

EXHIBITION CATALOGUE

INTERNATIONAL ITINERANT EXHIBITION "RESEARCH IN BUILDING ENGINEERING EXCO'25"

INTERNATIONAL ITINERANT EXHIBITION EXCO 2025
ETS DE INGENIERÍA DE EDIFICACIÓN
UNIVERSITAT POLITÈCNICA DE VALÈNCIA
Camino de Vera S/N, 46022 Valencia – Spain

Location:

JADE HOCHSCHULE

Jade University of Applied Sciences

From 30th October to 12th November 2025

Ofener Straße 16/19

26121 OLDENBURG - GERMANY

Curators of Exhibition:

Dr.-Ing. Anja Henrike KLEINKE (Local Curator)

Dr. José Ramón ALBIOL IBÁÑEZ (International Curator)

Exhibition

XXXIX INTERNATIONAL SHOWROOM OF CONSTRUCTION TECHNOLOGIES - EXCO 2025 ©

INTERNATIONAL ITINERANT EXHIBITION "Research in Building Engineering - EXCO'25"



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Jade Hochschule
Wilhelmshaven/Oldenburg/Emsfleth
Fachbereich Bauwesen Geoinformation Geotechnik
Abteilung Bauwesen
Otener Str. 10/19
26121 Oldenburg

PROLOG OLDENBURG

Vom 30. Oktober bis zum 12. November 2025 verwandelte sich der Lichthof der Jade Hochschule am Campus Oldenburg in ein Zentrum für innovative Bau- und Ingenieurkunst.

Die internationale Wanderausstellung Exco'25, wurde von Prof. Dr. Jose Ramon Albiol Ibañez der Polytechnischen Universität Valencia initiiert und Oldenburger Kuratorin war Prof. Dr.-Ing. Anja Henrike Kleinke. Die Ausstellung lockte Studierende, Wissenschaftler, Fachleute und Interessierte aus der Region und darüber hinaus an und präsentierte eine Sammlung aktueller Forschungsergebnisse aus über 60 Hochschulen und Universitäten weltweit. Mit einem breiten Spektrum an Themen wie beispielsweise Bau- und Immobilienwirtschaft, Umwelt, Kulturerbe, Technologie, 3D-Druck, Stadtplanung, Projektmanagement, Bauwesen und Baumaterialien bot die Exco'25 den Besuchern tiefgehende Einblicke in die neuesten Entwicklungen der Bauindustrie. Die Jade Hochschule war in diesem Jahr mit einer Auswahl aktueller Forschungsthemen ihres Fachbereichs Bauwesen Geoinformation Gesundheitstechnologie vertreten.

„Wir freuen uns sehr über die Zusammenarbeit mit Prof. Dr. Jose Ramon Albiol Ibañez zu der Wanderausstellung Exco'25 in Oldenburg. Sie bringt uns spannende internationale Forschungsergebnisse näher und ermöglicht den Studierenden, die Breite und Tiefe zukünftiger Tätigkeitsfelder aus Sicht von Forschenden zu erleben.“

PROLOGUE OLDENBURG

From 30 October to 12 November 2025, the atrium of the Jade University of Applied Sciences on the Oldenburg campus was transformed into a centre for innovative architecture and engineering. The international visiting exhibition Exco'25 was initiated by Prof. Dr. Jose Ramon Albiol Ibañez of the Polytechnic University of Valencia and Oldenburg curator was Prof. Dr.-Ing. Anja Henrike Kleinke. The exhibition attracted students, scientists, experts and interested parties from the region and beyond and presented a collection of current research results from over 60 colleges and universities worldwide. With a wide range of topics such as construction and real estate, environment, cultural heritage, technology, 3D printing, urban planning, project management, construction and building materials, Exco'25 offered visitors an in-depth look at the latest developments in the construction industry. This year, the Jade University of Applied Sciences was represented with a selection of current research topics from its Department of Civil Engineering, Geoinformation and Health Technology.

"We are very pleased to be collaborating with Prof. Dr. Jose Ramon Albiol Ibañez on the traveling exhibition Exco'25 in Oldenburg. It brings us closer to exciting international research results and enables students to experience the breadth and depth of future fields of activity from the perspective of researchers."

Dr.-Ing. Anja Henrike Kleinke

Department of Civil Engineering, Geoinformation, Health Technology
Jade University of Applied Sciences, Oldenburg Germany



FOREWORD DIRECTOR EXCO'25

The Faculty of Building Engineering of the UNIVERSITAT POLITÈCNICA DE VALÈNCIA - SPAIN, organized on February 24th to 28th, 2025, "The XXXIX Construction Technology Exhibition" EXCO'25 and the International Itinerant Exhibition "Research in Building Engineering" along year, at CEVISAMA - International Fair of Valencia - SPAIN.

Conferences are scheduled in UNIVERSITAT POLITÈCNICA DE VALÈNCIA - SPAIN, the speakers are national and international of recognized prestige from Europe, Asia and America. These conferences are aimed at professionals and students of the UPV to broaden their knowledge and experiences.

EXCO'25 promotes the entrepreneurship of the young UPV generations, participation in conferences.

The International Itinerant Research Exhibition EXCO'25 has the collaboration of 63 Universities from America, Europe, Africa, Asia and Oceania. Promoting collaboration between institutions and professors at the international level.

It fosters interdisciplinary collaboration of the professor staff within the UPV with 63 International Universities; It has the participation of 9 departments and 8 research institutes of the UPV in EXCO'25.

The participating entities are:

1. Universitat Politècnica de València, España.
2. Politecnico di Milano, Italia.
3. Mimar Sinan Fines Arts University, Istanbul, Turkey.
4. Nottingham Business School, England.
5. Vilnius Gediminas Technical University, Vilnius, Lithuania.
6. Universidad de Costa Rica
7. Università degli Studi di Basilicata, Matera, Italia.
8. Universidad Tecnológica de La Habana José Antonio Echeverría, Cuba.
9. Università degli Studi Firenze, Italia
10. Università di Pavia, Italia.
11. Odessa State Academy of Civil Engineering & Architecture, Odessa, Ukraine
12. Università di Salerno, Italia.
13. Silesian University of Technology, Politechnika Śląska, Gliwice, Poland.
14. University of British Columbia, Vancouver, Canada.
15. Universidad de Alcalá de Henares, Madrid, España.
16. Florida A&M University, Florida, USA.
17. Universidad Mayor de San Andrés, La Paz, Bolivia.
18. Universidad de la República (UdelaR) de Uruguay.
19. Universidad John F. Kennedy, Argentina.
20. Universidad de Castilla-La Mancha, España.



21. Universidad de Granada, España.
22. Università degli Studi della Campania "Luigi Vanvitelli", Napoli.
23. Politecnico di Bari, Italia.
24. Università degli Studi di Roma "Tor Vergata", Italia.
25. Hanze University of Applied Sciences, Groningen. Nederland.
26. Jade University of Applied Sciences, Wilhelmshaven/Oldenburg, Germany.
27. New York University, Tandon School of Engineering. USA.
28. McGill University, Canada
29. Nanyang Technological University, Singapore.
30. University of New South Wales, Sydney, Australia.
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35. Universitat Jaume I, Castellón, España.
36. University of Applied Sciences and Arts of Southern Switzerland
37. Institut für Bau- und Infrastrukturmanagement /ETH Zürich
38. University North, Varaždin, Croacia
39. South Ukrainian National Pedagogical University, Odessa, Ukraine.
40. Kharkiv National University of Civil Engineering and Architecture, Ukraine.
41. Universitat de València, Spain.
42. Perm National Research Polytechnic University, Perm, Russia
43. University of Cape Town, South Africa.
44. National University of Singapore.
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52. Universidad de la Salle, Bogotá, Colombia.
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54. Universidad Católica de Valencia. España.
55. Universidad UTE. Quito. Ecuador.
56. Universidad de Napoles Federico II, Napoles, Italy.
57. Telematic University Pegaso, Italy.
58. University of Guanajuato, México.
59. University of La Salle Bajío, México
60. Universidad Jesuita de Guadalajara, ITESO, México



61. Tecnológico de Monterrey. México.
62. MIT Massachusetts Institute of Technology. USA.
63. Gdańsk University of Technology, Poland.

Thank you all for making EXCO possible.

All the best for EXCO'26!

Best Regards

Dr. José R. Albiol-Ibáñez

Vice Dean Digital Transformation, Business Cathedra &

Entrepreneurship Director EXCO'25

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CHAPTER 1: ECONOMY

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J. Fuentes-del-Burgo / E. Navarro-Astor

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Fabiola Colmenero Fonseca / Alejandro Guzmán Ramírez
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Javier Cárcel-Carrasco / Fidel Salas Vicente / José Ramón
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A. Esteller Agustí / A. Martínez-Ibernón / C. Aparicio-
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Fernando Cos-Gayón López / Ángel Martín Furones / Igor
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Fabiola Colmenero Fonseca / Maria del Carmen Ixtepan
Turrent / Javier Cárcel Carrasco / Juan Francisco Palomino
Bernal / Ramiro Rodríguez Perez

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María Eugenia Torner Feltre / Mar Cañada Soriano /
Carolina Aparicio Fernández / José Luis Vivancos Bono

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Juan Francisco Palomino Bernal / Javier Cárcel-Carrasco /
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Ramiro Rodríguez Pérez / Javier Cárcel Carrasco / Fabiola
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Quiteria Angulo-Ibáñez / Aitana Puig-Rocher

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XXXIX SALÓN TECNOLÓGICO DE LA CONSTRUCCIÓN EXCO 2025
INTERNATIONAL EXHIBITION "RESEARCH IN BUILDING ENGINEERING - EXCO'25"



GRUNDLEGENDE INFORMATIONSANFORDERUNGEN ALS FEHLENDE VERBINDUNG ZWISCHEN BIM UND DEM FACILITY MANAGEMENT
BASIC INFORMATION REQUIREMENTS AS THE MISSING LINK BETWEEN BIM AND FACILITY MANAGEMENT

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EINLEITUNG

Facility Services sind für den Betrieb jeder Immobilie notwendig und erfordern verlässliche Bestandsdaten, etwa Flächenangaben für die Reinigung oder technische Informationen für die Wartung. In BIM-Projekten können diese Daten grundsätzlich im Modell bereitgestellt und an das Facility Management (FM) übergeben werden. In der Praxis scheitert dies jedoch häufig, da das FM während der Planung oft nicht eingebunden werden kann bzw. eingebunden wird oder die Akteure Schwierigkeiten haben, ihre Anforderungen zu formulieren (Abb. 1). Die Folge sind unvollständige Informationen, die nur mit hohem Aufwand nachträglich beschafft werden können. Ein zentrales Problem bleibt daher die Sicherstellung von durchgängigen, standardisierten Informationsanforderungen für den Gebäudebetrieb.

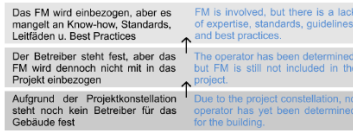


Abbildung 1. Hindernisse bei der Definition von Informationsanforderungen für das FM
Figure 1. Obstacles in defining information requirements for FM

INTRODUCTION

Facility services are necessary for the operation of any property and require reliable inventory data, such as floor space information for cleaning or technical information for maintenance. In BIM projects, this data can generally be provided in the model and transferred to facility management (FM). In practice, however, this often fails because FM cannot be involved / is not involved during the planning stage, or because the parties involved have difficulty formulating their requirements (Fig. 1). The result is incomplete information that can only be obtained retrospectively at great expense. A key problem therefore remains, ensuring consistent, standardized information requirements for building operations.

FORSCHUNGSZIEL UND -METHODE

Ziel dieser Forschung und Dissertation ist die Entwicklung und Evaluation grundlegender Informationsanforderungen für das operative FM im Kontext des BIM4FM-Prozesses. Die Informationsanforderungen sollen so gestaltet sein, dass es auch von Projektbeteiligten ohne FM-spezifisches Wissen angewendet werden kann.
Das Vorgehen folgt dem Design Science Research-Ansatz. Aufbauend auf dem Stand der Praxis wird ein BIM-basierter Prozess für den sogenannten Facility Service Handover entwickelt, der die Übergabepunkte relevanter Informationen strukturiert. Auf Grundlage dieses Prozesses werden die grundlegenden Informationsanforderungen für die Facility Services definiert und iterativ mit Experten evaluiert. Anschließend wird eine geeignete Methode gewählt, um diese strukturiert darzustellen, und durchgeführt.

OBJEKTIVE AND METHODOLOGY

The aim of this research and dissertation is to develop and evaluate basic information requirements for operational FM in the context of the BIM4FM process. The information requirements should be designed in such a way that they can also be applied by project participants without FM-specific knowledge.
The project follows the design science research approach. Building on the current state of practice, a BIM-based process for the so-called facility service handover is being developed, which structures the handover points of relevant information. Based on this process, the basic information requirements for facility services are defined and iteratively evaluated with experts. Subsequently, a suitable method is selected to present these requirements in a structured manner and implemented.

ERGEBNISSE

Die Analyse des aktuellen Stands der Praxis verdeutlicht, dass es bislang keine Informationsanforderungen gibt, die alle in einer vorherigen Arbeit definierten Bedingungen an grundlegende Informationsanforderungen für das FM erfüllen. Zwar existieren unterschiedliche Ansätze zur Spezifikation von Informationsbedarf, diese sind jedoch meist auf spezifische Anwendungsfälle, Gebäudetypen oder einzelne Facility Services beschränkt.
Um solche zu entwickeln, wurde im ersten Schritt der bestehende BIM-Handover-Prozess mit dem Facility-Service-Prozess verknüpft. Dadurch war es möglich, klare Datenübergabepunkte (Data Drops (DD)) zu definieren, an denen die für das FM relevanten Informationen bereitgestellt werden müssen. Ausgehend von diesem Prozess wurden die konkreten Informationsbedarfe abgeleitet, die für Facility Services erforderlich sind (Abb. 2).
Die Definition dieser Informationsbedarfe erfolgte mithilfe von Expertendiskussionen aus Forschung und Praxis. Dabei wurde ein Konsensansatz gewählt: Berücksichtigt wurden ausschließlich Attribute, bei denen Einigkeit darüber bestand, dass sie für den

	Vergabe Awarding	Grundlagen- ermittlung Basic determination	Planung Planning	Ausführung Execution	Fertigstellung Completion	Betrieb Operation
FSM / FS FSM / FS						
FM FM	MA anfragen Create EIR	BAP anfragen Create BAP	Zwischenbe- gabe überprüfen Check interim submission	Übergabe überprüfen Check submission	Übergabe überprüfen Check submission	FS-Prozess fortsetzen Continue FS-process
Informations- beschreiber Information requester			Informations- erstellen Create information	Informations- erstellen Create information	Informations- erstellen Create information	
Informations- bereitsteller Information provider						

FSM / FS Facility Service Management / Facility Service, AIA: Auftraggeber-Informationsanforderungen, BAP: BIM-Abwicklungsplan
FSM / FS Facility Service Management / Facility Service, EIR: Exchange information requirements, BAP: BIM Execution plan

Abbildung 2. Facility Services Handover Prozess
Figure 2. Facility Services Handover Process

Betrieb eines jeden Gebäudes zwingend erforderlich sind. Dieses Vorgehen führte zu einem „kleinsten gemeinsamen Nenner“, der sicherstellt, dass die resultierenden Informationsanforderungen universell anwendbar sind. In Abb. 3 ist zu sehen, wie sich aus dem Anwendungsfall zuerst der entwickelte Prozess ableiten ließ und dieser wiederum für die Ableitung von Informationen genutzt wird. Im nächsten Schritt wurde die methodische Umsetzung betrachtet. Mittels einer Multi-Kriterien-Analyse wurde bewertet, welche der verfügbaren Methoden zur

The next step was to consider the methodological implementation. A multi-criteria analysis was used to evaluate which of the available methods for information requirements was most suitable for this application. As a result, the developed information requirements were transferred to an Information Delivery Manual (IDM) and an Information Delivery Specification (IDS). Fig. 3 on the right shows how the information requirements are transferred into technical test rules for the IDS, which are then used in an Industry Foundation Classes (IFC) to check whether this information is available.

Informationsanforderungen für diesen Anwendungsfall am geeignetsten ist. Als Ergebnis wurden die entwickelten Informationsanforderungen in ein Information Delivery Manual (IDM) und ein Information Delivery Specification (IDS) überführt. In Abb. X lässt sich auf der rechten Seite erkennen, wie die Informationsanforderungen in technische Prüfrregeln für das IDS überführt werden, welche dann in einer Industry Foundation Classes (IFC) überprüfen, ob diese Informationen vorhanden sind.

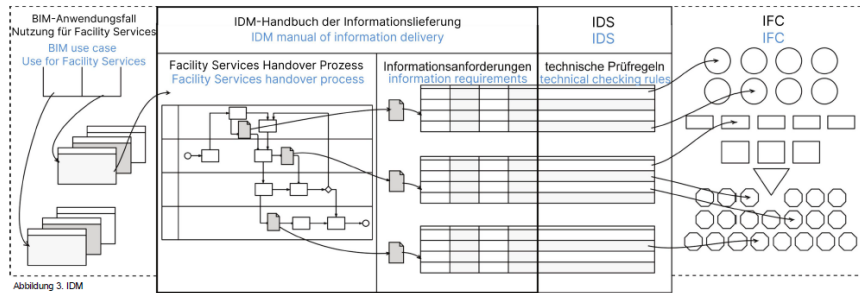


Abbildung 3. IDM
Figure 3. IDM

FAZIT UND AUSBLICK

Mit dieser Arbeit wurden der Facility Service Handover Prozess und die grundlegenden Informationsanforderungen für das FM entwickelt sowie eine geeignete Methode zu ihrer Kodierung gewählt. Der nächste Schritt besteht nun darin, diese Ergebnisse in Pilotprojekten praktisch zu erproben, um ihre Anwendbarkeit, Wirksamkeit und Integration in BIM-Projekten zu überprüfen.

CONCLUSION AND OUTLOOK

This work developed the facility service handover process and the basic information requirements for FM and selected a suitable method for encoding them. The next step is now to test these results in pilot projects to verify their applicability, effectiveness, and integration into BIM projects.

XXXIX SALÓN TECNOLÓGICO DE LA CONSTRUCCIÓN EXCO 2025 INTERNATIONAL EXHIBITION "RESEARCH IN BUILDING ENGINEERING - EXCO'25"



Mobilität im ländlichen Raum Herausforderung ÖPNV
Mobility in Rural Areas Challenges for Public Transport

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Die Mobilitätswende ist eine zentrale Herausforderung des 21. Jahrhunderts, verschärft durch globale Klima- und Umweltkrisen. Ziel ist es, den Verkehrssektor grundlegend zu transformieren, um Klimaziele zu erreichen und Umweltbelastungen zu verringern. Dafür braucht es nicht nur nachhaltige, sondern auch inklusive Mobilitätskonzepte, die allen Menschen Zugang sichern. Das Auto steht dabei im Mittelpunkt, da es Hauptverursacher der Emissionen ist. In ländlichen Räumen gestaltet sich die Wende besonders schwierig. Viele Menschen sind wegen schwacher ÖPNV-Anbindung stark auf das Auto angewiesen. Etwa ein Drittel der Bevölkerung lebt in ländlichen Regionen, deren Beitrag für die Klimaziele entscheidend ist. Soziale und infrastrukturelle Hürden bremsen jedoch den Wandel. Abbildung 1 zeigt die Gehzeit zu Bushaltestellen mit mindestens 25 Abfahrten werktags in Niedersachsen. Der Stadt-Land-Unterschied ist deutlich: In Städten liegen die Wege meist unter 10 Minuten, auf dem Land oft bei 40 Minuten oder mehr. Lange Wege mindern die Alltagstauglichkeit des ÖPNV – besonders für Ältere und Familien – und verstärken die Abhängigkeit vom Auto sowie soziale Ungleichheiten.

The mobility transition is a key challenge of the 21st century, intensified by global climate and environmental crises. It aims to transform the transport sector to meet climate goals and reduce environmental harm. Beyond promoting sustainable mobility, it requires inclusive concepts that ensure accessibility for all. The private car stands at the center of this change as a major contributor to emissions. In rural areas, the transition is particularly difficult. Many residents rely heavily on private cars due to limited public transport. About one third of Germany's population lives in rural regions, making their participation vital for climate targets. Yet social and infrastructural barriers often hinder progress. Figure 1 shows walking times to bus stops with at least 25 weekday departures in Lower Saxony. The urban-rural divide is evident: cities have short access times, while rural areas often face 40-minute walks or more. Long walking distances reduce the usability of public transport, especially for elderly people and families, reinforcing dependence on cars and limiting a fair mobility transition.

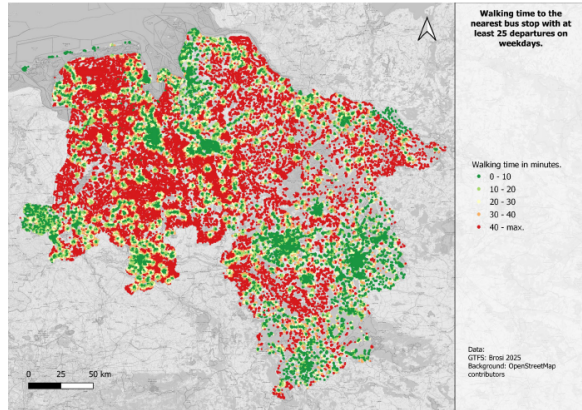


Abbildung 1: Gehzeit zur nächstgelegenen Bushaltestelle mit mindestens 25 Abfahrten werktags.
Figure 1: Walking time to the nearest bus stop with at least 25 weekday departures.

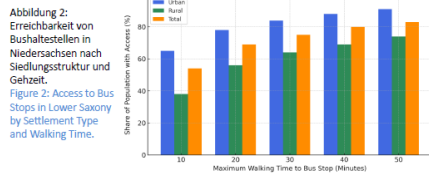


Abbildung 2 zeigt die Stadt-Land-Disparitäten im ÖPNV. In Städten erreichen 65 % der Bevölkerung eine Bushaltestelle mit 25+ Abfahrten werktags in 10 Minuten, bei 50 Minuten sind es 91 %. In ländlichen Regionen sind es nur 38 % bzw. 74 %. Städte profitieren von dichten, häufigen Netzen, ländliche Räume bleiben unterversorgt. Das mindert Mobilität und Teilhabe, besonders ohne Auto und erschwert den Umstieg auf nachhaltigen Verkehr.

Figure 2 shows the urban-rural gap in public transport. In cities, 65 % of people reach a bus stop with 25+ daily departures within 10 minutes, rising to 91 % at 50 minutes. In rural areas, only 38 % reach such a stop in 10 minutes, and 74 % within 50 minutes. Cities benefit from dense, frequent networks, while rural regions remain underprovided. This limits mobility and social participation, especially for those without cars, and hinders the shift to sustainable transport.

Die Gemeinde Dunum im Nordwesten Niedersachsens verdeutlicht die Mobilitätsprobleme auf dem Land. GIS-Analysen von Punkten des täglichen Bedarfs (POIs) zeigen sogenannte „White Spots“ – Bereiche mit schlechter ÖPNV-Anbindung. Die Grundschule ist in 20 Minuten erreichbar, eine Apotheke hingegen nicht. Andere Einrichtungen wie Arztpraxen, Kindergärten, weiterführende Schulen und Supermärkte haben meist nur eine Verbindung innerhalb von zwei Stunden. Tabelle 1 zeigt, dass der ÖPNV nur eingeschränkten Zugang zu wichtigen Einrichtungen bietet, was ihn für alltägliche Eriedlungen unpraktisch macht. Das Auto ermöglicht nahezu universelle Erreichbarkeit, Fahrer bieten mittlere Reichweite, zu Fuß ist der Zugang am eingeschränktesten. Insgesamt kann der ÖPNV in Dunum private Autos nicht ersetzen, was die Abhängigkeit vom Auto in ländlichen Regionen verdeutlicht.

The municipality of Dunum in northwest Lower Saxony illustrates rural mobility challenges. GIS analysis of points of interest (POIs) revealed "white spots" – areas poorly connected by public transport. For example, the primary school is reachable within 20 minutes, but a pharmacy is not. Other essential services like doctors, kindergartens, secondary schools, and supermarkets have very limited connections, often only one within two hours. Table 1 shows that public transport offers restricted access to essential facilities, making it impractical for daily errands. Motorized private traffic provides nearly universal access, while bicycles offer moderate coverage, and walking is the most limited mode. Overall, in Dunum, public transport cannot replace private cars for reaching multiple essential services, highlighting rural dependence on private vehicles.

Tabelle 1: Erreichbarkeit wichtiger Einrichtungen nach Verkehrsmittel und Verfügbarkeit in Dunum, Niedersachsen.
Table 1: Accessibility of POIs by Mode of Transport and Availability in Dunum, Lower Saxony.

	# POIs	Pharmacy	General Practitioner	Primary School	Kindergarten	Secondary School	Supermarket
Walking	0	100%	100%	15%	0%	100%	100%
	1	0%	0%	52%	0%	0%	0%
	>1	0%	0%	33%	100%	0%	0%
Cycling	0	32%	15%	100%	87%	49%	22%
	1	56%	52%	0%	13%	51%	42%
	>1	12%	33%	0%	0%	0%	36%
Motorized Individual Traffic	0	0%	100%	0%	15%	0%	0%
	1	0%	0%	0%	52%	0%	0%
	>1	100%	0%	100%	33%	100%	100%
Public Transport	0	87%	15%	0%	50%	52%	50%
	1	13%	52%	0%	42%	11%	36%
	>1	0%	33%	100%	7%	37%	13%

Der ÖPNV in ländlichen Regionen wie Dunum ist im Vergleich zu Städten benachteiligt. Lange Wege und geringe Taktung schränken die Alltagsmobilität ein, besonders für vulnerable Gruppen. Trotz scheinbar guter Abdeckung ist die Nutzung aufgrund unpraktischer Anbindung und weniger Verbindungen zu wichtigen Einrichtungen begrenzt. Das Auto dominiert weiterhin, verstärkt soziale und räumliche Ungleichheiten und erschwert eine inklusive Mobilitätswende. Gezielte, regional angepasste Maßnahmen sind nötig: dichtere Takte, neue Haltestellen oder On-Demand-Angebote, bessere Radinfrastruktur sowie Mobility Hubs. Eine erfolgreiche und gerechte Mobilitätswende muss die praktischen Bedürfnisse aller berücksichtigen – besonders der Menschen ohne Auto – und sicherstellen, dass ländliche Regionen nicht abgehängt werden.

Public transport in rural areas like Dunum remains disadvantaged compared to cities. Long walking distances and limited service frequencies restrict everyday mobility, especially for vulnerable groups. Although coverage may appear wide, inconvenient access and few connections to essential services make public transport less usable. As a result, private cars dominate, reinforcing social and spatial inequalities and limiting an inclusive mobility transition. Targeted, region-specific strategies are needed, such as denser services, new stops or on-demand solutions, better cycling infrastructure, and mobility hubs to improve connections. A successful and fair mobility transition must address the practical needs of all residents, particularly those without cars, ensuring rural areas are not left behind.

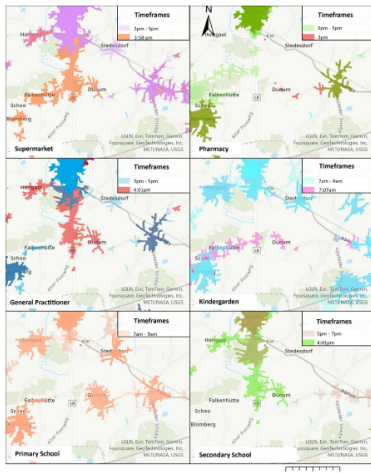


Abbildung 3: 20-Minuten-ÖPNV-Einzugsbereiche ausgewählter Einrichtungen in Dunum, Niedersachsen.
Figure 3: 20-Minute Public Transport Catchment Areas for Selected POIs in Dunum, Lower Saxony.

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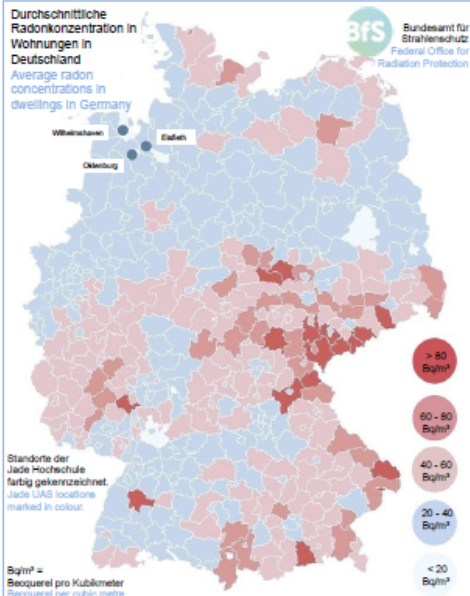
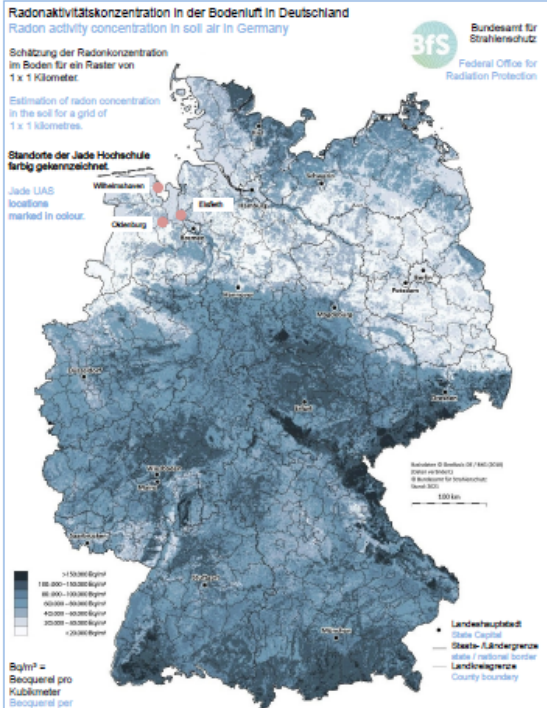
XXXIX SALÓN TECNOLÓGICO DE LA CONSTRUCCIÓN EXCO 2025 INTERNATIONAL EXHIBITION "RESEARCH IN BUILDING ENGINEERING - EXCO'25"



RADONFORSCHUNG AN DER JADE HOCHSCHULE IN OLDENBURG
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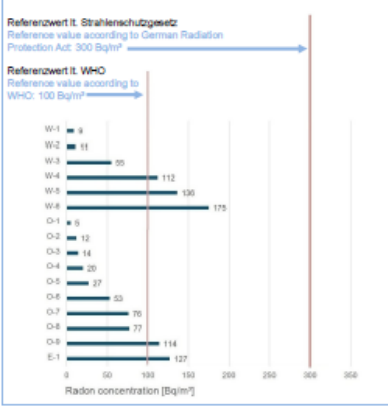
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GRUNDLAGEN UND RELEVANZ // BASICS AND RELEVANCE



ERGEBNISSE // RESULTS

Radon-Messwerte in ausgewählten Räumen der Jade Hochschule In Relation zu den Referenzwerten Deutschlands und der WHO
 Radon-Measurements in selected rooms at Jade UAS in relation to reference values of Germany and the WHO



ABSTRACT

Radon is a gaseous, radioactive, odorless, tasteless and colourless noble gas. It is part of the decay chain from uranium to lead. The relevant form is usually Rn-222 with a half-life of 3.8 days. During decay it releases alpha radiation, which makes up approximately 50% of exposure to radioactive radiation from natural sources in Germany. If the noble gas is inhaled then the above-mentioned decay occurs in the lungs, leading to damage to DNA strands in cells of this organ. The human body can compensate for this to a certain extent, but increased radon exposure is considered a significant factor in the development of lung cancer. One in ten of these cases is assumed to have been caused by radon. This makes it the second most common cause of lung cancer behind smoking. Radon is also suspected of causing further diseases or making their occurrence more probable. According to the relevant maps, measurements taken in selected rooms at the three Jade UAS locations indicated that only very low levels of radon were to be expected in the soil air and indoors. In fact, the radon levels measured in Wilhelmshaven (W, 6 rooms), Oldenburg (O, 9 rooms) and Etsfleth (E, 1 room) in 2022/23 and 2023/24 were well below the reference value specified in the German Radiation Protection Act. However, some individual values are surprising because they exceed not only the WHO reference value but also the expectations of the Federal Office for Radiation Protection's maps. The author's research on this topic will therefore be continued.

Natürliche Strahlenquellen
 Natural sources of radiation



Künstliche Strahlenquellen
 Artificial sources of radiation



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