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Preface of the publisher

26th Journal für Facility Management: Science meets Practice

Real estate and facility management are enablers of sustainability. The master thesis "Corporate Social Responsibility & Sustainability and Facility Management: Facility Management as driver of CSR" pointed this out already in 2012! So, the research was focusing on this topic already 12 years ago. But the industry was not really taking up. The thesis was submitted to competitions but the industry representatives did not honour it. Industry was mainly focusing on cleaning, maintenance and operation. Only one or two years ago, industry took up on sustainability. But in most companies, other departments are already in the driver seat. No FM raises hands and want to be part of the development. I personally ask myself, how academics research can be better disseminated in practise. What we can do that our messages are considered? Industry always stresses the importance of education and research. But if we researchers put something forward that is more strategic or not in the main stream, we are often not taken as relevant. I invite you to give me hints, what we as Real Estate and Facility Management community can do, to shape the future together. There is a lot to be done. In Europe we have to be carbon neutral by 2050. Together we can develop NEW approaches to reach the goal not only with big investment, but adding value.to the users. Therefore, this issue focuses already on solutions in this area:

- *How FM can improve organisations' ESG reporting: Compliance or Strategy as driver?*
- *Reporting Metrics and Benchmarking Results in Hotel Energy Consumption: a Systematic Literature Review (SLR)*
- *The relocation process into a refurbished work environment: A sample case study incorporating employers' and employees' needs and wishes.*

The first two papers analyse specific industries or a country as a whole and suggest management approaches for ESG. The third paper is based on case studies to provide suggestions for an optimisation of the change management process within workplace management: The first paper focuses on the ESG readiness of a Nordic country. The paper investigates how the EU ESG legislation relates to other sustainability frameworks and to FM to establish an understanding of the historical foundation. The paper will also discuss how ESG reporting can be a strategic driver for FM organizations based on a Danish survey A main result of the paper is a model and a

guideline for how FM can contribute to ESG as a strategic driver for environmental, social and economic value creation. The second paper focuses on sustainability in the hospitality sector. Current regulative policies and sustainable tourism goals require the European hotel industry to create environmental intensity metrics for non-financial reporting matters. Within this field, optimizing and understanding energy use is crucial for enhancing sustainability and operational efficiency. An extensive literature review shows the currently used intensity metric energy use divided by hotels' floor area and occupant-related metrics. The review analyses the energy audit results of 1,494 hotels and finds an average EUI of 273.9 kWh/m2. But not only the consumption but also factors influencing were analysed to make the results of specific hotels comparable. This is the basic for general management decisions. The third paper focuses on change management to enable the implementation of new working environments that enable hybrid work. The present article deals with a case study documenting all the steps of relocating a research department. The paper sheds light on a change and design-thinking process incorporating different employers' and employees' wishes. Concepts like these, which collect needs directly from the people concerned, make it possible to realise changes that are in the interest of those affected and, therefore, require no further far-reaching changes.

At this point, I want to thank all international researchers who sent us numerous abstracts and papers for the double-blind review. The decline rate was kept high. I also want to thank the members of the editorial and the scientific board for their terrific work. They supported me in reviewing first the abstracts and then the full papers and gave a lot of input to the authors. The high decline rate, the high reputed members of the editorial and the scientific board and the supporting universities ensure that the articles are not only highly scientifically qualified, but also that practitioners can put them into practice easily. I also want to thank my team, especially Barbara Gurdet and Lisa Thrainer. Without their personal engagement the journal would not be available in this high quality.

I wish you all the best from Vienna, an enjoyable read, a lot of input for your research and/or for your daily work. I look forward to new striking research in the next IFM Journal and a refreshing exchange at the 18th IFM Congress 2025.

Your
Alexander Redlein (Head of Editorial Board)
To my family Barbara, Caroline Sidonie und Alexander David

In Memoriam
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Table of contents

Science meets Practice:
ESG and its Implementation

How FM can improve organisations' ESG reporting: Compliance or Strategy as driver?

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Abstract

Environment, Social and Governance (ESG) reporting is the next step in sustainability frameworks and has now become mandatory for large companies in the EU. Facilities Management (FM) has a significant role in meeting the new legislative requirements through provision of documented data from FM-related activities and this calls for new capabilities and new practices. This paper will investigate how the EU ESG legislation relates to other sustainability frameworks and to FM to establish an understanding of the historical foundation. The paper will also discuss how ESG reporting can be a strategic driver for FM organizations based on a Danish survey, which found that most companies and FM organisations focus on compliance. An informative example of how a large company voluntarily have reported ESG in their annual report is also presented. A main result of the paper is a model and a guideline for how FM can contribute to ESG as a strategic driver for environmental, social and economic value creation. The authors argue that specifically managing the social aspect can be a competitive advantage.

Keywords: Facilities Management, ESG, sustainability, SDGs

1. Introduction

Sustainability reporting has become increasingly important in recent years and large organisations in EU must according to the CSRD directive (EU 2022) declare audited data about their Environmental, Social and Governance performance starting from the financial year 2024. As such, sustainability reporting is not new. The Trible Bottom Line (TBL) introduced in 1993 by Elkington (2018) was one of the first reporting frameworks that included environmental reporting. In Denmark, which is the local context of this paper, green accounts were introduced as mandatory for some types of companies in 1995. The legal requirement was removed in 2015, but several companies and municipalities continue to prepare green accounts as part of their sustainability reporting (Jensen 2021).

The understanding of sustainability has changed over the years due to the general development in sustainability and frameworks for working with it. The Brundtland report "Our common future" (UN 1987) states: “Sustainable development requires meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life.” Thus, sustainability is about much more than the physical environment, and the quality of life is at the centre. Improving the quality of life is one of the two main purposes of FM according to the definition in ISO 41011 (2017) with the other being productivity of the core business.

The research questions directing our investigations were:

1. How do the EU ESG requirements relate to other sustainability frameworks and to FM?
2. How prepared are Danish companies and FM organisations to make ESG reporting and planning to comply with and possibly benefit from ESG reporting?

Based on this and the authors’ theoretical and practical experiences from working with FM and sustainability the paper will propose a model and a guideline for FM to become not just compliant but also use the ESG reporting as a strategic driver for environmental, social and economic value creation.

2. Methodology

The authors are a mixed group of experienced researchers and practitioners, who strive to present practice-oriented research with a clear contribution to the FM profession in Europe and beyond. The paper applies a pragmatic, mixed-method approach in 4 steps:

1. A literature and document review to set the background leading to the new EU requirements for ESG reporting, a review of guidelines for SFM and ESG, and a document analysis of the EU CRSD document to map the relevant KPI´s to ESG related to FM.
2. A survey of FM practices in Denmark in 2023 on the preparedness to ESG reporting.
3. A case study of an example of an annual report with ESG-reporting.
4. A proposal for a model and a guideline for using ESG as a strategic driver by FM.

The literature and document review (section 3)

The paper presents a literature and document review on sustainability frameworks leading up to ESG. The aim is to show how the EU ESG relates to the former sustainability frameworks: The three pillars Environmental, Social and Economic (ESE), TBL, Corporate Social Responsibility (CSR) and Sustainable Development Goals (SDGs), and how SDGs relates to FM. The review resulted in a mapping. The review also included the ISO standard on FM and a comparison of its guideline on SFM with IFMA's ESG guideline, a mapping of FM relevant KPI´s in the ESRS documents in EU ESG regulation, and a comparison on two guidelines.

Survey of FM-practices in 2023 (section 4)

A qualitative survey among Danish private and public companies was conducted in 2023. The purpose of the survey was to:

5. Analyse the companies' preparedness for ESG reporting and their compliance with the new ESG requirements set out in the CSRD and ESRS.
6. Define best practices for governing and managing FM operations with an ESG focus.

Fifteen companies and organisations participated in the survey with an almost even distribution on the following four types:

- Private global companies: Private companies operating in multiple markets within Europe and the rest of the world.
- Private local companies: Private companies operating only in Denmark.
- Public authorities and companies: Governmental, regional, or municipal entities.
- Facility Management service providers: Private companies delivering FM services, either global or local

The survey was conducted through interviews with FM and ESG representatives from the participating companies, typically the heads of FM and heads of sustainability. These interviews were based on a questionnaire distributed prior to the interviews. The survey took place from April to June 2023, before the ESG legislation was implemented in Danish law. Therefore, this survey can be considered a baseline study for assessing the impact of ESG legislation in a Danish context.

Case study of an example of ESG reporting in an annual report (section 5)

The case concerns the global engineering company Ramboll, which was selected due to their commitment to sustainability. Ramboll became a signatory to the United Nations Global Compact in 2007 and is part of other international sustainability ratings and rankings. ESG reporting is voluntarily included in their annual report for 2023: “The Partner for Sustainable change”, which is also the company strategy. It provides as an informative example of ESG reporting.

A model and a guideline for ESG reporting in the context of FM (section 6)

Various guidelines have been developed to communicate the appropriate steps in ESG reporting in a company. We propose a model and a guideline for FM not just to become compliant but also use the ESG reporting as a strategic driver for environmental, social and economic value creation, which includes the interactions with the external environment.

The mixed-method approach has been appropriate to connect sub-studies and has enabled the sharing of knowledge and experiences from practice and research. The

outcome and the new knowledge created in this collaboration is the new model and guideline to use in ESG-reporting. The intended users are FM organisations with responsibility for facilities and support services.

3. Literature and document review

3.1 Development of Sustainability Frameworks

ESG is the current framework, that unifies the way EU countries work with sustainability reporting, but a lot of companies have a foundation and internal knowledge from former sustainability regimes to build on. The literature review in this sub-section shows essential developments of sustainability concepts and frameworks leading up to the present EU ESG as shown in Fig. 1.

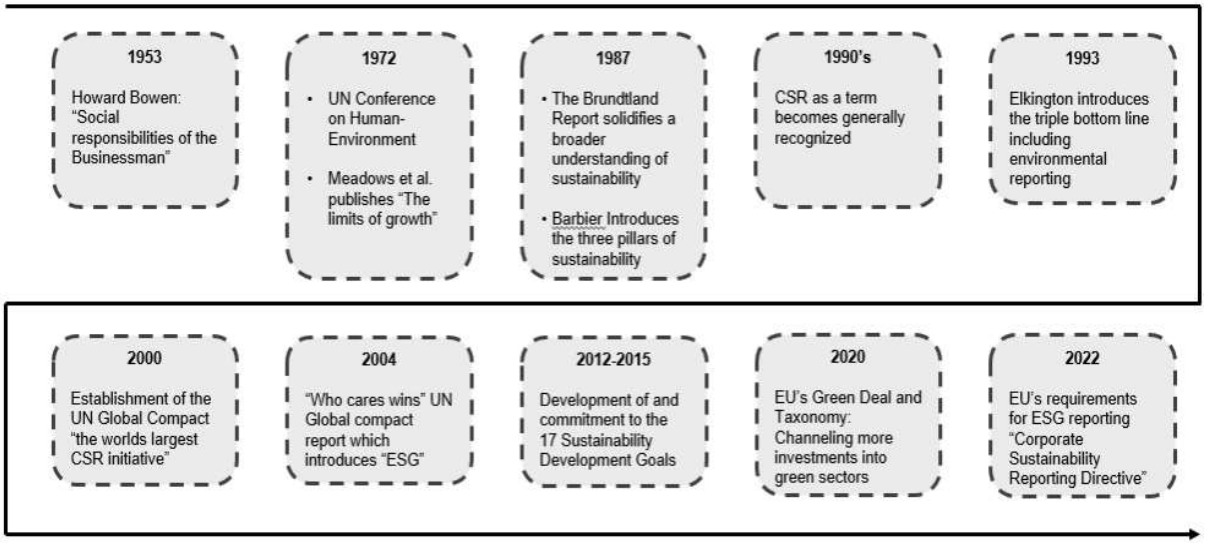

Fig. 1: Development of sustainability concepts and frameworks

A broader focus on sustainability than just the environment became common after the Brundtland report (UN 1987). This report did not in fact introduce the three pillars: Environmental, Social and Economic sustainability, although they often are referred to originate from the report. According to Purvis et al. (2019) the triplet emerged gradually since the first global UN Environmental Summit (The 1972 UN Conference on the Human–Environment in Stockholm) and the publication of the book "The Limits to Growth" (Meadows et al. 1972). The common figure of the triplet with three interwoven circles was first introduced by Barbier (1987).

The focus on corporate ethics and accountability for social aspects goes even further back and can be traced to the book "Social Responsibilities of the Businessman" by

Howard Bowen from 1953 (Macesar 2024). However, it was not before the 1990's that Corporate Social Responsibility (CSR) became more generally recognized. The UN Global Compact was launched in 2000 "to bring business and the United Nations together to give a human face to the global market" It is the world largest CSR initiative with more than 20.000 businesses in more than 160 countries (UN Global Compact 2024).

An initiative under the UN Global Compact resulted in the report "Who Cares Wins" (The Global Compact 2004), which coined the term "Environment, Social and Governance" (ESG) and established a crucial link between ESG actions and financial performance. That same year, the UNEP Finance Initiative (UNEP/fi) highlighted the relevance of ESG issues in financial valuation and the launch of the Principles for Responsible Investment (PRI) in 2006. According to ISO/TR 41019 (2024), CSR is a precursor to ESG: "CSR provides a qualitative assessment of an organisation's effects on its stakeholders and society. ESG measures an organization's impact on the environment and society, using quantitative measurement methods with the aim of delivering long-term stakeholder value."

The SDGs were developed at the UN Conference on Sustainable Development, held in Rio de Janeiro, Brazil, 2012. Later, in 2015, the UN decided on 17 SDGs for the world sustainability goals towards 2030 (UN 2016). The concept of sustainability in the Brundtland report and in ESE mainly focuses on the societal level, while CSR and ESG mainly focus on the corporate level. The SDGs were developed to be primarily actionable by governments and countries, not investors and businesses.

EU's Green Deal is a "package" of political initiatives from 2020, which are aimed to help restructure the European economy by channelling more investments into green sectors and companies and to make the EU carbon neutral in 2050. The EU's regulation on taxonomy translates the EU's climate and environmental goals into a series of criteria that determine when an economic activity is environmentally sustainable. The regulation entered into force on 1 July 2022 (EU 2020). ESG reporting includes key figures for non-financial activities. The regulation for ESG is called the Corporate Sustainability Reporting Directive (CSRD) (EU 2022). From 2024, all listed companies with more than 500 employees must report on their work with the sustainable transition, including in their value chain, as well as provide comprehensive information on consumption, emissions, etc. As something new, the reporting

requirements also include social conditions, information about employees, human rights, impacts on surrounding communities and information about corporate management (Governance). From 2025, other larger companies are covered and from 2026 listed SMEs will be included.

3.2 Sustainability Frameworks and FM

Lok et al. (2023; 2024) with reference to IFMEC (2018) claim that FM can contribute to all 17 SDGs. Similarly, ISO/TR 41019 (2024) shows how FM potential can contribute, directly or indirectly, to all the 17 SDGs. Furthermore, Annex B, Table B.2, in the standard shows examples of FM actions striving for sustainable development.

Jensen (2021) made an assessment for which of the 17 UN SDGs that FM mainly can contribute to. This includes SDG 3 Health and well-being, and it also applies to SDGs 6, 7 and 13 concerning water, energy and climate. As a business area, FM also plays a role in relation to SDG 8 Decent jobs and economic growth, SDG 9 Innovation and infrastructure, SDG 10 Reduced inequalities, and SDG 12 Responsible consumption and production. FM also has a very central role in relation to SDG 11 Sustainable cities and local communities. Finally, FM has good opportunities to contribute to SDG 17 Partnerships for action, for instance in collaboration with supplier companies.

Ballesty (2023), who has been involved in developing ISO FM standards, including the upcoming technical report on sustainability (ISO/TR 41019 2024), made a similar assessment. There is high commonality between the two assessments, and both show that FM can contribute to many of the 17 SDGs. Jensen (2021) includes 9, and Ballesty (2023) includes 8 SDGs. The only differences are that Jensen (2021) includes SDG 10 Less inequality and SDG 17 Partnerships for Action, while Ballesty (2023) includes SDG 16. Peace, justice, and strong institutions. The 7 SDGs which they agree on are listed in the first column in Tab. 1.

Tab. 1: SDGs particularly related to FM and relations to ESE and EU ESG + Taxonomy

SDG	Environment	Social	Economy	Taxonomy	Governance
1. Good health and well-being	X	X	X		
2. Clean water and sanitation	X	X	X	X	

3. Affordable and clean energy	X	X	X	X	
4. Decent work and economic growth		X	X	X	
5. Industry, innovation, and infrastructure			X	X	
11. Sustainable cities and communities	X		X	X	X
12. Responsible consumption and production	X		X	X	X
13. Climate action	X		X	X	X

Tab. 1 also includes the results of assessments of which of the 3 ESE pillars and the 4 EU ESG and Taxonomy dimensions that are important for the 7 SDGs. This is based on classification of ESE in relation to SDGs by Barbier & Burgess (2017) and one of the authors similar earlier assessment of ESE as well as the of EU ESG and Taxonomy (Jensen, 2023). In Barbier & Burgess (2017) each SDG is only related to one of the three dimensions: Economic, Social and Environmental. Jensen (2023)'s assessment was made before becoming aware of the assessment by Barbier & Burgess (2017) and only concerns the 9 SDGs that the author found were particularly related to FM. The main difference between Barbier & Burgess' (2017) and Jensen (2023)'s assessments is that the latter did not find that SDGs relate to just one of the three pillars. The only big difference is for SDG 3 Good health and well-being, which Barbier & Burgess (2017) see as related to economy, which Jensen (2023) disagree with. The difference might be due to Barbier & Burgess (2017) is published in the journal Economics, and it takes a predominately economic viewpoint, while the author has an FM perspective.

3.3 Sustainable Facilities Management (SFM)

The ISO committee for FM standard has produced the technical report ISO/TR 41019 (2024) about FM and sustainability, which at the time of writing is out for public hearing. The technical report includes an illustration of how SDG's and ESG can provide input to the demand organisation's FM strategies, policies and operations to support the quality of life, see Fig. 2.

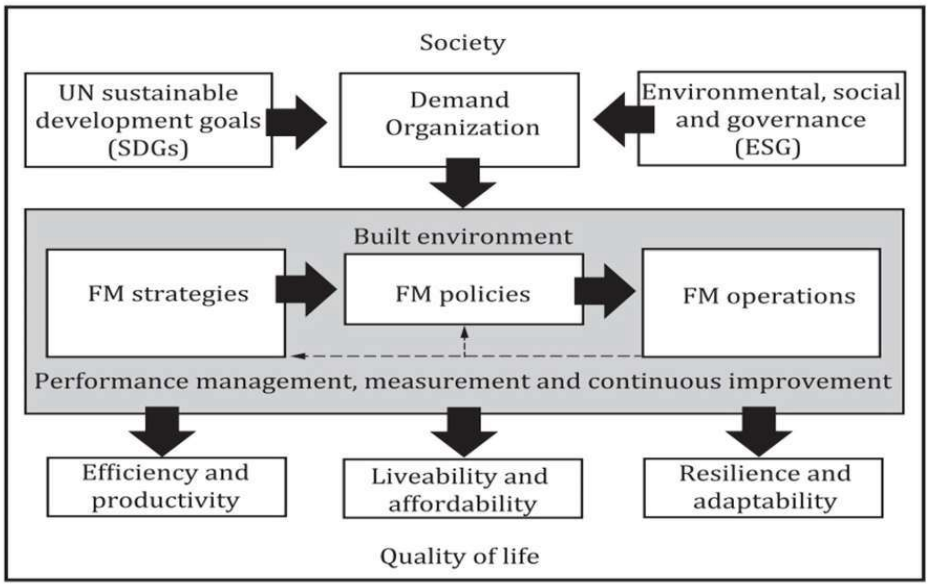

Fig. 2: SDGs and ESG as input to FM (ISO/TR 41091, 2024)

The technical report also includes a 10-step guideline to achieve sustainable FM by use of the ISO 41000 family of FM standards in Appendix B, Table B.1, as well as an overview of international reporting standards and frameworks in Annex B, Table B.3.

The international FM association IFMA has developed a 7-step guideline to integrate ESG into FM operations displayed as a cycle with input from and output to the demand organisation. These two guidelines are summarized in Tab. 2 and have been used as inspiration for the model and guideline we present in section 5.

3.4 Mapping ESG regulation to Facility Management

The CSRD does not define fixed KPIs for ESG reporting but requires in the directive's associated standards that the company prepares a double materiality analysis, based on which it is assessed and documented, which KPIs are relevant for the company in question in its specific context. The directive's standards are called ESRS (European Sustainability Reporting Standards) (EFRAG 2023). A mapping of all 82 disclosure requirements in the CSRD found that 21 of these requirements were FM-relevant, see

Tab. 3. The specific requirements for each company can vary, but these 21 requirements are a relevant starting point for most FM organisations.

Tab. 2: Comparison of the ISO/TR 41009 and IFMA guidelines

Step	ISO/TR 41019: SFM	IFMA: FM + ESG
Input		Input from to demand organization
1	Define success criteria based on the demand organization's FM requirements.	Awareness: Develop your ESG awareness
2	Identify the appropriate FM organizational design, culture and capabilities.	Knowledge: Understand your company's ESG ambitions
3	Prepare facility performance assessments and service analyses by objective and location and across the organization's portfolio.	Resources: Identify the resources
4	Prioritize required actions under the organization's FM strategy to identify the most important efforts in order to reach the organization's target.	Develop: FM and real estate plan
5	Benchmark internally and externally across relevant sectors nationally and internationally to identify good practice and thought leadership.	Data management: Calculate your organization's current baseline
6	Invest in preparation and planning to ensure a qualified base and data set for decision-making.	Application: Apply at scale
7	Ensure knowledge development and a competence-based approach across stakeholders, FM professionals and end users as part of informed communications to develop ambassadors and minimize the risk of greenwashing.	Monitor: Monitor FM team and vendors in progress towards FM goals
Output		Output to demand organization
8	Document the organization's specific expectations for suppliers and require progressive reporting of SDG alignments, innovations and performance over time.	
9	Maintain the FM plan, and modify it to suit, based on actual results, changing requirements and communications feedback.	
10	Conduct strategic reviews, challenging the FM plan in terms of contributions to the organization's sustainability, reliance and adaptability.	

Examples of KPI's are shown for Catering in Tab. 4. The KPI's and underlying initiatives are relevant to both internal FM organisations and outsourced FM contracts. Mapping the KPI's to match the ESG requirements makes it easily applicable to existing KPI procedures and thus easy to implement in existing FM structures.

4. Survey findings

The aim of the survey was to determine whether Heads of FM collected and monitored performance on some or all these 21 requirements, as a proxy to analyse the degree

of compliance with ESG regulations among the participating companies and organisations. The conclusion was that none of the participating companies were fully compliant, and overall, the degree of compliance was limited, especially among public sector companies. This conclusion may not be seen as surprising, given that the survey was conducted in 2023, before the ESG regulations had been implemented in Danish law.

ESG Regulation as a Driver for Competitive Advantage

Unlike regulations such as GDPR, some participants viewed ESG regulations as a means to achieve new market opportunities, secure competitive advantages, or even redefine the company's purpose. This perspective was primarily observed among private global companies, in contrast to private local companies and public sector entities, which were mainly focused on legal compliance.

Tab. 3: EU ESG reporting standards of relevance to FM

European Sustainability Reporting Standards (ESRS)		**Disclosure Requirements (DR)**	
ESRS E1	Climate change	DR E1 - 1	Transition plan for climate change mitigation
		DR E1 - 2	Policies implemented to manage climate change mitigation and adaptation
		DR E1 - 3	Action plans and resources in relation to climate change policies and targets
		DR E1 - 4	The undertaking shall disclose its climate-related targets
		DR E1 - 5	The undertaking shall provide information on its energy consumption and mix
		DR E1 - 6	The undertaking shall disclose its Scope 1,2 og 3 GHG
ESRS E2	Pollution	DR E2 - 1	The undertaking shall disclose its policies implemented to manage its material impacts, risks and opportunities related to pollution prevention and control
ESRS E3	Water and marine resources	DR E3 - 4	The undertaking shall disclose information on its water consumption performance related to its material impacts, risks and opportunities

ESRS E4	Biodiversity and ecosystems	DR E4 - 1	Transition plan in line with the targets of net zero loss by 2030, net gain from 2030 and full recovery by 2050
		DR E4 - 2	The undertaking shall disclose its policies implemented to manage its material impacts, risks and opportunities related to biodiversity and ecosystems
		DR E4 - 3	The undertaking shall disclose its biodiversity and ecosystems-related action plans and the resources allocated for their implementation
		DR E4 - 4	Targets related to biodiversity and ecosystems
ESRS E5	Resource use and circular economy	DR E5 - 1	The undertaking shall disclose its policies implemented to manage its material impacts, risks and opportunities related to resource use and circular economy
		DR E5 - 2	The undertaking shall disclose its resource use and circular economy actions and the resources allocated to their implementation.
		DR E5 - 3	The undertaking shall disclose the resource use and circular economy-related targets it has adopted.
		DR E5 - 4	The undertaking shall disclose information on its material resource inflows.
ESRS S2	Workers in the value chain	DR S2 - 1	Policies related to value chain workers
		DR S2 - 2	Processes for engaging with value chain workers about impacts
		DR S2 - 3	Processes to remediate negative impacts and channels for value chain workers to raise concerns
ESRS G1	Governance, risk management and internal control	DR G1 - 2	The undertaking shall provide information about the management of its relationships with its suppliers and its impacts on its supply chain.
		DR G1 - 6	The undertaking shall provide information on its payment practices to support transparency about these practices given the importance of timely cash flows to business partners, especially with respect to late payments to small and medium enterprises (SMEs).

Tab. 4: FM KPI's for Catering

KPI	Objective	Measure	Initiative	Ambition (1-3)	ESG
Food waste	Reduce food waste	% of food waste / total food purchased	New technology What type of food is being wasted -> Avoid in future meals Clear the buffet initiative Weight vs fixed price	1	E5-6
CO2 emissions	Reduce CO2 emissions related to catering services	CO2 emissions (baseline) vs CO2 emissions (result)	Measure CO2 emission in entire value chain from production via transport and storage to consumption in canteen	1	E1-6
Organic food ratio	Increase ratio of organic produced food	Fødevarestyrelsens Bronze/Sølv/Guld*	Measure baseline and set target	1	(E4-1)
Meat ratio	Reduce ratio of meat to other foods	% meat consumed / total food consumed	Measure baseline and set target. Potentially set individual targets for chicken, pig and cow.	1	E1-6
Local produce	Increase ratio of locally produced food	% af local produced / total food produced	Measure baseline and set target Individual targets for continent (eg Europe), country (eg. DK) and local region	2	E1-6
Animals protection	Acceptable living conditions for the animals used in production	Dyrevelfærdsmærket*	Measure baseline and set target	2	G1-1
Sustainable fish & shellfish	Only use sustanable fish+shellfish	WWF's categorisisation of "green" fish	Measure baseline and set target	2	(ESRS2 /E3-1)
Efficiently use of ressources in kitchen	Reduce water & electricity consumption	Co2 neutral operation in kitchen	Seperate meters in kitchen to meassure consumption. Initiatives to reduce	2	E3-4
Biodiversity from farmers	Enhance biodiversity	Reduce m2 used to produce /kg food	Dialogue with selected farmers	3	E4-1
Plastic and single use materials	Reduce use of plastic and single use materials	Volume consumed plastic + single used materials (baseline) vs Result	Requirement of sustainable packaging of foods and drinks	3	E5-6

*Danish certifications

FM Service Providers Responding to Client Requests Rather Than Leading

The survey found that the drive for ESG initiatives and investments primarily comes from customers rather than FM service providers. Most FM service providers plan to follow and react to customer requirements. The only exception was one global FM service provider that planned to invest heavily in ESG initiatives, even if not yet in demand. Thirty-three percent of the participants see the development of ESG solutions as a joint responsibility between customer and service provider, thus in line with the partnership approach to FM sourcing.

ESG data is primarily managed manually or via stand-alone IT systems

Complying with all 82 ESG disclosure requirements involves reporting on more than 1,000 data points. Many of these data points will potentially be new and not currently reported in the company's ERP system. This suggests that ESG regulations will lead to significant IT investments to ensure structured and audit-approved data collection and reporting. The survey shows that ESG data is currently managed manually (e.g., by Excel or similar tools).

FM contracts include ESG data requirements - however data is often not used proactively

Existing FM contracts between customers -and service providers include some ESG requirements and data points. However, all respondents viewed these data points as insufficient, see Fig. 3. Not only is the ESG data from service providers limited, but many customers also reported that the available ESG data is often not used proactively.

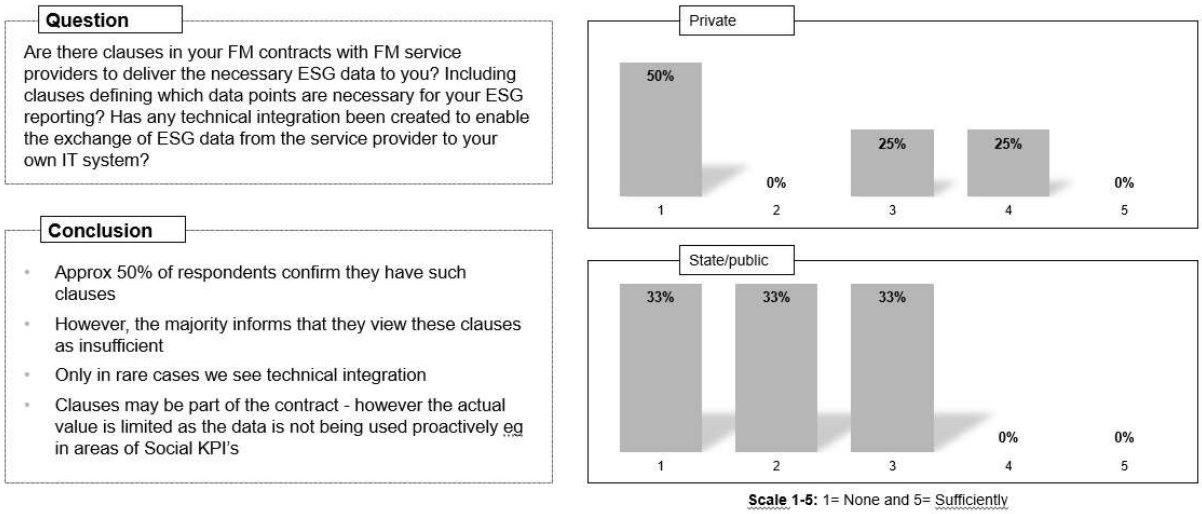

Fig. 3: Survey results concerning ESG data clauses in FM contracts

5. Case study - Informative example from an annual report

The global engineering, architecture and consultancy company Ramboll is strongly value driven and has the mission: “Create sustainable societies where people and nature flourish”. For this paper the Ramboll annual report 2023 was chosen as an informative example of the FM challenges addressed in the paper, as Ramboll chose to align with the EU ESG requirements already in 2024 to prepare the reporting in compliance with the CSRD and ESRS in the future. The Ramboll approach might not be unique but could inspire others, who have not yet found an appropriate way for their future annual reports to meet the CSRD requirements of reporting and documentation of verified data.

The annual report (Ramboll, 2024) is lengthy with 129 pages about the company's financial and ESG performance, and the impact on clients and key stakeholders through the year. The dedicated section on sustainability reporting is divided in following 4 sections:

7. ESG governance
8. Assessing material impacts
9. Group policies
10. Accounting policies.

The mandatory reporting requirements are provided in the format of a table informing the reader about the compliance requirements according to Danish law and a reference where to find the specific information in the report, e.g. share of women in top management. Along with the table is also an organisational chart to inform that sustainability is governed and implemented across group functions and business units.

A double materiality assessment has been conducted to identify, which sustainability matters are most relevant for the company and its stakeholders by valuating their impact on environmental and social factors (inside-out perspective), while also considering how these factors influence the organisation (outside-in perspective). The materiality boundary is set to be the companies own operation namely their office buildings and assets and the projects under the corporate strategy "The partner for Sustainable Change". The conducted double materiality assessment identifies 6 material ESRS out of 10. The six (E1, E4, E5, S1, S4 and G1) having material impact and financial impact, while the four (E2, E3, S2 and S3) are assessed to be in the category non-material or out of materiality boundary.

A page in the annual report is dedicated to group policies, which describe the global commitments and processes made available to all employees on their intranet. The following pages declare the accounting principles for ESG key figures and ratios. The selection of data has been externally audited by an independent third-party audit provider.

The operational boundaries of Ramboll's Green House Gas inventory for 2023 include scope 1, 2 and 3 emissions according to the GHG protocol, see Tab. 5. It is mentioned

in the annual report that it has been challenging to collect data and that data management needs to improve.

Tab. 5: Ramboll activities causing emissions

Scope	Company activities coursing emissions
Scope 1	Stationary combustion including heat consumption from assets under operational control
Scope 1	Mobile combustion from company vehicles including manager cars
Scope 2	Purchased electricity and heat
Scope 3	Category 1-Purchased goods and services
Scope 3	Category 3 - Fuels- and energy-related activities (not in scope 1 or 2)
Scope 3	Category 6 – Business travel
Scope 3	Category 7 – Employee commuting
Scope 3	Category 11 – Use of sold products

The company has been prioritized to focus on the scope 3 categories, where Ramboll has an impact on influencing the financial spend to reach a manageable as well as meaningful level of reporting. This reduces the amount of data that needs to be managed. The intention is to continue to improve the reporting practices and associated data management as well as developing the sustainability-related practices within the company.

The Ramboll case is provided to exemplify the translation of the general ESG reporting requirements into the context of a specific organisation. A similar process is needed for all organisations. However, it is expected that EU and others will provide sector/branch specific standards and guidelines to ease the implementation throughout Europe.

6. Discussion and Recommendation

In this section we discuss how FM organisations become compliant and use the ESG reporting as a strategic driver for environmental, social and economic value creation.

Environment

FM is directly responsible for managing the resources used during the operation of buildings and infrastructure like energy, water and materials for maintenance etc. as well as for handling waste. Therefore, FM is essential to provide data and KPIs for environmental reporting. This is particularly the case for CO_2 emissions related to scope 1 (caused by the company itself) and scope 2 (from the energy the company

buys). It is mostly for scope 3 (from the products and services the company buys) that there are other contributors to environmental reporting inside the company. By analysing energy consumption data, usage of buildings etc. FM can give critical insight to top management and thus be an important strategic partner for companies to find solutions to reduce the use of resources and the emission levels with minimal impact on the company's daily operations.

Social

FM is responsible for the workplace heavily affecting the well-being of the employees within the company, as well as external related people (e.g. employees in supplier organizations). This includes areas suchs as accessibility, e.g. access for disabled, health safety, e.g. indoor climate and ergonomics, and support services, e.g. office support, catering and welfare. FM employs thousands of people directly or indirectly providing a wide range of services and consisting of people with very different levels of education. FM represents many low-wage jobs, and the workforce often includes people from different cultures, ethnicity and religions. Because of the diverse group of people, FM must work with inclusion, equality, fair wages and to prevent discrimination. This also applies to the supply chain and FM often engage external service providers, so FM has an obligation and good opportunity to influence the providers working and employment conditions, e.g. by including social clauses in their procurement practice.

Taking a strong position on the social aspect will impact companies' ability to attract and retain employees. For a service provider, a stable and motivated workforce is a critical factor. End users often only meet the handyman or cleaning personnel, so the service provider depends on their employees being good ambassadors for the brand. Thus, in FM the social aspect can be a strong competitive advantage, because the service experience is often an interpersonal transaction rather than a transaction of goods.

Governance

Governance in a company is usually a concern for the top management, but if FM is going to be a proactive partner for the top management in relation to using ESG as s strategic driver for creating sustainability value, the FM organisation need to develop high competences in this regard. FM should include a sustainability manager, who can

take the lead in organising the internal ESG process and develop internal and external networks to be able to continuously improve the process.

Model and guideline for how FM can work strategically with ESG

ESG can be seen as just another bureaucratic EU legislation, which companies of a certain size need to comply with. However, society as whole as well companies and citizens must face the threat that our current way of producing, consuming and living has for the sustainability of our planet and civilization. ESG should therefore be seen as one of many tools to create sustainable development. ESG is here to stay, and we can get the best out it by using it as proactive, strategic tool. FM has an essential role to contribute to a more sustainable built environment. In this paper we have investigated the relation between FM, ESG and former sustainable framework and how prepared Danish companies and FM organisation are to comply with ESG reporting and use ESG to their benefit.

To support companies and FM organisations to work with ESG as a strategic driver, we have developed a model and a guideline. The model and guideline have 6 phases as shown in Fig. 4 and detailed in Tab. 6.

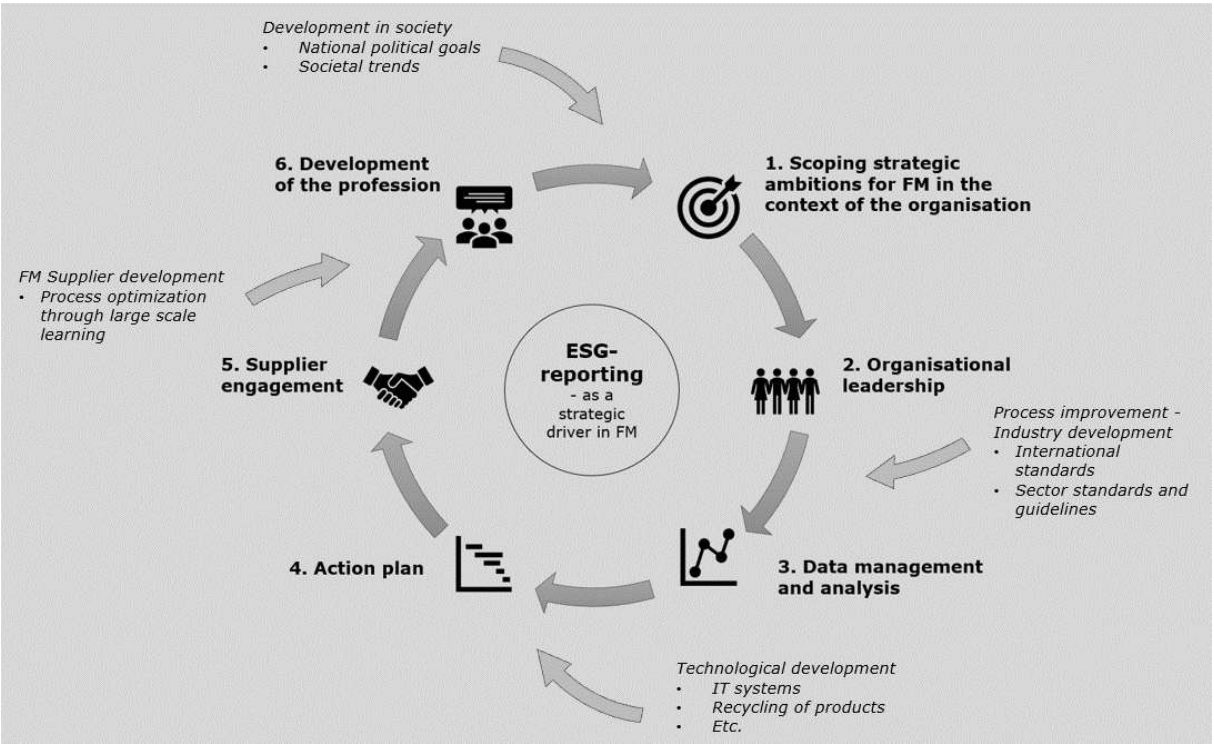

Fig. 4: Model for strategic driven ESG in FM

Tab. 6: Detailed description of the 6 phases in model shown in Fig. 4

1. Scoping strategic ambitions for FM in the context of the organisation • Understand the Company ESG strategy and identify how FM can contribute to fulfilling the goals • Be curious and investigative – can the ESG goals go beyond compliance and turn into strategic ambitions for the FM organization? • Know your numbers – set targets according to high level internal or external benchmarking • Prioritize – What now, and what later?	**4. Action plan** • Identify actions and project targets based on insights from current data • Prioritize the actions and projects in accordance with the strategy • Be aware of the FM organizations internal need for development in ESG context
2. Organizational Leadership • Human resources. Educate and attract a strategic mindset and demand a strategic engagement from your suppliers. • Digital resources and procedures. ESG reporting and strategic work needs a lot of data, prioritize making data management easily accessible and connected with existing procedures. • Continuous learning and optimization based on increasing data – it's a journey	**5. Supplier engagement** • FM suppliers deliver important data input to your ESG-report, so engage and motivate them • Reflect the ESG data demand in FM contracts and incorporate ESG follow up activities in the FM supplier governance structure
3. Data Management and analysis • Identify relevant ESG data through spend analysis, existing reports such as GHG-reports and double materiality assessment • Define a data strategy including data collection, storage, verification, analysis, benchmarking and reporting	**6. Development of the profession** • Explore eventual synergies with other FM-professionals. • Share lessons learned and benefit from others experiences via networks, peer benchmarking etc. • Gather lessons learned from external and internal sources and improve the organizations internal FM ESG approach

The model in Fig. 4 is like the IFMA model centred around an annual cycle or wheel, but it also includes interactions with the external environment. This is for simplicity shown by the curved arrows from outside-in, but the impact could also to a certain degree be from inside-out. We recommend that companies and FM organisations engage in public and professional activities to influence regulations, standards and guidelines of relevance to their business.

7. Conclusion

Sustainability has over the years to a high degree been driven by the UN with an initial focus on the societal levels. Later with CSR and ESG a more business-oriented sustainability focus was developed. The SDGs were also mostly focused on the societal level. In Europe the EU has been the main driving force and the Green Deal from 2020 meant a strong focus of sustainability reporting for companies, including ESG.

By mapping the ESG requirements in an FM context and by illustrating several Catering relevant KPI's this paper concludes that FM is an important input provider, as well as a strategic partner to companies working with the sustainability agenda. The survey shows that the Danish companies were unprepared in 2023 and most the participants aim at compliance. A few global companies and a large FM service provider had decided on a more strategic approach. The paper presents a model and a guideline for companies and FM organisations to help follow such a road.

This paper is limited by the fact that it is based on a Danish survey, which is conducted before the law was in force. The authors suggest a follow-up survey in a few years to gather inspiration for best practice guidelines for FM. Environmental reporting is well developed but the authors suggest further research and development of methods for managing social sustainability.

Contribution by the authors

The first author initiated the paper and is the main author of section 2.1 and 2.2. The second author was responsible for conducting the survey as partner in the management consultancy firm Konsulentgruppen Strandgade. Together with the third author he was the main author of sub-section 3.4 and section 4. The fourth author is the main author of section 5 with a case study of ESG reporting in an annual report from the company Ramboll, where she is now employed, but she was not involved in producing the annual report, which the case is mostly based on. The other sections, including the guideline and model in section 5, were developed and written jointly by all authors.

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Reporting Metrics and Benchmarking Results in Hotel Energy Consumption: A Systematic Literature Review (SLR)

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Abstract

Current regulative policies and sustainable tourism goals require the European hotel industry to create environmental intensity metrics and benchmarking initiatives for non-financial reporting matters. Optimizing and understanding energy use in this field is crucial for enhancing sustainability and operational efficiency. Arising from 40 key-words around the topic, this systematic literature review screened 1,170 peer-reviewed papers from Scopus and Web of Science Databases. Applying distinctive exclusion criteria, 99 key papers were identified and analyzed in detail using the Grounded Theory approach. Findings show that there is growing interest in the re-search field. The dominant intensity metric to measure energy consumption is primary energy use divided by hotels' floor area (Energy Use Intensity, EUI). Furthermore, occupant-related metrics must also be integrated to display the hotel industry's distinctive features adequately. This review analyzes the energy audit results of 1,494 hotels and finds an average EUI of 273.9 kWh/m2. Further findings indicate that consumption generally depends on hotel characteristics such as size, quality level, and number of services. In addition, location and climate normalization play crucial roles when benchmarking on a global scale. Further research is needed to create a regulative-compliant intensity metric matrix and validate it with quantitative data from benchmarking audits in Central European and continental climate regions.

Keywords

Energy Benchmarking, Green Intensity Metrics, Sustainable Hotel Industry, Systematic Literature Review

1. Introduction

According to the UN Enironment Programme (2020), approximately 38% of global carbon dioxide (CO_2) emissions are from the real estate industry. Tourism contributes to greenhouse gas emissions and is responsible for 5% of global CO_2 emissions (UNWTO, 2023), with 21% of those emissions being due to the hotel sector (hotels and other lodging units) (UNWTO, 2019). The hospitality sector has developed and applied green practices for decades to mitigate its environ mental footpath (Han et al., 2018; Jones et al., 2016; Kim et al., 2016). Rosselló-Batle et al. (2010) concluded that energy use in the operation phase is 4 to 6 times greater than in the planning and construction phases. Thus, this is the phase where achieving the highest reduction in resource use is possible (Cunha and Oliveira, 2020; Rosselló-Batle et al., 2010). To report sustainability matters (so-called non-financial reporting) in the hotel industry, a plethora of schemes, including methods, calculators, and measuring tools (e.g., HCMI, Net Zero Methodology for Hotels), reporting standards (e.g., GRI; SASB), certification programs (e.g., EMAS, ECO-Label), energy management frameworks (e.g., ISO 14001, ISO 50001, ISO 50004) have been developed. In addition, the EU legislative framework asks for the "*development of sustainability benchmarks*" in the defined catalog of measures (European Commission, 2018, p. 8 f). Research found that reuse programs in linen, energy-efficient light bulbs, green purchasing, and wastewater treatments are among the most popular green practices in the hospitality industry (Acampora et al., 2022; Manganari et al., 2016). Nevertheless, as postulated Agyeiwaah et al. (2017), scientific and existing standards and certification initiatives seem ineffective. Therefore, this research generally follows the inherent call of several authors, such as Manning (1999) Cheong and Lee (2021) formulating sustainability indicators for the operating system of a hotel and promoting the measurement of emissions. Therefore, this study aims to perform a Systematic Literature Review (SLR) to identify, collect, and categorize the academic field of sustainability intensity indicators in the field of energy consumption to measure and benchmark hotel real estate operations. A further focus is placed on the validity and reliability of the encountered benchmarks by analyzing resource audit results and the factors affecting resource consumption in the hotel real estate.

2. Methodology

When writing a literature review, the basics of teleology process theory must be internalized. The process should be adaptable, with possible movement back and forth between the stages (Juntunen and Lehenkari, 2021). In the study Snyder (2019) a process model was developed out of well-known literature review standards (e.g. Okoli, 2015; Saunders et al., 2012; Tranfield et al., 2003; Wong et al., 2013; Templier and Paré, 2015), four main steps – designing the review, conducting the review, analyzing, and writing the review. This model was also used by most recent literature review articles focusing on environmental accounting for business studies (e.g. Schaltegger et al., 2022) and specifically in the given research field tailored to the tourism industry (Acampora et al., 2022; Antonova et al., 2021; Warren and Becken, 2017). Furthermore, the stages align with the proposed data analysis technique of Grounded Theory, highlighting that the stages are intended to be a guide to help systematize the existing literature (Wolfswinkel et al., 2013).

Pre-specified exclusion and inclusion criteria are set to narrow the list of articles and answer research questions (Snyder, 2019; Wolfswinkel et al., 2013). In terms of geographical location, no exclusion was taken, thus covering relevant publications worldwide within the set boundaries of research. Furthermore and to the contrary of other literature reviews in this field journals were not restricted to only tourism-related literature (Acampora et al., 2022; Kim et al., 2017) or limited database use (e.g., only use of Scopus in Reem et al., 2022) as well as any restrictions of the article's publication date (e.g., Antonova et al., 2021). The review process started by conducting Web of Science and Scopus, the main online databases for academic literature collection (Chadegani et al., 2013). When searching in the literature, a combination of search terms was formed to search strings, and the so-called Boolean logic was used. This concept links the defined keywords together with AND, OR, NOT combinations (Jalali and Wohlin, 2012; Ridley, 2012; Wee and Banister, 2016).

Group 1: in the title or keyword or abstract (linked intra-group with OR connector) energy OR energ* OR electricity OR heating OR power Linked with AND connectors to **Group 2: in the title or keyword or abstract (linked intra-group with OR connector)** account* OR management OR approach OR materiality OR process* OR benchmark* OR system* OR management* OR intensity OR indicator* OR model* OR scorecard OR management OR tool* OR framework* OR performance* OR measure* OR development* OR system* OR index OR kpi* OR indicator* OR report* OR life-cycle* OR assessment* OR audit* OR index* OR consumption* Linked with AND connectors to **Group 3: in the title or keyword or abstract (linked intra-group with OR connector)** hotel* OR motel* OR lodging OR accommodat* OR hospitality OR restaurant* OR resort* Please note: Each Term in Group 1, 2 and 3 is matched with each other so that combinations in energy consumption benchmarking for the hotel industry are being captured. The symbol (*) has the function to include all possible variations (e.g. benchmark* instead of benchmarking).

Table 1: Keyword Groups

As the research elaborated, the main authors within the subtopics were identified. To further enrich the database for the research, an iterative backward and forward snowballing search was used as a research technique (Jalali and Wohlin, 2012; Wee and Banister, 2016; Xiao and Watson, 2019). As suggested by Denyer and Tranfield (2009), the selection and evaluation of the studies were taken by skimming the title and abstract. Whenever the relevance was perceived as high, the full text was read. The analysis section of the conducted research deals with the abstracting of relevant information and making sense of it (Bearman et al., 2012; Snyder, 2019). The collected data was subsequently analyzed in an Excel formatted codebook using a concept matrix, which changed over time as research evolved (Webster and Watson, 2002; Wolfswinkel et al., 2013). The assessment of study quality (e.g., methodological rigor) was not further investigated due to the quality level of the underlying research databases identified. The validity of the research was secured by following the guidelines building on the concept already used by various other literature reviews within this research field (Hahn and Kühnen, 2013; Hansen and Schaltegger, 2016).

For this study, the Grounded Theory approach created by Glaser and Strauss (2010) is used. This analysis involves specific stages, precisely the open coding stage (data is chunked into high-abstraction level type categories, which are then assigned a code), the axial coding stage (the collected codes are grouped together into categories and sub-categories), and the selective coding stage (categories are integrated, contrasted and refined) (Onwuegbuzie et al., 2015; Wolfswinkel et al., 2013). When sub-categories emerge, comparative analysis continuously relates, compares, and

links the identified categories to refine the concept (Wolfswinkel et al., 2013). As a result of the coding steps, this method enables the researcher to identify significant patterns within the collected data and build a robust theoretical framework for the collected data. The last part of the process is associated with the writing process or dissemination of the analysis to express essential aspects of the review. Tables and figures were used to illustrate the findings (Juntunen and Lehenkari, 2021).

3. Results

Applying the above-described procedure (see Table 2), the initial search yielded 1,170 articles. The first data cleaning and removal of duplicates reduced the total number by 349 articles. The application of the defined exclusion criteria to abstracts and full texts narrowed down the publication set further to 91 articles. The literature references of articles in this preliminary set were screened for further publications meeting the above criteria as well as the expert opinion was consulted, resulting in 8 additional publications. A final set of 99 papers from 1979 to 2023 were eligible for data extraction.

Database from origin to November 2023	**Scopus**	**Web of Science**	**Total**
First scan - citations	715	455	1170
Data cleaning, removal of duplicates and incorrect entries	-199	-150	-349
Data cleaning, adjustment to exclude non-english, non-german articles	-5		-5
Articles after data cleaning	511	305	816
Reading of title and abstract according to defined exclusion criteria	-310	-193	-503
Articles subjected to full text review	201	112	313
Exclusion based on full text review	-132	-90	-222
Articles included after full text review	69	22	91
Snowballing technique, expert opinion			8
Total			**99**

Table 2: Exclusion Strategy Process

Figure 1 shows the yearly evolution of publication and reveals a growing pattern; most articles (57%) have been published within the last ten years. This development is in

line with the adoption of the initiation of *Sustainable Development Goals* (SDGs) as well as *2030 Agenda for Sustainable Development* (United Nations, 2015) and proves that the interest in the field under investigation is of increasing importance.

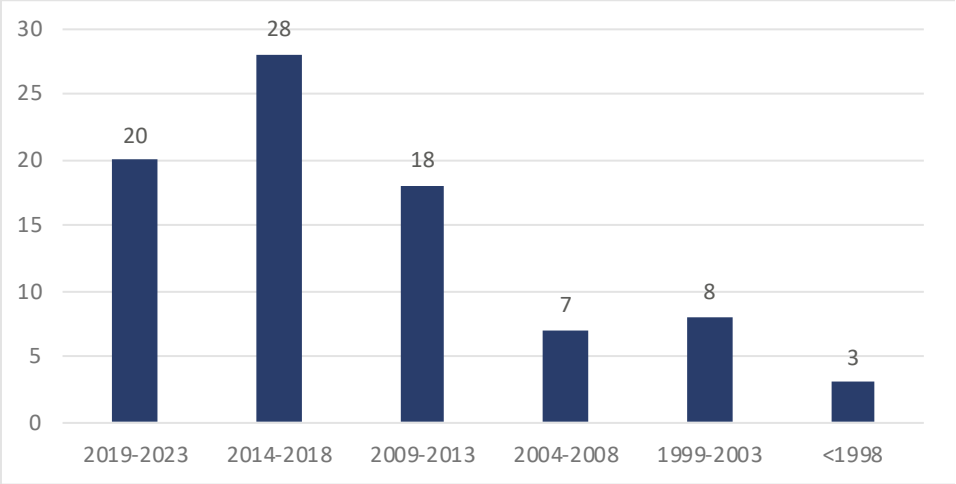

Figure 1: Year of Publication

The identified 99 articles have been issued in a total of 34 different journals. The most significant journal, as shown in Table 3, is *Energy and Buildings*, with a total of 19 articles, followed by the *International Journal of Hospitality Management*, with 7 papers. It is worth noting that the identified journals have a business and management, sustainability, building science as well as hospitality background, indicating the multitude of areas involved in research on corporate sustainability matters in the hotel industry.

Source title	Publisher	Topic	Publications	Country
Energy and Buildings	Elsevier	Building Science	19	United Kingdom
International Journal of Hospitality Management	Elsevier	Hospitality	7	United Kingdom
Journal of Cleaner Production	Elsevier	Environmental Management	5	United Kingdom
Sustainability	MDPI	Environmental Management	4	Switzerland
Renewable Energy	Elsevier	Environmental Management	3	United Kingdom
Tourism Management	Elsevier	Hospitality	2	Elsevier
Ecological Economics	Elsevier	Environmental Management	2	United Kingdom
Tourism Management	Elsevier	Hospitality	2	Elsevier

Table 3: Contributing Journals

Figure 2 illustrates the geographical areas of authors and hotel samples under investigation, showing that Asia and Europe are the most prominent. The top examined regions are Southern Europe (18 articles) and Eastern Asia (24 articles). Interestingly, all other regions under investigation are below six articles, revealing an uneven distribution in the geographical spread of studies. This result may be due to the fact that the author's location and sample location are 90% similar, resulting in a pattern that accessibility to data is easier in the author's country.

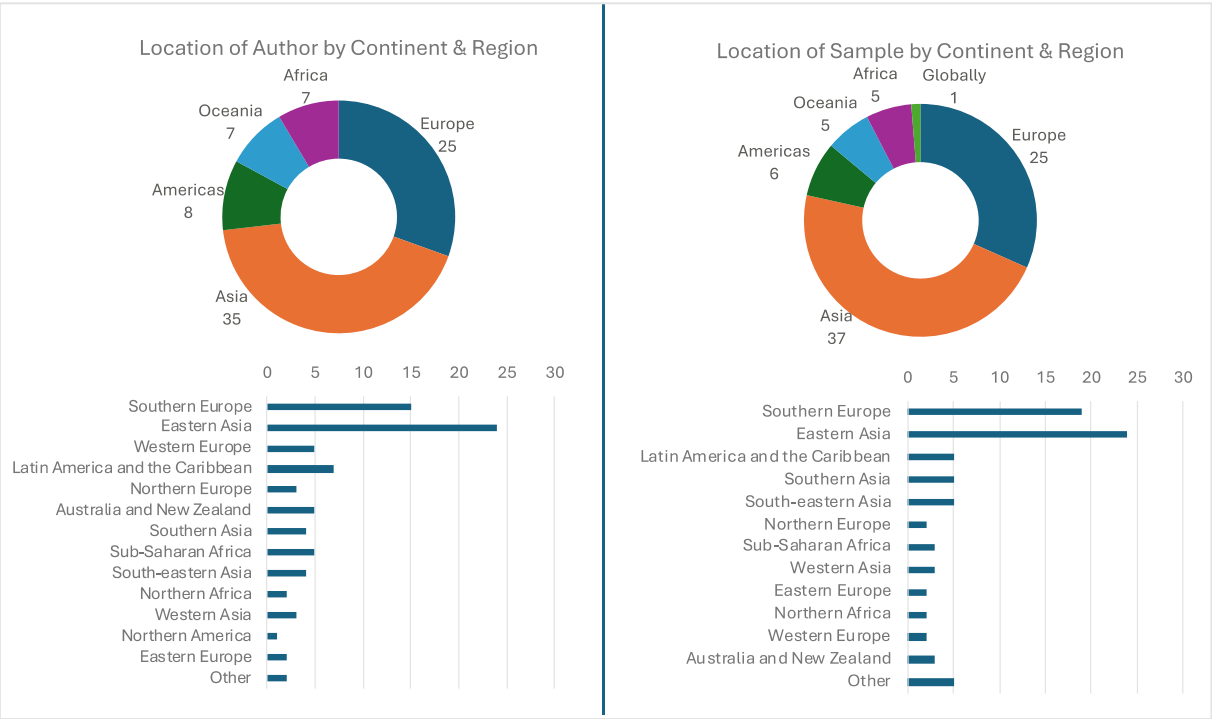

Figure 2: Sample Location by Continent and Area

As illustrated in Figure 5, most studies (77%) analyzed a sample below 50 hotels. Larger samples were generally found in quantitative studies where data was extracted from an external data set (Alkhalaf and Yan, 2018; Becken and McLennan, 2017; Bohdanowicz and Martinac, 2007). With sample sizes below ten hotels, data collection was with qualitative methods, often using semi-structured interviews.

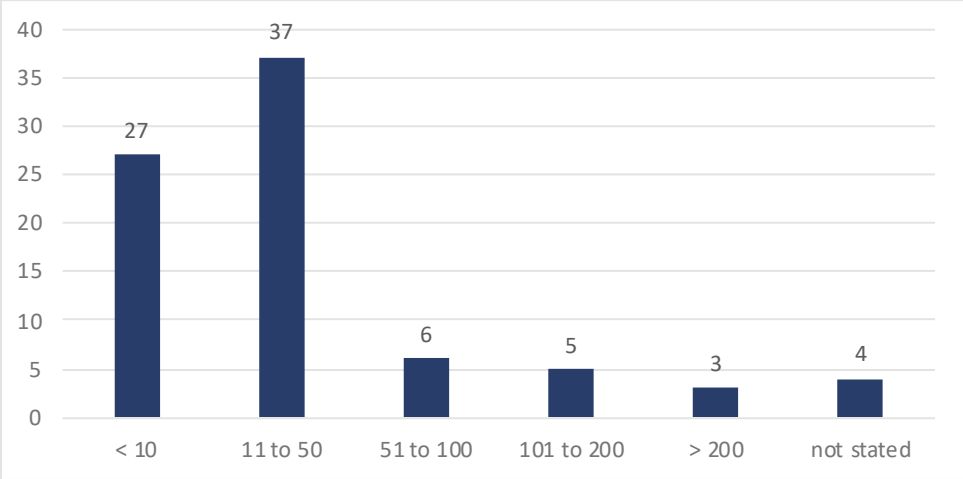

Figure 3: Sample Size

The research type and statistical analysis of the selected articles are displayed in Table 4. Data collection was predominantly done by questionnaire-based quantitative research methods (71% of the total sample). Most of the studies were collecting information about structural building characteristics (e.g., building age, floor area, number of rooms) and operational data (e.g., occupancy level, outlet characteristics) as well as associated resource consumption statistics (e.g., electricity and fuel use). In a publication where a single-case was studied, often semi-structured interviews with lead management and technical staff were being done to complete data collection (Debnath, 2015; Karagiorgas et al., 2007; Scholz et al., 2020).

	Frequency (*n*)	in %
Research Type		
Quantitative	57	71.3
Qualitative	16	20.0
Mixed	7	8.8
Statistical Analysis*		
Descriptive Analysis	36	40.4
Linear Regression Analysis	12	13.5
Multiple Regression Analysis	22	24.7
Correlation Analysis	6	6.7
Variance of (co)variance (e.g. ANOVA)	5	5.6
t-test	1	1.1
Data Envelopment Analysis (DEA)	2	2.2
Chi-square Analysis	1	1.1
Cluster Analysis	1	1.1
Other	3	3.4

*multiple counts possible

Table 4: Research Type and Statistical Analysis used

Regarding the statistical analysis of the data, there is a tendency to use descriptive analysis (40% of the total sample) exploiting results from distribution models, using medians and percentiles. To allocate main drivers for energy consumption, correlation analyses were frequently performed by different authors. Linear and multiple regression analyses are being used to calculate the regression coefficients of significant factors affecting the resource consumption of hotel real estate. Ultimately, predicting total energy consumption was the main goal in the regression analysis of the studies. Hybrid models by mixing descriptive and regression analysis are used as well frequently by different authors.

Regarding the resource use measurement process, there is no consensus as to how to report energy consumption in the hotel industry. During the 1990s first calls were imposed to perform environmental management and audits (Dale and Kluga, 1992; Kirk, 1995). Therefore, simple calculations to benchmark predominantly energy resources using averages, medians, and rankings were executed to determine environmental efficiency (Santamouris et al., 1996; Zmeureanu et al., 1994). However, several authors stressed that metrics are often misunderstood by operations of the hotel (Coles et al., 2016) or non-financial reporting's from large hotel chains do not use the same measurement units for reporting, making comparisons nearly impossible (Legrand et al., 2013). For example, Legrand et al. (2013) found that energy intensity of six hotel chains are reported in six different metrics kWh/m^2, MJ/m^2, kWh/Available Room (AR), MWh/AR, MJ/Guest Night (GN), and in kg (CO_2 equivalent/GN). Due to the aim and objective of this research, all analyzed studies within this literature review developed intensity metrics. More precisely, this kind of indicator measures resource consumption (input) with a specific measurement of the provision of services (output) of the company (Duric and Potočnik Topler, 2021). Both refer to a certain time unit (e.g., day, month, or year).

$$intensity\ indicator = \frac{total\ input\ of\ used\ resources\ per\ unit\ and\ time}{total\ output\ of\ provided\ service\ per\ time\ unit}$$

Input measures are commonly referred to as the respective resource unit (e.g., electricity and heating). Energy consumption (Q) of a hotel is usually calculated using the following formula adding annual consumption of electricity (Q_e), chilled water (Q_c), hot water (Q_h), steam (Q_s), diesel oil (Q_d), gasoline (Q_g) and natural gas (Q_n) respectively (Sheng et al., 2018).

$$Q = Q_e + Q_c + Q_h + Q_s + Q_d + Q_g + Q_n$$

Electricity consumption is generally the dominant source of carbon emissions in hotels (Beccali et al., 2009; Lai, 2015; Santiago, 2021). Other energy sources than electricity generally play a minor role in the hotel industry (Önüt and Soner, 2006). Hotel electricity share varies according to location, classification, infrastructure, and concept but is generally around 80% of total energy use (Önüt and Soner, 2006; Santiago, 2021; Yao et al., 2015). Output may be used using building industry benchmarks (e.g., per floor area), specifically tailored to the hotel industry (e.g., number of guests accommodated, number of rooms or beds) or individualized for specific outlets of the hotel (e.g., laundry consumption expressed in kg per linen, in restaurant number of meals served) (De Burgos-Jiménez et al., 2002). The extracted magnitudes used for inputs and outputs in the hotel industry, as well as resulting indicators, are illustrated in Table 5.

Input Units	Output Units	Unit of measurement	Time unit	Top 5 metrics	Abbreviation	Frequency Count	
						Total*	Audits**
electricity, chilled water, hot water, steam, diesel oil, gasoline and natural gas, renewable energy	per floor area, per room, per outlet, per guest night, per bed, per employee, per food cover	MWh, kWh, MJ	per day, per month, per year	Energy use intensity	EUI	**68**	**46**
				Energy use per guest night	EUPGN	**19**	**15**
				Energy use per occupied room	EUPOR	**10**	**5**
				Energy use per room per year	EUPAR	**9**	**6**
				Energy use per bed per year	EUPAB	**4**	**1**

*the frequency count is defined as whether an indicator was mentioned in the respective article.
**out of frequence count total, counted when article was applying the indicator(s) to the research sample

Table 5: Intensity Indicators Overview

The Energy Use Intensity metric (EUI) or average energy use index, defined in units of resource use per gross floor area per annum (kWh/m^2/annum), is usually used as the hotel industry's energy consumption indicator.

$$Energy\ use\ intensity\ (EUI) = \frac{primary\ energy\ consumption}{total\ floor\ area\ (in\ square\ meter)}$$

Numerous authors analyzed and audited this indicator (68 counts in the sample under investigation, 46 of audits). Quantification and auditing of different hotel properties started in the early 90ies (Lam and Chan, 1994; Zmeureanu et al., 1994) and has a long track record until today. The authors stress that the EUI is not satisfactory for

hotels' highly fragmented asset class (Kim and Oldham, 2017; Qi et al., 2017; Teng et al., 2017) and needs to be normalized for other secondary drivers (Bohdanowicz and Martinac, 2007). Therefore, the second group of identified intensity metrics suggests using the energy consumption per production unit, defined as the ratio between energy consumption and an operational reference value. The most prominent one within the energy segment is energy use per guest night (per day), which has been mentioned 19 times and audited 15 times in the chosen sample.

$$Energy\ use\ per\ guest\ night\ (EUPGN)\ = \frac{primary\ energy\ consumption}{total\ guest\ nights}$$

Less frequently used indicators are energy use per occupied room (mentioned ten times and audited five times), energy use per room per year (mentioned nine times and audited six times), and energy use per bed per year (mentioned four times and audited one time).

$$Energy\ use\ per\ occupied\ room\ (EUPOR)\ = \frac{primary\ energy\ consumption}{occupied\ rooms}$$

$$Energy\ use\ per\ room\ per\ year(EUPAR)\ = \frac{primary\ energy\ consumption}{available\ rooms}$$

$$Energy\ use\ per\ bed\ per\ year\ (EUPAB) = \frac{primary\ energy\ consumption}{available\ beds}$$

The resource audit results of previous scientific studies are analyzed in Table 7. It is found that the vast majority of studies analyzed city hotels (25 studies), followed by studies with a mixed focus (11 studies) and countryside hotels (5 studies). Overall, regardless of climate, quality level, or location, the analyzed sample possesses an EUI of 273.9 kWh/m^2 (1,494 hotels). Regarding the operational concept, it is found that city hotels (EUI 305.9 kWh/m^2, 718 sample hotels) consume considerably more energy than countryside hotels (EUI 182.4 kWh/m^2, 156 sample hotels). However, it must be acknowledged that this number may be distorted due to the low number of sample hotels in the countryside hotels sample.

	Number of Studies	Average Sample Size	Total Sample Hotels	in %	Mean EUI in kWh
Vacation	6	26	156	9.6%	182.4
City	26	28	718	44.0%	305.9
City and Vacation	10	72	722	44.3%	225.3
Not stated	4	9	35	2.1%	348.5
1 star	6	72	430	9.9%	238.2
2 star	9	55	496	11.5%	245.1
3 star	23	48	1096	25.3%	277.0
4 star	30	42	1254	29.0%	288.6
5 star	26	41	1055	24.4%	285.9
Temperate	15	43	651	46.2%	237.1
Tropical	13	25	327	23.2%	352.4
Dry	10	18	182	12.9%	143.9
Continental	3	83	250	17.7%	278.5
Polar	0				
Various	0				

Table 6: EUI Audit Comparison by Hotel Type, Quality Level and Climate

Furthermore, several authors argue that consumption per floor area generally relates to climate (Table 6). There, properties located in hot and humid areas (Chan et al., 2003; Deng and Burnett, 2002; Prasad and Singh, 2015; Xuchao et al., 2010) consume substantially more energy than those in dry (Khemiri and Hassairi, 2005; Tang et al., 2016; Teng et al., 2012; Xin et al., 2012) and temperate (Atmaca and Yýlmaz, 2019; Dat and Quang, 2018; Santamouris et al., 1996) climate. However, it has to be acknowledged that even within the same region, indicators vary significantly. For example, Santamouris et al. (1996) analyzed 158 hotels in the Athens area and concluded an EUI of 273 kWh/m^2 and Pieri et al. (2015) found an EUI of 430 kWh/m^2 when analyzing 32 hotels in Greece. This review finds that, on average, the EUI varies between 143.9 kWh/m^2 in dry regions (182 sample hotels, average sample size 18 hotels) up to 352.4 kWh/m^2 in tropical regions (327 sample hotels, average sample size 25 hotels). Regarding the quality level of hotels, there is a trend towards more luxurious hotels consuming more energy (EUI 5 star 285.9 kWh/m^2, EUI 4 star 288.6 kWh/m^2) than hotels offering more basic accommodation (EUI 1 star 238.2 kWh/m^2, EUI 2 star 245.1 kWh/m^2). This result is generally in line with the authors claiming that resource consumption increases with the quality level of a hotel (Nguyen and Rockwood, 2019; Priyadarsini et al., 2009; Xuchao et al., 2010; Yao et al., 2015; Qi et

al., 2017). A detailed analysis of studies conducting energy consumption audits is illustrated in Table 7.

Source	Year of Publication	Research Method	Sample Size (No. of hotels)	Location of Sample	Mean EUI (kWh/m2/ year)	Quality Level	Type of Hotel (City / Vacation)	Climate Region
Zmeureanu, R.G., Hanna, Z.A., Fazia, P.	1994	Quantitative	16	Canada	**612.0**	Not stated	Not stated	Temperate
Shiming, D., Burnett, J.	2002	Quantitative	16	Hong Kong	**563.8**	3, 4, 5	City	Tropical
Deng, S.-M., Burnett, J.	2000	Quantitative	16	Hong Kong	**563.8**	3, 4, 5	City	Tropical
Deng, SM	2003	Quantitative	36	Hong Kong	**541.6**	4 star	City	Tropical
Chan K.T., Lee R.H.K., Burnett J.	2003	Quantitative	26	Hong Kong	**519.4**	3, 4, 5	City	Tropical
Prasad, K; Singh, A	2015	Quantitative	2	Fiji	**482.2**	Not stated	Vacation	Tropical
Gonçalves, P., Gaspar, A.R., Silva, M.G.	2012	Qualitative	1	Portugal	**446.0**	4 star	City	Temperate
Xuchao W., Priyadarsini R., Siew Eang L.	2010	Quantitative	29	Singapore	**427.0**	3, 4, 5	City	Tropical
Priyadarsini, R., Xuchao, W., Eang, L.S.	2009	Quantitative	29	Singapore	**427.0**	3, 4, 5	City	Tropical
Pieri, S.P., Ioannis, T., Santamouris, M.	2015	Quantitative	35	Greece	**420.0**	2, 3, 4, 5	City	Temperate
Onut, S; Soner, S	2006	Quantitative	32	Turkey	**407.2**	5 star	City	Temperate
Hui, S., Wong, M.	2010	Qualitative	1	Hong Kong	**402.0**	Not stated	City	Tropical
Lam, J.C., Chan, A.L.S.	1994	Quantitative	17	Hong Kong	**366.0**	Not stated	Not stated	Tropical
Lai J.H.K.	2016	Mixed	30	Hong Kong	**356.6**	4, 5	City	Tropical
Ricaurte, E.	2011	Quantitative	20	Global	**351.5**	1, 2, 3, 4, 5	City and Vacation	Continental
Chan, W.W., Lam, J.C.,	2002	Quantitative	17	Hong Kong	**342.0**	3, 4, 5	City	Tropical
AlFaris F., Abu-Hijleh B., Abdul-Ameer A.	2016	Quantitative	12	Dubai	**320.5**	4, 5	City	Tropical
Bohdanowicz, P., Martinac, I.	2007	Quantitative	184	Europe	**297.0**	3, 4	City and Vacation	Continental
Huang, K.-T., Wang, J.C., Wang, Y.-C.	2015	Mixed	58	Taiwan	**277.0**	4, 5	City and Vacation	Temperate
Babatunde O.M., Oluseyi P.O., Denwigwe I.H.	2019	Quantitative	28	Nigeria	**273.7**	1, 2, 3, 4, 5	City and Vacation	Tropical
Santamouris, M., Balaras, C.A., Dascalaki, E.	1997	Quantitative	158	Greece	**273.0**	1, 2, 3, 4, 5	City	Temperate
Oluseyi, PO; Babatunde, OM; Babatunde, OA	2016	Quantitative	28	Nigeria	**266.0**	2, 3, 4, 5	City	Tropical
Yao, Z., Zhuang, Z., Gu, W.	2015	Mixed	45	China	**243.4**	3, 4, 5	City	Dry
Cunha, F.O., Oliveira, A.C.	2020	Qualitative	1	Portugal	**214.0**	4 star	Vacation	Temperate
Filimonau, V., Dickinson, J., Robbins, D.	2011	Quantitative	2	United Kingdom	**213.0**	Not stated	Not stated	Temperate
Wang, J.C.	2012	Quantitative	200	Taiwan	**208.0**	1, 2, 3, 4, 5	City and Vacation	Temperate
Chedwal, R., Mathur, J., Agarwal, G.D., Dhaka, S.	2015	Quantitative	79	India	**207.9**	Not stated	City	Tropical
Bianco, V., Righi, D., Scarpa, F., Tagliafico, L.A.	2017	Quantitative	not stated	Italy	**203.0**	1, 2, 3, 4, 5	Not stated	Temperate
Coles, T., Dinan, C., Warren, N.	2016	Quantitative	29	UK	**190.8**	3, 4	City and Vacation	Tropical
Qi, M., Shi, Y., Li, X.,	2017	Quantitative	46	China	**187.0**	5 star	City and Vacation	Continental
Farrou, I., Kolokotroni, M., Santamouris, M.	2012	Quantitative	90	Greece	**182.0**	Not stated	City and Vacation	Temperate
Khemiri, A; Hassairi, M	2005	Qualitative	1	Tunisia	**170.9**	3 star	City	Dry
Becken, S., Frampton, C., Simmons, D.	2001	Quantitative	30	New Zealand	**158.6**	Not stated	City and Vacation	Dry
Atmaca, M., Yýlmaz, Z.	2019	Quantitative	2	Turkey	**155.5**	4 star	City	Temperate
Dat, M.V., Quang, T.N.	2018	Quantitative	32	Vietnam	**151.2**	3, 4, 5	City	Temperate
Xu C.Q., Pan S., Hui Z., Wu J.S., Wang Y.M.	2014	Qualitative	1	China	**145.7**	5 star	City	Dry
Zhao, J., Xin, Y., Tong, D.	2012	Quantitative	19	China	**142.5**	Not stated	City	Dry
Rosselló-Batle, B., Moià, A., Cladera, A., Martínez, V.	2010	Qualitative	2	Spain	**140.0**	3, 4	Vacation	Temperate
Udawatta L., Perera A., Witharana S.	2010	Qualitative	1	Sri Lanka	**139.9**	5 star	Vacation	Temperate
Trung, D.N., Kumar, S.	2005	Quantitative	37	Vietnam	**127.4**	3 star	City and Vacation	Temperate
Lu, S., Wei, S., Zhang, K., Kong, X., Wu, W.	2013	Quantitative	27	China	**125.3**	4, 5	City	Dry
Xin, Y., Lu, S., Zhu, N., Wu, W.	2012	Quantitative	19	China	**123.2**	4, 5	City	Dry
Tang M., Fu X., Cao H., Shen Y., Deng H., Wu G.	2016	Mixed	24	China	**119.9**	1, 2, 3, 4	City	Dry
Lau C., Tang I.L.F., Chan W.	2021	Quantitative	13	China	**118.0**	4, 5	Vacation	Dry
Teng Z.-R., Wu C.-Y., Xu Z.-Z.	2017	Quantitative	3	China	**91.2**	2, 3	City	Dry

Table 7: EUI Audit Results[1]

[1] Please note: to facilitate comparability, all formats were recalculated to a common numerical standard (e.g., MJ to kWh or feet to m2). When several quality levels of hotels were being investigated within the study, a weighted average was formed. Furthermore, when more than one year was analyzed in the study, the mean of all years under investigation is presented. The climate zone was differentiated by the

4. Discussion and Conclusion

This paper investigates energy consumption benchmarking intensity metrics and associated audit results for the hotel industry by conducting a systematic literature review. Implementing reproducible research criteria, an extensive keyword search on relevant research databases, 1,170 articles were screened, revealing 99 articles for detailed analysis. The synopsis of the relevant literature presented shows that energy intensity metrics must consist of input and output variables to gain comparability in benchmarking. Regarding input variables, there is a consensus that the primary energy consumption, i.e., the total energy demand for operating the hotel building and its appliances, must be collected. It has been seen that most studies used the Energy Use Intensity (EUI) as the primary output variable for energy benchmarking in the hotel industry. Nevertheless, different authors claimed that an occupant-related variable should be integrated as well to display the usage degree of the building. This relevance is further increasing due to events such as the Corona crisis, in which EUI figures may be highly distorted. As a result, as already highlighted in the study of Farrou et al. (2012), a range of intensity metrics may be more suitable than a single-value benchmark. Therefore, an effective intensity metric should be easy for hotel staff to collect, understandable for all parties involved, and fulfill regulatory frameworks' reporting needs. Installing smart meters and sensor automation in data transfer would increase data validity and reduce the possibility of human error.

Out of 46 articles analyzing EUI audit results, an average EUI of 273.9 kWh/m^2 is found. Scholars agree that specific parameters of the hotels must be displayed to cluster results and increase comparability effectively. It is advisable to differentiate characteristics into operational (e.g., performance metrics, operations concept, hotel classification, types of services offered) and physical attributes (e.g., building structure, building age, total number of rooms and beds, number of floors, gross floor area), as well as factors related to location and climate. The review results find that variations occur mainly based on climate, quality level and service level of hotels, which is similar

widely used Köppen Climate Classification System and was classified according to hotel location like in other studies in the respective research field (Bohdanowicz and Martinac, 2007; Huang et al., 2015). The presented data is not climate-normalized.

to other study findings (Nguyen and Rockwood, 2019; Priyadarsini et al., 2009; Xuchao et al., 2010). However, it has been found that 5-star hotels do not consume more energy than 4-star hotels. However, it has to be acknowledged that studies analyzing solely 5-star properties are rare (Lanka Udawatta et al., 2010; Önüt and Soner, 2006; Xu et al., 2014). Furthermore, this study finds that countryside hotels consume less energy than hotels in urban areas. Concerning climate variations, it is found that previous audits in humid regions consume considerably more energy than other locations. Therefore, climate plays an often underestimated role in energy consumption analysis and data must be normalized to be comparable with other geographical regions. Nevertheless, it has to be acknowledged that numerous other non-researched factors, such as thermal insulation, roofing, type of carpentry, or guest behavior, might influence energy consumption patterns. These considerations necessitate a critical evaluation of the applicability of these indicators for external benchmarking, as their lack of direct comparability can lead to misleading interpretations and hinder rigorous comparisons for benchmarking purposes. Nevertheless, the mentioned indicators are valid for assessing the progress in energy performance improvements of each hotel in internal benchmarking.

Further elaboration on the above-listed influencing factors and their impact on energy consumption is advisable for additional research. In addition, creating and implementing an intensity metrics matrix on a large-scale sample size in locations such as Central or Northern Europe is perceived as researchable. There, a strong focus must be on differentiating characteristics to further elaborate on regression models predicting total energy consumption. Integrating the latest developments of regulative frameworks is necessary to comply with financial reporting and can be seen as a further research field. In addition, existing benchmarks do not consider the influence of guest and staff behavior (Warren and Becken, 2017), which forms a further field of future research. This study contributes to the existing body of knowledge by listing and categorizing intensity metrics for energy benchmarking for the hotel industry. Furthermore, energy audit results are displayed and clustered according to hotel characteristics and location. Scholars and practitioners may use the identified benchmarks to achieve better environmental performance and enhance their sustainability performance. Furthermore, the created metrics and energy benchmarks could benefit green lease negotiations between owners and operators. Additionally, policymakers and regulative authorities may use intensity metrics and audit results to

set boundaries within the operational phase of hotel real estate. Nevertheless, as other authors have noted (Guix, 2020; Guix et al., 2018; Kang et al., 2015), research attempting to incorporate environmental issues into hotel operations remains in an explorative stage.

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Science meets Practice:
Workplace Management and its Implementation

The relocation process into a refurbished work environment: A sample case study incorporating employers' and employees' needs and wishes.

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Keywords:

Transitioning Processes, Change Management, Hybrid Work Environment, Building Refurbishment, Users' Participation.

Abstract:

Relocating a team into new office premises requires successful management incorporating the needs of all those affected. The current case study faced various challenges: moving from larger to smaller premises, retrofitting the structural conditions in the "new" 120-year-old premises, and implementing new working environments that would enable hybrid work. These changes are a significant transition for teams. Change Management and design-thinking allow the combination of methods for transformation implementing processes, including all change steps, that are crucial for sustaining success. The present article deals with a case study documenting all the steps of relocating a research department. Preceding a literature review and using a survey to assess the users' needs, the case study sheds light on a change and design-thinking process incorporating different employers' and employees' wishes. The survey among the later users of the hybrid work premises revealed an amplified wish for facilitated, barrier-free communication among the team. Visiting exemplary office environments dispelled partial scepticism towards activity-based infrastructure, which resulted in curiosity about innovative office furniture and emerging technologies. Finally, implementing new working environments resulted in an optimised layout with high technological standards in a 120-year-old building structure. The presented use case shows an example of implementing sustainability in terms of durability. Concepts like these, which collect needs directly from the people concerned, make it possible to realise changes that are in the interest of those affected and, therefore, require no further far-reaching changes.

1 Introduction:

“Hybrid work” is increasingly essential for modern working culture. When working in a hybrid setup, employees choose not only the premises but also the distribution of the working days in which they work in the office or from elsewhere (Kaufman et al. 2020: 3). Entailing a mix of fully working at the company’s office and other teleworking locations (Kaufman et al. 2020: 3; Farre 2021), hybrid work affects multidisciplinary factors: these range from technological aspects to social and organisational matters (Ganguly et al. 2022). Most obviously, companies strive to achieve high productivity of their employees, which also depends on these aspects. Involving management and employees in transitioning to hybrid work is crucial for the success of wide-ranging changes to office infrastructures. While management considers strategic goals and economic factors (Management Study Guide 2024), the productivity and engagement of the employees ensure a company’s success (van Koetsveld and Kamperman 2011). Only when involving both sides lasting solutions can be developed, which – in a successful case – anchor in long-term implementations. Involving all stakeholders in a workplace transitioning process is a significant task for the management, especially when considering the diversity of employees in a company.

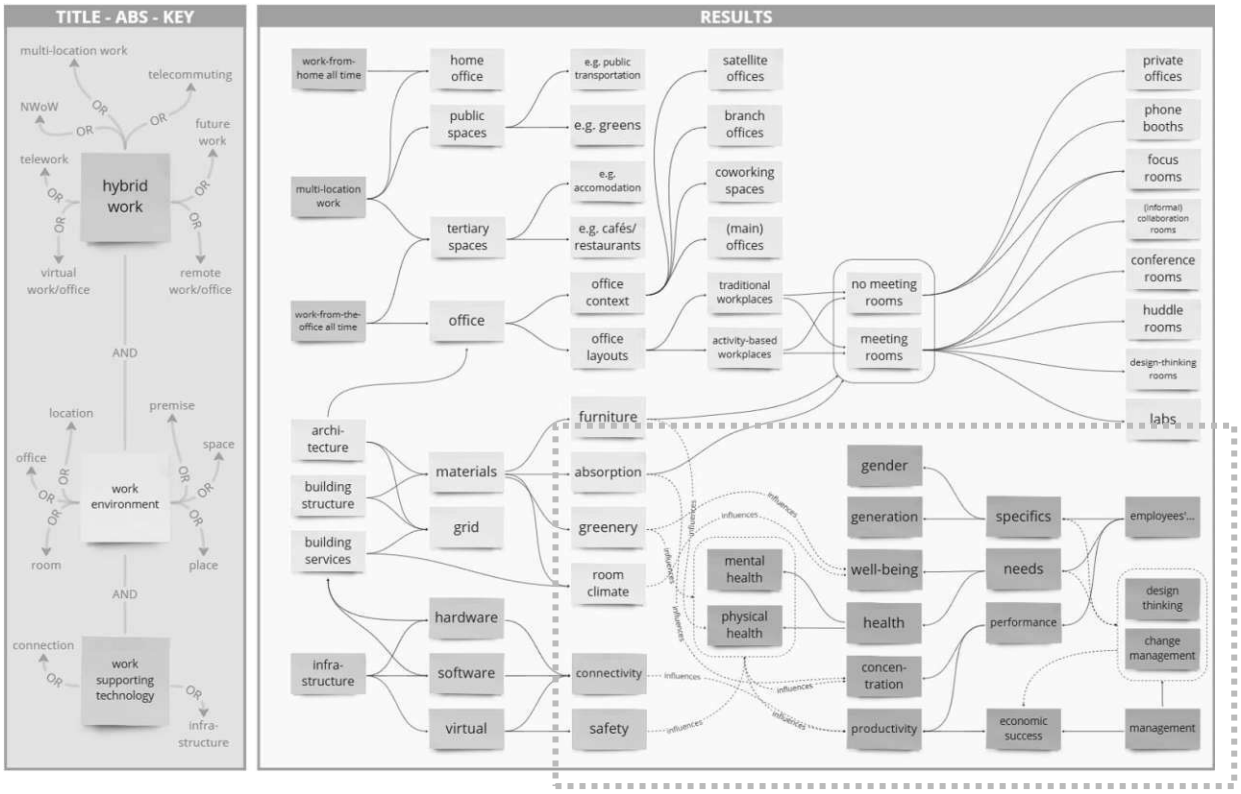

Figure 1. Developed relations among categories from a systematic literature review (SLR). The highlighting rectangle shows the influence of surrounding workplaces on employees - Compilation by the author.

Figure 1 is the result of the author's systematic literature review (SLR), highlighting the influence of surrounding workplaces on employees working within (see the dashed rectangle in figure 1). Focusing on the core issues like personal specifics (e.g. gender (Rodríguez-Modroño and López-Igual 2021) and age (Nanayakkara et al. 2021)) or individual needs (e.g. health (Robertson et al. 2022) and well-being (Aloisi and Stefano 2022: 289)) and performance (e.g. concentration (Chow et al. 2022) and productivity (Naor et al. 2022)), management needs to develop an inclusive approach, supporting the transition to new work arrangements (Hamouche and Parent-Lamarche 2023). Participatory processes help avoid resistance caused by a lack of, e.g. involvement and communication (Lines 2004; Alas 2007). Neves and Caetano argue that employees who recognise that a proposed change measure is in line with their own values are more likely to show commitment and enthusiasm (2009).

While some organisational or structural changes appeal to younger generations, some employees struggle with various adaptions (Haynes et al. 2017). Giving employees a voice and empowering them creates greater acceptance and commitment towards their company (Yaakob et al. 2021). Including employees in decision-making helps building company culture and buy-in for the hybrid work solution. Fostering company culture helps to tie employees to the company, even if the physical presence is lowered for hybrid work (Farcane et al. 2023). Sometimes, implementation becomes complex if the implementation includes technological advances (Skelsey 2013). When expecting difficulties in implementation, companies need to consider all aspects to convince even doubtful employees. Therefore, the main task for management is not just to change the organisation but also to involve the employees in the transitioning process itself (Lines 2004). Few publications provide insight into such transitioning processes applying Change Management and Design-Thinking measures (Smollan and Morrison 2019; Jemine et al. 2020). However, these are not linked to articulated needs and aspirations and solutions applied to them.

Ensuing this need, the present article seeks to provide information on the transitioning processes in context with work environments and their users and aims to answer the following research questions:

- How can employers and companies, their employees, HR, Facility and IT management be supported in developing a hybrid workplace?
- What support do supervisors and teams need when working from different locations?

The paper starts by introducing all applied methods and their correlations. Based on the findings of a Systematic Literature Review (SLR), which identifies general factors that influence employees in their work environment, the paper focuses on relocating a research department. It excerpts relevant results of a rolled-out survey and, applying elements of Change Management and Design-Thinking, presents a relocation case study.

2 Methodology:

2.1 Research Design:

While the author conducted other research steps in context with earlier research (e.g. Inductive Content Analysis (ICA), Systematic Literature Review (SLR), Observation of Field Research (OoFR) and Autoethnography (AE) (Thrainer and Redlein 2024)), additional research steps as part of the research strategy complement the obtained results. The present article excerpts relevant results of a rolled-out Survey stipulating employee's and employer's needs (SUR) and presents a relocation Case Study (CAS), applying elements of Change Management and Design-Thinking. Figure 2 summarises the relevance of all methods applied in this paper.

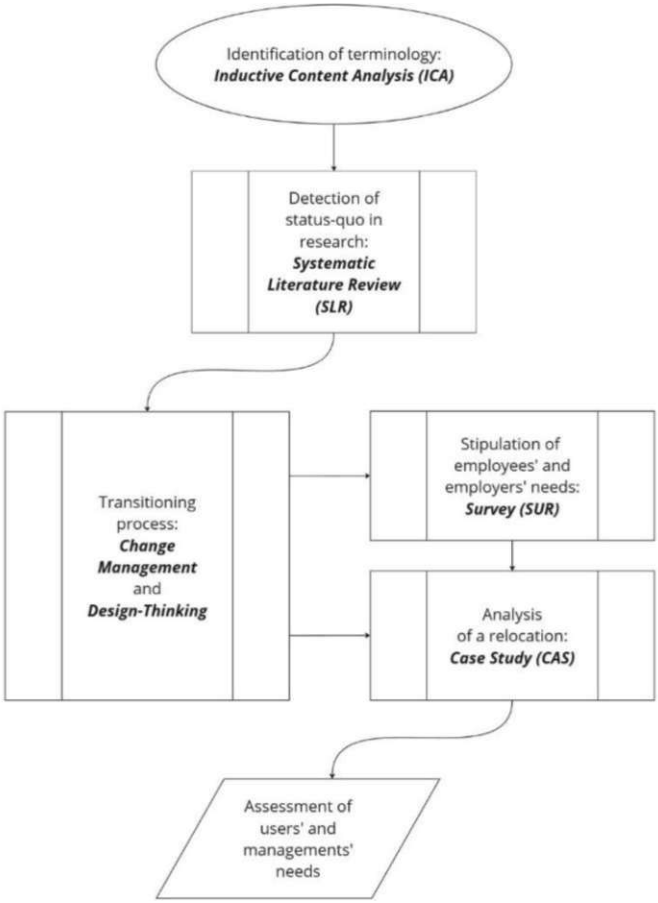

Figure 2. Flowchart expressing the relevance of all methods applied.

2.2 Change Management and Design-Thinking:

There is a variety of Change Management models that aim to implement change in organisations. The present research focuses on Kotter‘s (1996) 8-step process for leading change, as it allows a detailed yet agile approach that leads change makers through transitioning processes. Compared to other Change Management approaches, Kotters 8-step model (Kotter 1996) offers a very detailed structure, that still allows flexibility for individual scenarios (Schreiber 2024). Supplemental to Kotter’s change model – which focuses on the transitioning process inside the organisation – Design-Thinking allows the incorporation of individual stakeholders by allowing an *“outside-in*” perspective (Husak 2023: 177) – perspectives from the employees themselves. Both approaches complement each other regarding change in an office context.

J. Kotter's (1996) 8-step model starts with creating a sense of urgency for change (Step 1). This step should help motivate action driven by e.g. economic conditions, employee needs, and technological innovation. The process involves all stakeholders to help design and implement the change (Step 2). Collaborating with this guiding team

allows for the creating a vision and strategy for change (Step 3). This is where the Design-Thinking method comes into play. In contrast to hierarchical organisations, Design-Thinking focuses on *"outside-in*" thinking (Husak 2023: 177). Meinel and Thienen describe Design-Thinking of *„using problems and unfulfilled human needs as a resource of inspiration to seek and find better user-centred solutions for the future"*[2] [translation by the author] (2016: 311). This human-centred approach contradicts a technology- or organisation-centred approach to problem-solving (Kimbell 2011: 287).

In both Change Management and Design-Thinking, communication is crucial for understanding and acceptance among the people affected. An essential part of communication is defining responsibilities, introducing that change will happen, and conveying the benefits of the change while maintaining open communication channels (Step 4). Encouraging people to act and spreading the message by providing resources can further reinforce the momentum for change (Step 5). Change processes profit from achieving and celebrating short-term successes, leading to wider acceptance among the target group (Step 6). Persistence in implementation and continuous adjustments ensure that the change process is driven forward (Step 7). This prevents falling back into old habits (Step 8). After all, the objective is to ensure that the change is implemented convincingly by all those affected to initiate successful and sustainable organisational change. (Kotter 1996)

2.3 Case Study and Survey:

Linking theoretical results to natural practice requires consideration of a contextualised study, the Case Study (CAS). Conducting a CAS often involves triangulation of different data collection methods. Usually, these include data collection such as e.g. questionnaires, surveys or in-depth interviews (Priya 2021: 95). In the case of the presented CAS, a Survey (SUR) and constant feedback sessions provided individual input for the targeted transformation process.

The CAS began with an initial team meeting in July 2020 to discuss the need to relocate a team of ten knowledge workers corresponding to eight full-time equivalents, targeting a completed relocation in December 2020. The team comprises people from different disciplines who each need different equipment to carry out their work. The

[2] Verbatim quote: *„…Probleme und unerfüllte menschliche Bedürfnisse als Inspirationsquelle zu nutzen, um für die Zukunft bessere, weil nutzerzentrierte Lösungen zu suchen und zu finden."*

team includes five women and five men, and the average age at the time the survey was conducted was 35,9 years. The SUR (see Appendix – Assessment of Needs "Relocation IFM") included open and closed questions aiming to gain a deeper understanding of the flow of work ensuing:

- team organisation,
- communication among all employees,
- contact with external parties/students,
- requirements for technical equipment,
- data storage and archiving,
- mobility,
- general comments and wishes.

The qualitative responses from all concerned users revealed daily work processes among the team and helped derive requirements on the relocation.

3 Results:

3.1 Organisational and technological prerequisites:

The relocation faced three significant challenges. Employees had to face downsizing the office premises and reorganizing from private offices into an open-plan layout (see figure). In addition to the necessity to retrofit technological infrastructures within the more than 120-year-old building structure, the Covid-19 pandemic sharpened the need to integrate infrastructures to facilitate hybrid work.

Table 1: The location of work performance by employee (E1-10) before the Covid-19 pandemic.

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
office	*on maternity leave*	100%	100%	90%	92%	95%	95%	90%	15%	50%
home office		0%	0%	0%	5%	5%	5%	10%	80%	50%
other environments		0%	0%	10%	3%	0%	0%	0%	5%	0%

By the time of the query (after the first lockdown in 2020), working from home was already practised within the team, but to a much smaller extent (see table 1). The desire to work from home or other premises, which was also asked about in the SUR,

was affirmed by most of the team (9 employees out of 10, one employee didn't practice WFH due to specific work activities that were not yet compatible with hybrid work).

The predominant focus of the case study is the involvement of employees in the transformation process – towards new ways of working. These comprised the following challenges:

- strengthened communication among all employees,
- an optimised infrastructure considering the needs of all employees, and
- implementing new working environments with optimal utilisation of the existing spatial conditions.

The teams' scope covers interdisciplinary research and hands-on projects in a university context. In addition to these projects, the research department is concerned with the editorial of a peer-reviewed journal, provides student mentoring, and organises an annual congress with more than 150 international participants on external premises.

3.2 The relocation process:

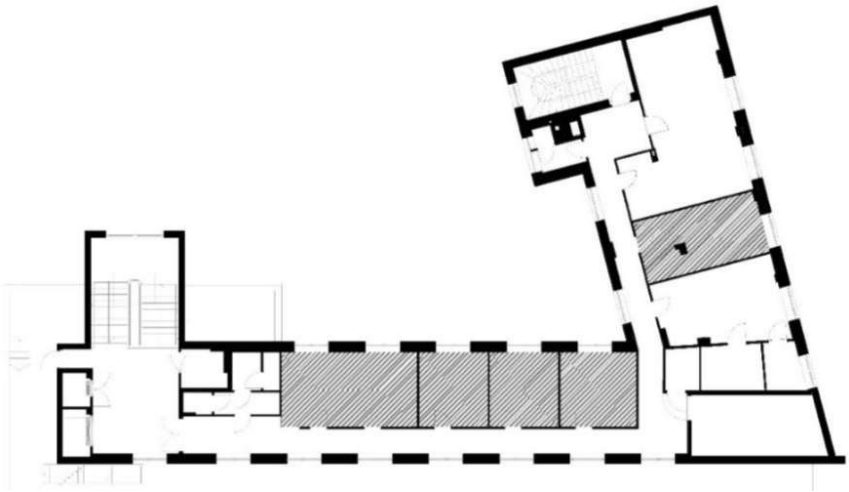

Figure 3: The greyed-out spaces show the single office structure of the original work environments (plan not to scale).

The original office premises comprised a private layout (see figure 3). One of the separate rooms included the library, and another the secretary's office hosted work stations for up to four people, which in reality was for individual use only. The use of individual rooms meant that colleagues only communicated with each other to a limited extent, even before the isolation enforced by the Covid-19 pandemic.

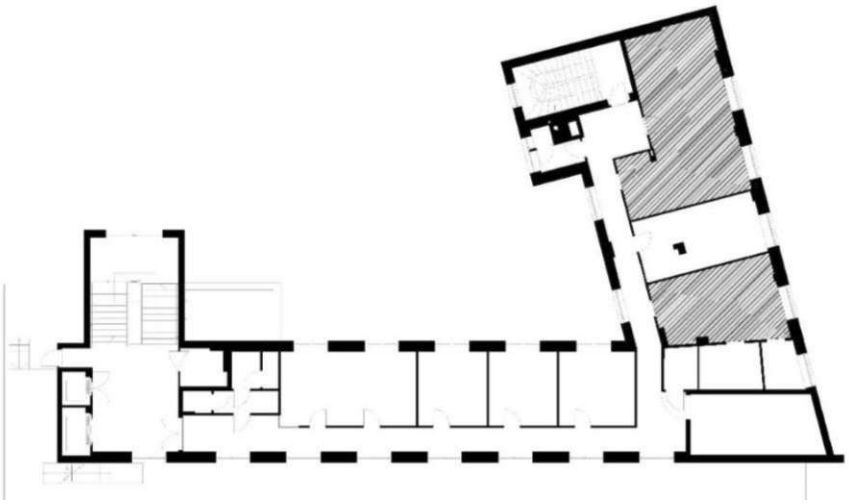

Figure 4: The greyed-out spaces show the meeting spaces of the original work environments (plan not to scale).

In addition to the private offices, two spatially separated meeting rooms complemented the office premises (see figure 4). The smaller meeting room offered a central meeting table, the bigger a theatre seating arrangement. Both spaces were frequently used for teaching purposes.

Following Kotter's 8-step method, the need to move to new office premises created a sense of urgency for change. As part of the first step of Change Management according to Kotter, the relocation process was communicated during an initial team meeting. The organisation offered two possible sites to move to. In order to involve the affected employees, they were included in the location decision, which was jointly discussed within the team (Step 2). The team could choose between a smaller premise near the original premises (offering excellent public transport connections via underground, buses and trams) and a much larger office behind the central train station (with few bus connections). After discussing the advantages of one or the other office space, a joint decision among the employees and the management was made to choose the smaller of the two options. The decision to move to the smaller office with excellent public transport links meant that the original idea of a single office was dropped due to the lack of available space. The decision to move to smaller premises also meant that the infrastructure had to be adapted in terms of technology. Nevertheless, the size and organisation of the other rooms made it possible to accommodate an additional person, and emerging technologies allow digital transformation.

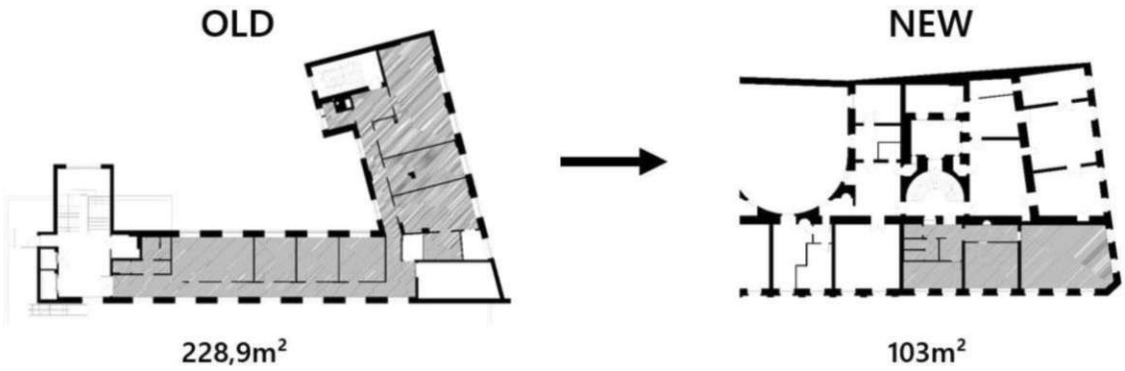

Figure 5: Floorplans of the old and new work environments (greyed-out spaces, plan not to scale but the same size relative to one another).

The above floorplans illustrate both office premises, the old one comprising 228,9m² and the new one 103m² (see figure 5). In contrast to the former office, the enclosed spatial structure had to be moved into an open space structure with shared workplaces.

Following the results of the assessment of needs and organisational prerequisites, the new office context had to establish new ways of working supported by appropriate technologies and combined with personal needs (Thrainer and Redlein 2024):

- ensuring virtual participation,
- a collaborative, concentrative and recreational workspaces,
- a hands-on laboratory and a collaboration room combined with a Design-Thinking room.

Figure 6: The new office premises under construction (Photo courtesy by L. Thrainer).

As part of all transformation steps, the SUR and constant individual and team feedback loops with all concerned further provided insight into the requirements of all employees (Step 3). Constant human-centred feedback in the sense of the Design-Thinking approach – aimed at transparent communication of the change – left enough space for the expression of individual wishes and responses to personal concerns. As the research department enforces research in workplace management and emerging technologies, some employees had a particular affinity with these topics. Other employees (mostly engaged with non-scientific content) expressed early doubts about moving from a traditional office layout into an activity-based one that supports hybrid work. These doubts were met by visiting different emerging work environments. With these visits, all employees concerned gained insight and were allowed to evaluate earlier opinions about their future work environment. During later feedback sessions, some participants expressed particular interest in trying out some innovative furniture.

Due to the need to downsize the research department when relocating and to incorporate new ways of working, the office structure and floorplan required a reorganisation. The researchers engaged with workplace management and emerging technologies were mainly included in the change process in the next step (Step 4). By involving these researchers, research-supporting measures should be taken, and researchers should be motivated to test research results thus enabling further research.

Compared to the former office layout, the prerequisite spatial configuration of the new office space required a division of the open space into zones and allocation of specific uses to the other rooms. While the open structure promotes the integration of employees, it also supports the simplified manageability of the whole organisational unit. The largest of the three available office rooms hosts the majority of six employees, while the smallest space remains a private office hosting two employees (see figure 7). Both of these rooms host all employees who are employed in this research department. As some of the employees work part-time, some jobs are double-occupied. Due to individual agreements, there are no overlaps. The third room received transformation, newly hosting a collaboration room combined with a Design-Thinking room. This setting should allow employees to host internal and external meetings but also seclude from the rest of their colleagues and take a break (see figure 7).

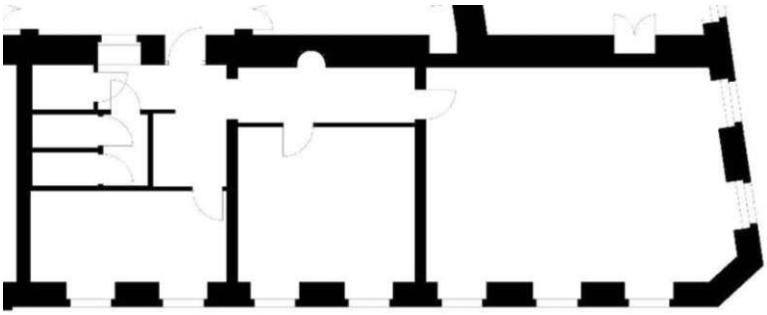

Figure 7: The spatial configuration of the new office premises (plan not to scale).

Concerning the meeting possibilities, the SUR showed two different meeting situations (see table 2). Either all ten employees would meet, which usually happens during the weekly jour fixes. The open room structure of the biggest of all office rooms allows one to participate in person or via conferencing tools. The other meeting scenario includes fewer participants (two to three team members). Depending on their research activities, this affects two or three team members. Table 2 reveals the problems of the timing of the query as a whole. Two employees responded that they would not participate in any meeting. This could be due to the fact that the interviewees assumed the time of the survey, when no meetings were taking place, and not the normal working day.

Table 2: Meeting scenarios to assess the need for meeting space.

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
meeting scenario 1	2	2	0	2	2	3	3	0	3	1-3
meeting scenario 2	10	10	0	10	10	10	10	0	10	n.d.

Due to the rigidness of the old office layout and previously carried out visits to state-of-the-art office layouts, not only the employees conducting research around workplace management or emerging technologies were curious about adaptable furniture and implemented technical tools which aimed to support hybrid work (see figure 8). In the spirit of Kotter's "spread the message", the other employees were also included in the change process (Step 5). They could see how research topics were directly translated into reality (Step 6). The direct exchange with the contractors, with whom the feasibility of the proposals was constantly discussed, was constructive for this process (Step 7).

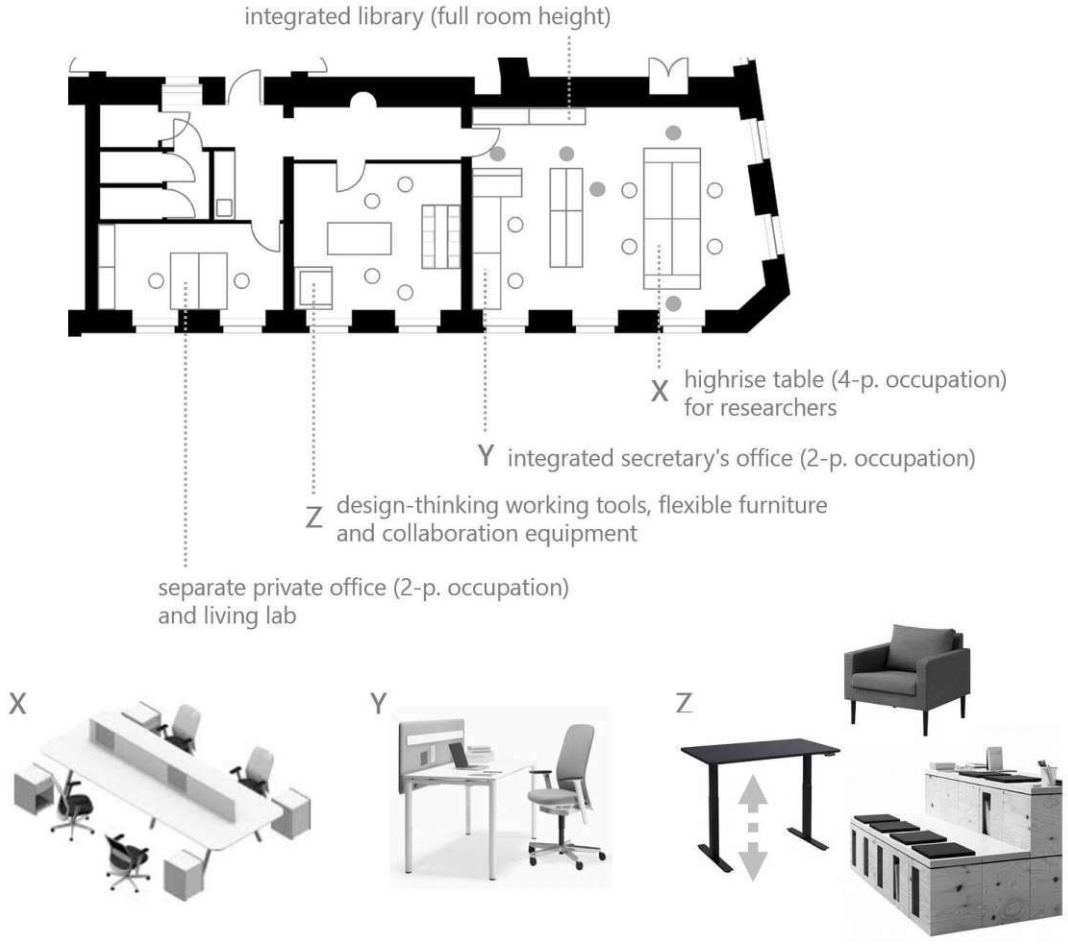

Figure 8: Final layout of the office premise and implemented furniture (plan not to scale).

Within the largest of all rooms (see figure 15), six employees find space for permanent work, allocated in different zones, and can work on their specific tasks accordingly. Two employees representing the secretary's office with assigned seats require optional external contact and administrative tasks. Following the wishes of both secretaries, non-adaptable tables were installed and close-by storing opportunities (see figure 16). The other four employees, researchers working free-address (based on the principle of first-come-first-serve basis and emphasises adaptability and spontaneity in the use of office-based workplaces (Knight and Haslam 2010)), can choose their seats on a highrise table according to availability to work on their research activities, which they described as mainly requiring focus and concentration. All four researchers articulated the need for a silent environment. One researcher described:

“more communication, possibly through a shared office, nevertheless there should be the possibility for personal space for concentrated work”[3] [translation by the author].

The researchers expressed interest in the highrise table setting, as they wished to try working alternately seated and standing. Some other employees raised concerns about the highrise table setting or height-adaptable tables, which is why not adjustable work settings supplemented the four stand-up work desks. In addition to permanent workstations, the highrise table and neighbouring cupboards allow intermediate meetings among the majority of the research group, cupboards allow temporary meetings and hot-desking. Room-dividing furniture offers enough space for storage while supporting the appearance of making the large room smaller and with plants on top, further supporting the improvement of the air-quality and the well-being of all users (Shafaghat et al. 2015) (see figure 9).

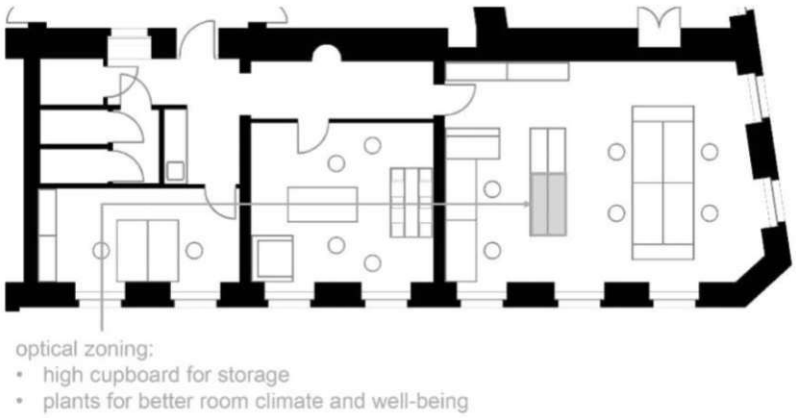

Figure 9: Optical zoning within the open-plan office space (plan not to scale).

Also, the library found space in the largest of all three premises, as both secretaries and researchers needed easy access to the books. One researcher expressed the wish of *“making the library easier accessible”*[4] [translation by the author], and another researcher added *“easier access, should invite in using the library”*[5] [translation by the author].

The mid-size room hosts all the tools necessary for a Design-Thinking process, including virtual participants. Offering toolboxes and boards for individual expression and adaptable furniture should support Design-Thinking processes and allow room

[3] Verbatim quote: *„Mehr Kommunikation, eventuell durch gemeinsames Büro, trotzdem Möglichkeit für persönlichen Bereich für konzentriertes Arbeiten“*
[4] Verbatim quote: *„Bibliothek leichter zugänglich machen“*
[5] Verbatim quote: *„leichte Zugänglichkeit, sollte einladen dazu benützt zu werden“*

reconfiguration. Providing a web-conference screen and additional seating options allows simultaneous use of the room as a collaboration room (see figure 18 and figure 19).

Even though private offices were criticised in the previous layout, the assessment of needs revealed that two of the employees needed constant access to a variety of hardware devices and close-by storage of these tools (see figure 17):

> *"It must be possible to look at one screen with [name of a colleague]. I'll need some space on the table for storing IoT devices and similar to test, wire up and put into operation.* (…) *Storage of unused electronic devices (e.g. screens, keyboards, server hardware) should be easily accessible"*[6] [translation by the author]

Also, another employee expressed concern about working in an open layout. This concern was discussed in team meetings and resulted in the offering of a second workstation within the private office. The employee agreed with this solution.

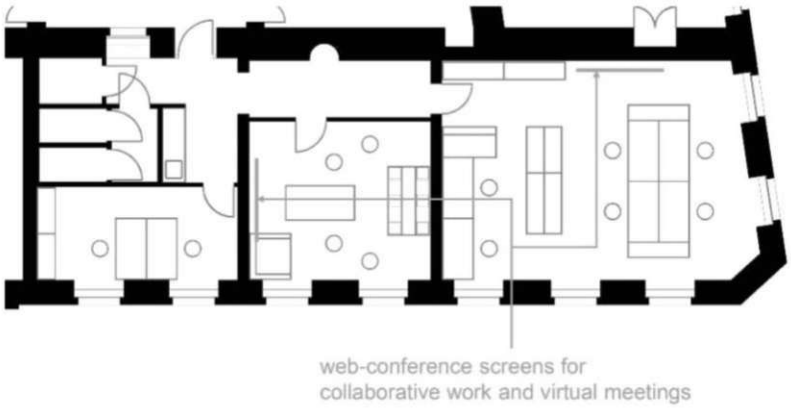

Figure 10: Position of web-conference screens allowing collaborative work and virtual meetings (plan not to scale).

In addition to furniture supporting the employees in carrying out their specific work tasks, several other infrastructural and technical facilities are installed within the new office premises. To ensure hybrid participation and collaboration, two web-conference screens connected to the local computer network enable virtual meetings (see figure 10).

[6] Verbatim quote: *"Muss möglich sein zusammen mit* [Name eines Kollegen] *auf einen Bildschirm zu sehen und nebeneinander zu sitzen. Gewisse Fläche auf dem Schreibtisch um IoT Geräte und ähnliches zu Testen/Verkabeln/Betrieb nehmen.* (…) *Lagerung von nicht gebrauchten Elektronikgeräten (Bildschirme, Tastaturen, Serverhardware etc.) sollte gut erreichbar sein"*

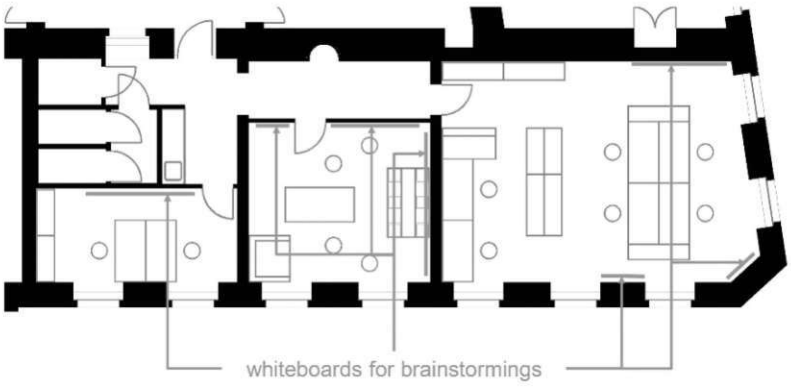

Figure 11: Position of whiteboards allowing brainstorming (plan not to scale).

The provision of whiteboards in all office rooms allows for personal expression, no matter in which room employees work. These spaces support on-site collaboration and personal expression in brainstorming sessions to further develop thoughts as a team (see figure 11).

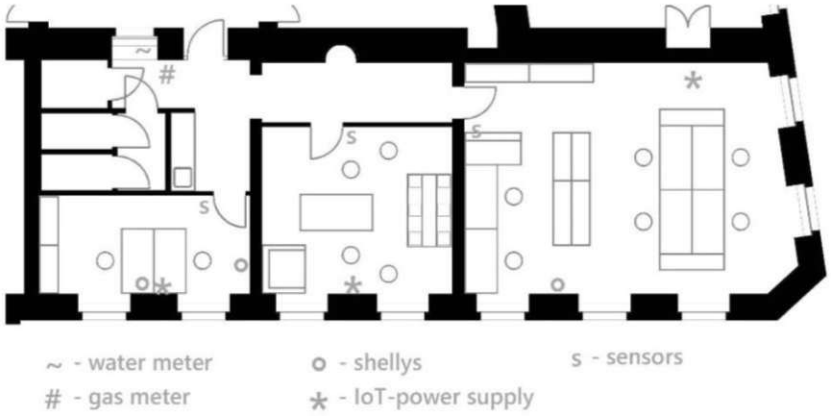

Figure 12: Position of all fixed installed technical devices (plan not to scale).

Given ideal working conditions, the spatial requirements of the new office premises set sustainable goals. All rooms become part of the living lab, enabling a better energy monitoring and optimisation overview. Modern electronic building automation is inexistent, as the premise dates back to around 1900. Therefore, installing sensors and observing meters should help gain further insight into high-energy consumers while safeguarding the well-being of the tenants. Along these lines, naturally available daylight should be preferred while supplemented by artificial light, and the implementation of emerging technologies should simplify the customisation of the work environment. The above plan reveals their positions within the lab (see figure 12), and the ensuing overview illustrates all tools implemented (see figure 13). These technical devices measure and transmit data (e.g., energy consumption, temperature, CO_2), which is then forwarded to servers and visualised, analysed and evaluated. This living-

lab configuration enables hands-on research, which led to further publications in other premises and case studies (Redlein and Thrainer 2022a, 2022b; Redlein et al. 2023).

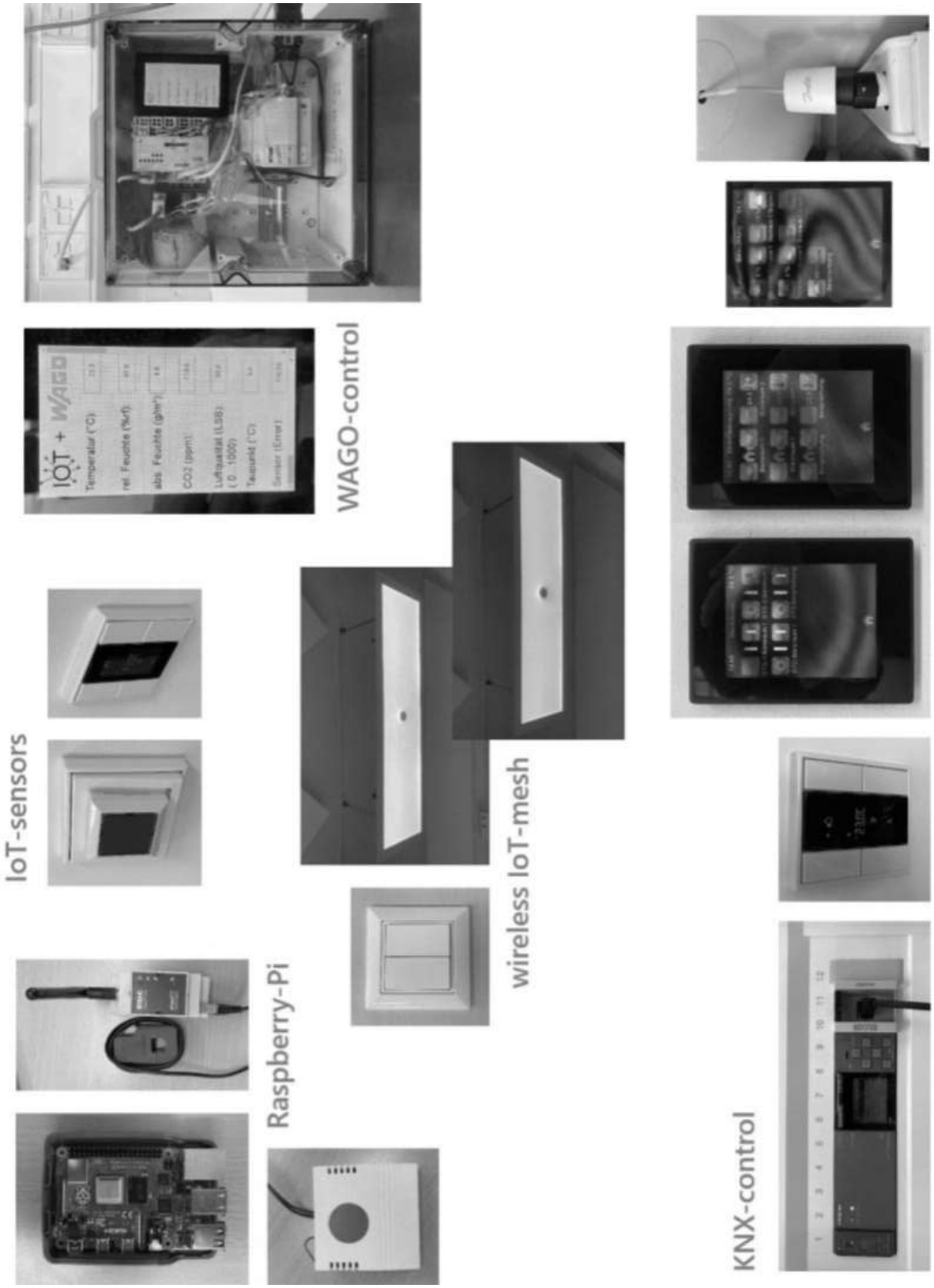

Figure 13: Installed hardware to monitor e.g. energy, temperature, humidity, CO2.

The following pages visualise the resulting transformation of the work environment from the construction phase to the finished layout. This includes organisational prerequisites and results from feedback rounds and the assessed SUR before and during the change process.

Figure 14: The open-space office under construction, before…
(Photo courtesy by L. Thrainer).

Figure 15: …and after: the finalised open-space office showing the researchers' zone.
(Photo courtesy by L. Thrainer)

Figure 16: The finalised open-space office showing the secretary's office. (Photo courtesy by L. Thrainer)

Figure 17: The private office hosting the hands-on laboratory. (Photo courtesy by L. Thrainer)

Figure 18: The finalised Design-Thinking and... (Photo courtesy by L. Thrainer)

Figure 19: ...and collaboration room. (Photo courtesy by L. Thrainer)

4 Conclusion

The present paper introduced a CAS based on relocating a research department, which became necessary due to the reorganisation of the existing office premises. Starting with a SUR depicting an assessment of all users' needs, the CAS enabled insight into a transitioning process by applying Kotter's 8-step Change Management method and introducing Design-Thinking aspects to incorporate different employees' needs. Transparent communication of all necessary relocation steps and offering feedback sessions among all stakeholders were crucial to the case studies' success. Open communication and feedback loops allowed supervisors and teams to understand and react to the planned change. Incorporating employees' perceptions allowed the management to gain a deeper understanding of (team)work processes while enabling the employee to act themselves. Primarily through incorporating all present disciplines, communication was crucial to understand and relate to opponent sites. Implementing new technologies makes hybrid networking possible, as well as energy monitoring and optimisation.

The team's decision to move to a smaller office (even though there is no separate office for the team leader) is proving successful in practice, as employees repeatedly mention that they are happy to come to the office for on-site teamwork and a personal chat alongside their hybrid work. The possibility of hot-desking or using the adjacent meeting/Design-Thinking room provides all users with a fully-equipped workplace. Over time, it could be observed that individual free-address seats were used by the same users, mainly reasoned by the availability (first-come-first-serve) and due to the used equipment. Due to the high rate of remote workers, workstations were always available for everyone.

5 Discussion

Changes in the workplace can lead to extensive changes in the work processes of co-workers. Observing of an individual case and considering qualitative results allows one to gain a deeper understanding, especially when a small group is concerned. It will be worthwhile to continue monitoring the use case over the coming years. It could be of particular interest to e.g. interview incoming new employees who were not involved in the relocation process about their experiences with the hybrid workplace. In comparison, multiple and cross-cases enable the identification of errors or the detection of similar phenomena and generalisable conclusions throughout different

cases (Yin 2014: 242). A subject of further research could be to observe further comparable use cases to enrol on meta-analysis.

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Appendix - Assessment of Needs „Relocation IFM"

ASSESSMENT OF NEEDS

Supplier: IFM TU Wien
Project: "Relocation IFM"
Date : July, 3rd 2020
Location: Treitlstraße/Resselgasse, 1040 Vienna

Participants and Job Description:

Participant: _____
Job description: _____

---

1. General Description of Processes and Workflow:

Please check the list below and add supplemental processes if necessary.
Please assess to what extent the activities are routine activities or complex tasks that require particularly concentrated work:

1.1. Working Hours at the Office: (tick where applicable)
o MON o TUE o WED o THU o FR
o weekly o interval: _____

1.2. Work Start and End:
- appr. ___:___ o'clock
- duration: _____ h
- deviations (e.g. general working hours MON-WED, reduced working hours on THU): _____

1.3. Lunch Break (Inside and Outside the Office):
- appr. ___:___ o'clock
- duration: appr. _____ h

1.4. Key Processes/Activities:
- _____
- _____
- _____

1.5. Description of Daily Work Processes:
- work process: _____ duration: ____
- work process: _____ duration: ____
- work process: _____ duration: ____
- work process: _____ duration: ____
- work process: _____ duration: ____
- work process: _____ duration: ____

1.6. Estimated Distribution of Working Time: (please indicate in percent %)
- phone calls: ___ %
- emails: ___ %
- routine working: ___ %
- concentrated working: ___ %
- creative working: ___ %
- meetings: ___ %
- other _____:___ %

p 1

Figure 4: Questionnaire on the assessment of needs, p 1.

1.7. Are there any special requirements for your work?

_____

_____

1.8. Are there any requests for improvement with regard to work processes? If yes, which ones?

_____

_____

2. Team Organisation: (to be worked out by the project manager)

If there is a hierarchical structure in your department (head of department - employees etc.), please provide a brief description of the number of teams including size, employees and their functions:

2.1. Number of Employees:

_____ employees

2.2. Scope of Employment:

_____ %

2.2. Core Working Hours of the Team:

___:___ - ___:___ o'clock

2.3. Occupancy:

- minimum: ____ people
- maximum: ____ people

2.4. Are there any requests regarding the occupancy of the department? If so, which ones?

_____

_____

3. Contact with Externals and Students

3a. Externals

3a.1. Amount of External Contacts (i.e. persons who are not directly affiliated or associated with the IFM):

number: _____

3a.2. Frequency of External Contacts: (tick where applicable)

o per week, or

o per month, or

o per year

3a.3. Peaks/Usual Time of External Contact:

appr. _____ : _____ o'clock

3a.4. Time Required per Contact and Process:

appr. ___

3a.5. Kind of Contact: (tick where applicable)

- meeting: *yes / no*
- exam: *yes / no*
- lecture: *yes / no*
- other _____ (fill in): *yes / no*
- other _____ (fill in): *yes / no*

3a.6. Organisation of Contacts:

o personally, unscheduled

o personally, scheduled

p 2

Figure 5: Questionnaire on the assessment of needs, p 2.

o via phone
o via email
o via internet application
o other:

3a.7. Are there any special requirements / needs for the contacts?

_____

_____

3b. Students

3b.1. Amount of Contacts with Students (i.e. persons who are not directly affiliated or associated with the IFM)**:**
(please fill in and mark with a cross)
number: _____

3b.2. Frequency of External Contacts: (tick where applicable)
o per week, or
o per month, or
o per year

3b.3. Peaks/Usual Time of Student Contact:
appr. _____ : _____ o'clock

3b.4. Time Required per Contact and Process:
appr. ___

3b.5. Kind of Contacts: (tick where applicable)
- meeting: *yes / no*
- exam: *yes / no*
- lecture: *yes / no*
- other _____ (fill in): *yes / no*
- other _____ (fill in): *yes / no*

3b.6. Organisation of Contacts:
o personally, unscheduled
o personally, scheduled
o via phone
o via email
o via internet application
o other:

3b.7. Are there any special requirements / needs for the contacts?

_____

_____

4. Communication among the Team

4.1. Which work processes (previously described in question 1.4.) **require intensive communication between employees and departments?**

_____

_____

4.2. Which employees do you have the most contact with? What kind of contact do you have?
- colleague: _____ kind of contact: _____
- colleague: _____ kind of contact: _____
- colleague: _____ kind of contact: _____

p 3

Figure 6: Questionnaire on the assessment of needs, p 3.

4.3. At what intervals are department meetings scheduled? (tick where applicable)
o daily
o weekly
o monthly
o other interval: _____

4.4. Where do these meetings happen? (tick where applicable)
o meeting rooms
o external premise
o at the work station
o other premise: (please fill in) _____

4.5. How many people participate in these meetings?
____ people

4.6. Are there any "Social Areas"? (tick where applicable)
yes / no
→ **if yes, which one are these?** _____

5. Description of ICT-tools

5.1. Soft- and Hardware:
- currently: _____
- in the future: _____

5.2. ICT-Tools:
- privately owned: _____
- company owned: _____

6. Mobility

6.1. Where do you work? (tick where applicable)
o office: *yes/no*
o home office: *yes/no*
o at another premise: *yes/no*
→ if *yes*, at which other premis(es)? _____

6.2. If the location of work is more than one location, how is the distribution among these premises?
(please indicate in percent %)
o office: ____ %
o home office: ____ %
o at (an)other premis(es): ____ %

7. Data Storage and Archiving

7.1. How is data currently archived? (tick where applicable and fill in)
- mainly electronically on a central server: *yes / no*
- mainly electronically on the companies' laptop: *yes / no*
- print-out archive: *yes / no*
- other: _____

7.2. If working archives are created, what kind of archives are they? (tick where applicable)
- temporary work archives: *yes / no*
- personal work archives: *yes / no*
- public work archives: *yes / no*

Figure 7: Questionnaire on the assessment of needs, p 4.

7.3. If yes, how long to you keep archived documents? (please fill in)

_____

7.4. Is the library in use? (tick where applicable)

yes / no

→ if yes:

- when? ____
- by whom? ____
- at which purpose? ____

7.5. Are there any suggestions for improving data archiving or the use of the library? (please fill in)

_____

_____

8. General

8.1. Wishes and suggestions for the new office?

_____

_____

8.2. What is currently working well?

_____

_____

8.3. What is working less well at the moment?

_____

_____

8.4. What would you want to change?

_____

_____

8.5. What are you currently very happy with in the office? What do you think should move into the new office?

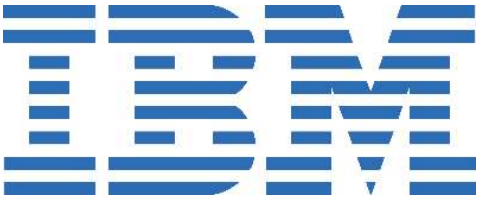
_____

_____

p 5

Figure 8: Questionnaire on the assessment of needs, p 5.

We would like to thank our partners of the 17th IFM-Congress 2024:



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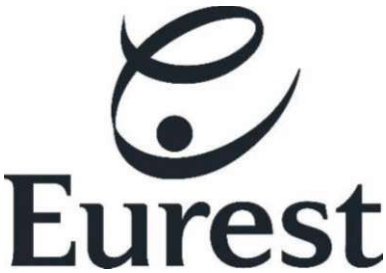

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Eurest Österreich ist der führende Anbieter für Food Services und Catering und deckt mit seinem umfassenden Leistungsportfolio den gesamten Bereich der Gemeinschaftsgastronomie ab.

Täglich frisch gekocht, bieten wir für die Segmente Business & Industry, Healthcare und Education individuelle Gastronomiekonzepte, die Frühstück, Mittag- und Abendessen sowie Snacks und Zwischenmahlzeiten umfassen. Für Mitarbeiter:innen, Gäste und Patient:in, ebenso wie Konferenz- und Eventcatering, Automatenlösungen und Kaffeekonzepte.

Gemeinsam mit unseren Kund:innen gestalten wir **maßgeschneiderte, ganzheitliche Gastronomielösungen**.

Unter dem Dach von Eurest Österreich vereinen sich **Topmarken** wie Hofmanns / Menümanufaktur, foodaffairs PREMIUM CATERING, Leonardi, La Pasteria und Kanne Café.

So bieten wir eine vielseitige Palette an Dienstleistungen für verschiedenste Märkte und Anforderungen. Unsere hauseigene **Technik- und Designabteilung** schafft **individuelle Raumkonzepte** und verwandelt Gastronomie in ein **nachhaltiges, multifunktionales Erlebnis**, in dem Leidenschaft und Qualität stets im Mittelpunkt stehen.