials, such as cloth, due to cleanliness concerns (Pepper, Spitz, & Adler, 2003). We will further test the idea that smooth materials may be used to positively influence perceived cleanliness.

#### *Architectural clutter*

Clutteredness and cleanliness may be approached from a non-aesthetic and aesthetic perspective (Leddy, 1995). The non-aesthetic perspective refers to the physical properties of a cleaned or uncluttered environment; cleaning (by using a cleaning cloth) or uncluttering a service environment (by restructuring objects such as document or clothing) may reveal and clarify the underlying objects or structures. Illustrated by metaphors, such as having clean lines, the concepts of cleanliness and clutteredness are used as aesthetic qualities in design. In this study, we tested the idea that the degree of clutteredness of an environment influences peoples' perception of cleanliness. The concept of clutteredness was defined by the number of objects present, variation between objects (e.g., colour, form), and their coherence (Olivia, Mack, Shreshta, & Peeper, 2004; Orth & Wirtz, 2014).

## METHOD

The effects of seating materials and architectural clutter on perceived cleanliness were tested in two separate experiments in the context of public transport.

### Seating materials

Effects of seating materials were evaluated in a field experiment. A total of 544 customers of a Dutch



railway company (56.1% female,  $M_{age} = 33.86$ ,  $SD_{age} = 17.01$ ) participated in this experiment. Participants were travelling in a train with either smooth (i.e., vinyl,  $n = 283$ ) or non-smooth (i.e., cloth,  $n = 261$ ) seating materials (Appendix 1, Figures 1-2). Except for the seating materials, the trains, train trajectories, and cleaning program of the train were identical. Seated passengers were invited to fill out a questionnaire that contained items related to the cleaned, fresh, and uncluttered dimensions of perceived cleanliness measured on a 10-point Likert scale.

### Architectural clutter

Effects of clutteredness were evaluated in an online photo experiment. A total of 220 members of an online customer panel of a Dutch railway company (female = 41.9%,  $M_{age} = 59.69$ ,  $SD_{age} = 22.46$ ) evaluated three photos of a waiting room at a train platform that only differed with respect to their architectural clutteredness, ranging from uncluttered to cluttered (Appendix 1, Figures 3-5). Participants were randomly assigned to one of the three photos (Figures 3-5) and instructed to evaluate the cleaned, fresh (i.e., I think this station smells fresh), and uncluttered dimensions of perceived cleanliness using a 7-point Likert scale.

## RESULTS

### Seating materials

The results of our seating materials experiment show that smooth seating materials positively influence the cleaned ( $F[1, 533] = 44.41$ ,  $p < .001$ ) and uncluttered ( $F[1, 522] = 13.45$ ,  $p < .001$ ) dimensions of perceived cleanliness, no meaningful differences were found for the fresh dimension ( $F[1, 523] = 1.02$ ,  $p = .18$ ). Train compartments with smooth seating materials were perceived as more cleaned ( $M = 7.17$ ,  $SD = 1.20$ ) and uncluttered ( $M = 7.52$ ,  $SD = 1.24$ ) compared to compartments with the non-smooth seating materials ( $M = 6.31$ ,  $SD = 1.74$ ;  $M = 7.08$ ,  $SD = 1.45$ ).

### Architectural clutter

The results of this experiment only showed effects for architectural clutter on the uncluttered dimension of perceived cleanliness ( $F[2, 217] = 2.86$ ,  $p = .05$ ). The uncluttered station (Figure 3) was perceived as most uncluttered ( $M = 5.70$ ,  $SD = 0.83$ ), followed by the lightly (Figure 4,  $M = 5.38$ ,  $SD = 1.07$ ), and heavily cluttered station (Figure 5,  $M = 5.30$ ,  $SD = 1.30$ ). No effects were detected for the cleaned ( $F[2, 217] = 0.32$ ,  $p = .69$ ) and fresh ( $F[2, 217] = 0.06$ ,  $p = .91$ ) dimensions of perceived cleanliness.

## DISCUSSION AND CONCLUSION

With the current study, we showed that perceptions of cleanliness is not only influenced by the design of services, but also by the design of spaces. More specifically, the use of smooth materials and uncluttered architecture were demonstrated to positively influence dimensions of perceived cleanliness. These findings confirm and complement previous research stating that perceived cleanliness may be influenced by other determinants than cleaning quality only (e.g., Vos et al., 2018a, Whitehead, May, & Agahi, 2007). The presence of smooth seating materials and uncluttered architecture as primes that make the concept of cleanliness more accessible in customers through an associative and affective process. Exposure to these stimuli may not only be experienced as pleasant but will also activate associations related to the concept of cleanliness (i.e., smooth = clean). Based on these insights, facility managers may reconsider the way in which perceived cleanliness is managed. Instead of solely increasing cleaning frequencies to improve customers' perception of cleanliness, facility managers might, for example, consider to invest in replacing seating materials, uncluttered architecture, but also in more visible cleaning, scent, and bright colours. A repaint or more visible cleaning staff will have adverse effects when an environment is unclean, so the above interventions should in all cases complement existing cleaning services.

## REFERENCES

- Barber, N. & Scarcelli, J. (2010). Enhancing the assessment of tangible service quality through the creation of a cleanliness measurement scale. *Managing Service Quality: An International Journal*, 20 (1), pp. 70-88. <https://doi.org/10.1108/09604521011011630>
- Bitner, M. J. (1992). Servicescapes: The impact of physical surroundings on customers and employees. *Journal of Marketing*, 56(2), pp. 57-71. <https://doi.org/10.1177/002224299205600205>

- Broeders, R., Lakens, D., Midden, C., & Ham, J. (2011). An embodied cognition approach to litter reduction: the grounding of clean in shininess. Presentation at the Environment 2.0: the 9th Biennial Conference on Environmental Psychology, September 26-28, 2011, Eindhoven, the Netherlands.
- Leddy, T. (1995). Everyday Surface Aesthetic Qualities: Neat, Messy, Clean, Dirty. *The Journal of Aesthetics and Art Criticism*, 53(3), pp. 259-268. <http://doi.org/10.2307/431351>
- Lockyer, T. (2003). Hotel cleanliness—how do guests view it? Let us get specific. A New Zealand study. *International Journal of Hospitality Management*, 22(3), pp. 297-305. [https://doi.org/10.1016/S0278-4319\(03\)00024-0](https://doi.org/10.1016/S0278-4319(03)00024-0)
- Orth, U. R., & Wirtz, J. (2014). Consumer processing of interior service environments: the interplay among visual complexity, processing fluency, and attractiveness. *Journal of Service Research*, 17(3), pp. 296-309. <https://doi.org/10.1177/1094670514529606>
- Olivia, A., Mack, M. L., Shrestha, M., & Peeper, A. (2004). Identifying the perceptual dimensions of visual complexity of scenes. In *Proceedings of the Annual Meeting of the Cognitive Science Society*, 26, pp. 1041-1046. <https://escholarship.org/uc/item/17s4h6w8>
- Pepper, J., Spitz, G., & Adler, T. (2003). Customer perspectives on multilevel coaches for increasing rail system capacity. *Transportation research record*, 1838(1), 19-29. <https://doi.org/10.3141/1838-03>
- Vos, M. C., Galetzka, M., Mobach, M. P., van Hagen, M., & Pruyn, A.T.H. (2018a). Cleanliness unravelled: a review and integration of literature. *Journal of Facilities Management*, 16 (4), pp. 429-451. <https://doi.org/10.1108/JFM-06-2017-0025>
- Vos, M.C., Galetzka, M., Mobach, M.P., Van Hagen, M. and Pruyn, A.T.H. (2018b). Exploring cleanliness in the Dutch facilities management industry: a Delphi approach, *Facilities*, 36 (9/10), pp. 510-524. <https://doi.org/10.1108/F-09-2017-0092>
- Vos, M. C., Galetzka, M., Mobach, M. P., van Hagen, M., & Pruyn, A.T.H. (2019a). Measuring perceived cleanliness in service environments: Scale development and validation. *International Journal of Hospitality Management*, 83, pp. 11-18. <https://doi.org/10.1016/j.ijhm.2019.04.005>
- Vos, M. C., Sauren, J., Knoop, O., Galetzka, M., Mobach, M. P., & Pruyn, A. T. (2019b). Into the light: effects of the presence of cleaning staff on customer experience. *Facilities*, 37 (1/2), pp. 91-102. <https://doi.org/10.1108/F-10-2017-0105>
- Whitehead, H., May, D., & Agahi, H. (2007). An exploratory study into the factors that influence patients' perceptions of cleanliness in an acute NHS trust hospital. *Journal of Facilities Management*, 5 (4), pp. 275-289 <https://doi.org/10.1108/14725960710822268>

APPENDIX 1: SEATING MATERIALS AND ARCHITECTURAL CLUTTER



**Figure 1** Photo of the train compartment with (smooth) vinyl seating materials.



**Figure 2** Photo of the train compartment with (non-smooth) cloth seating materials.



**Figure 3** Original photo of the waiting room (uncluttered condition).



**Figure 4** Manipulated photo of the waiting room (lightly cluttered condition).



**Figure 5** Manipulated photo of the waiting room (heavily cluttered condition).



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