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SUSTAINABILITY ASPECTS IN REAL ESTATE MANAGEMENT – BASICS AND OPPORTUNITIES FOR AN INDICATOR-BASED TARGET AND REPORTING SYSTEM IN REAL ESTATE COMPANIES

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Abstract. The challenge for real estate companies to assess and communicate sustainability aspects at corporate, portfolio and building level is constantly increasing due to many external and internal influences. Corresponding requirements address the sustainability reporting of the company or the environmental performance of the building stock for example. In order to meet legal requirements and to stay competitive, companies use specialisation techniques. One possibility is provided by indicators which can help to gather, assess and communicate sustainability aspects. This paper investigates the information flows between different decision levels of Real Estate Management (REM) that can be established with the help of indicators. The results reveal the relevance of indicators for a horizontal as well as for a vertical integration of sustainability-related information in REM. Moreover, synergies for the development and interpretation of indicators across decision levels can be identified by taking into account measuring units, reference units and system boundaries. Results from a research that reflects the situation in Germany and considers current developments in the EU will be presented.

Keywords: Sustainability indicators, key performance indicators, sustainability assessment, corporate sustainability reporting, information management, portfolio management.

1. Introduction

Researchers, politicians, economists and society agree on the key role that the real estate industry plays in the combat of climate change. The construction, operation, renovation and deconstruction of buildings still draws responsible for vast amounts of energy use, greenhouse gas emissions (GHG emissions), resource consumption and waste creation. Since political goals to slow down climate change are ambitious, legal binding requirements on the sustainability of companies, institutional building stocks and buildings are under discussion or have been established in Germany and worldwide already. Therefore, and due to the growth of institutional real estate companies that can be observed in Germany, the information management of sustainability aspects in companies became more complex. In the past these developments led to the existence of supporting tools and sustainability assessment methods that either exclusively address sustainability aspects on a corporate or building level or do not differentiate clearly between the context of decision levels in REM. The result is that real estate companies use various sustainability indicators for business processes, building stocks or single buildings without integrating the relevant flow of information horizontally and vertically in their organisation. This leads to the following research question: *How can real estate companies use sets of indicators to support the management and communication of sustainability aspects on a corporate, portfolio and single building level and what kind of information flows go along with that?*

This paper builds on the results of a master's thesis at the Karlsruhe Institute of Technology (KIT) and further develops them by incorporating new information sources and new perspectives. The thesis can be found here [1]. To answer the research question, the definition of the three levels of action and decision in institutional REM is given first. Second, a variety of the most important decision support systems and assessment tools for sustainability in real estate companies that include indicators is characterized. Finally, an approach is presented that links sustainability indicators to tasks in REM and considers the relevant information flows, while an example supports the understanding for the correct interpretation of an indicator. The system can be used for different building types by weighting single or multiple indicators according to their relevance. Since the research focuses on institutional REM the findings are primarily applicable to the rented building stock.

2. Analysis of sustainability indicators in Real Estate Management

For a systematic analysis of sustainability-related indicators used in REM the most relevant concepts of REM and the related flow of information will be in-

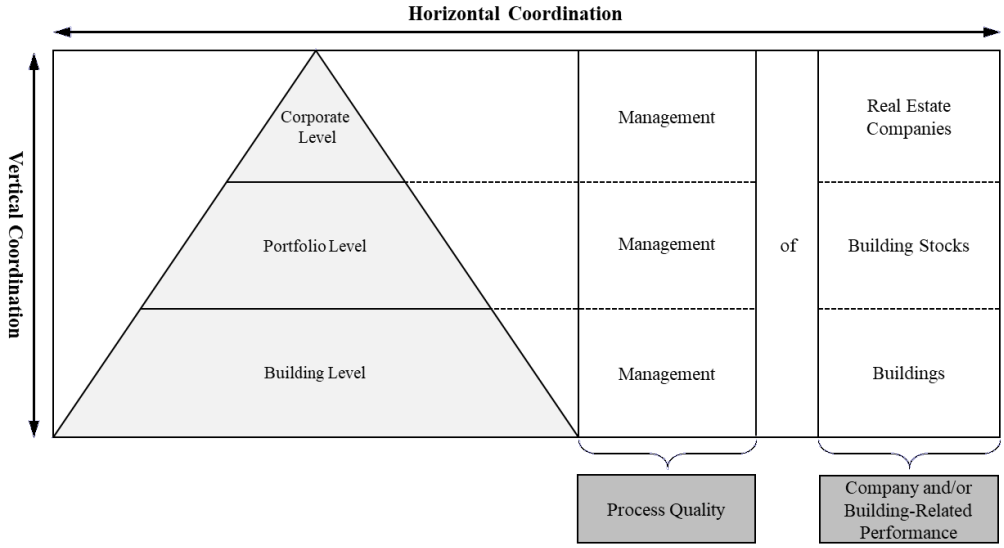

Figure 1. Decision levels in Real Estate Management adopted from [2].

troduced. Additionally, possible sources for indicators will be identified and described.

2.1. Decision levels in institutional Real Estate Management

REM combines many essential tasks within the real estate industry. In specific, it deals with leadership tasks concerning social systems and individuals that are private, corporate or public and that focus on value creation processes within the lifecycle of buildings [2]. REM processes can be characterised by three different dimensions: the management or decision level, the lifecycle phase of a building and the perspective which is either use-oriented, financial-oriented or technology-driven. This research focuses on the different decision levels which are shown in Figure [1]. The pyramid reflects the hierarchy of processes and information flows within REM. For detailed information about the basic concept consider [2].

2.2. Types and functions of sustainability indicators

There is no general definition for the term "indicator", but it is generally considered as an aid to support decision-making through the precise presentation of required information. This also includes the abstraction of complex objects of interests to measure, analyse and assess those in a quantitative or qualitative way. Further functions of indicators refer to the orientation they can give in the identification of problems, conditions and trends, to their role in controlling as well as to their ability to communicate complex objects of interests effectively and comprehensively [3]. To fulfil their functions, the formulation of scientific, use-oriented and practical-analytical requirements according to the needs of a user is recommended [3].

Practical use of indicator sets has primarily been known from politics, for example in form of indicators in the context of the Sustainable Development Goals (SDGs) [4]. In REM, indicators have been developed mostly under the name of criteria or key performance indicators (KPIs). The special characteristics of REM not only led to a differentiation between quantitative and qualitative indicators but also to a distinction between process- and object-orientation (see Figure 1). Quantitative indicators define themselves by a measured variable that is set in relation to a specific reference unit. To be able to compare certain quantitative indicators details about the system boundaries as well as the reference units are required. An example will be given in Section 3.3. More details about the relevance of reference units can be found in the literature, e.g. [5].

2.3. Sources and frameworks for indicators in Real Estate Management

Since sustainability aspects affect real estate companies in many ways depending on the object of assessment and the respective system boundaries, indicators can origin from a variety of sources and frameworks. Table 1 categorises different types and explains their relevance for the formulation of indicators. An analysis of representative examples of each category delivered a list of 179 possible sustainability indicators for the three different decision levels of REM which can be looked up in [1].

3. Proposal for an overall indicator system to support corporate information management

The system of indicators that will be presented is based on the definitions of REM and indicators. Identified indicators from the literature can be allocated

Type	Description	Examples	References
Corporate mission	Since sustainability finds its way more and more into corporate processes and companies need to react on the development of legal requirements, societal pressure and market competition, it is common practice nowadays to integrate the company-wide understanding of sustainability into the corporate mission. The corporate mission reflects sustainability on a normative level which sets the frame for guidelines and rules on a strategic, tactical and operational level and therefore plays a relevant role for the use of sustainability indicators especially on a corporate level. A term that is often used analogously to sustainability in this sense is "Corporate Social Responsibility" (CSR).	–	[6, 7]
Political requirements	Political requirements manifest themselves in the case of Germany in legislations on a regional, national and EU-wide level. They determine the frame for all corporate activities while requirements in terms of sustainability grew more and more relevant in the past. Legislation influences corporate sustainability activities on all decision levels of REM, e. g. in form of requirements for the disclosure of non-financial aspects on the corporate level or in form of requirements on the energetic quality on a single building level. Since legislation already involves the specification of certain figures at some points, the respective data can also serve as sustainability indicators to a company.	Legal requirements for CSR reporting (CSR-RUG), German Building Energy Law (GEG)	[7]
Stakeholder analysis	Stakeholder analysis serves companies as a tool to incorporate sustainability requirements of stakeholders and thus to adapt adequately to external influences. The relevance of stakeholder analysis for real estate companies is illustrated through the heterogenous structure of the industry and the differences of the environment on a corporate, portfolio or building level.	–	[7]
Industry guidelines	Industry guidelines published by state institutions, industry federations or research institutions can support companies at different stages of a building lifecycle and in different disciplines of REM. There are guidelines that define principles for a sustainable development in the industry as well as guidelines that specify recommendations.	Guideline for Sustainable Building, NUWEL	[8, 9]
Standards	Standardisation is evolving constantly under the premise of sustainability requirements for companies, building stocks and buildings. Standards play a universal role in the real estate industry because they set the basis for a common understanding of terms, concepts and methods. Relevant standards on a corporate level refer e.g. to social or environmental aspects while on a building level construction-related standards are widespread.	ISO 26000, DIN ISO 14001, DIN EN 16309	[10–12]
Lifecycle Assessment (LCA) methods	LCA in the real estate industry stands for methods that assess the sustainability of buildings while in the narrow sense the focus lies on ecological impacts on the environment. Over time a variety of different methods evolved mainly depending on the target variable, e.g. greenhouse gases or cumulative energy demand. The results of LCAs often can serve as aggregated indicators in REM.	LCA, Carbon Footprint, Cumulative Energy Demand	[13]
Building certification	Building certification became a popular instrument to assess and to reflect the sustainability of a building after a predetermined scheme. It builds on an assessment in an aggregated index that can be subdivided in categories and specific criteria. Especially single criteria can be taken as example in the selection of sustainability indicators on a building level. Due to the lasting Covid-19 pandemic, certification systems that focus on the health of occupants are gaining relevance.	DGNB, LEED, BREEAM, WELL, Fitwell	[13]
Benchmarks	The popularity of benchmarking in the real estate industry increased recently due to the needs of sustainability. Systematic approaches for ESG-Benchmarking have been developed from an investor point of view. They incorporate building-related criteria as well as management criteria in their assessment.	GRESB, EPRA sBPR	[14, 15]
Reporting standards	Large real estate companies are obligated to disclose about non-financial aspects of their business in Germany and also smaller companies use the opportunities to report about the sustainability of their business and their building stock. Reporting standards fulfil legal requirements and provide specific guidance to companies. Industry-specific additions address real estate companies separately.	GRI, The Sustainability Code (DNK)	[16, 17]

TABLE 1. Sources and frameworks for indicators.

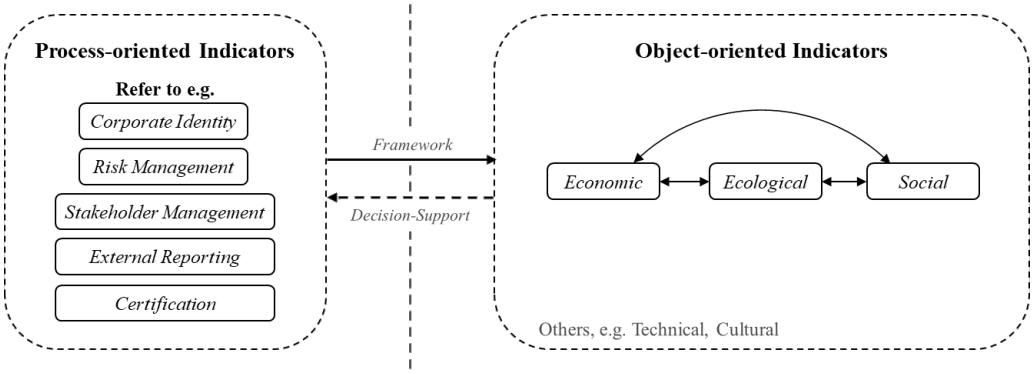

Figure 2. Horizontal information flows through indicators.

to the three decision levels of REM according to their relevance for companies, institutional building stocks and single buildings. For this, the specific tasks and challenges of the decision levels play a decisive role. The allocation of indicators reveals that there exist several similarities between the portfolio level and the building level which can be explained by the building focus on both levels. Indicators on a corporate level differ to the point that they reflect the normative and strategic relevance of this decision level. On all decision levels, indicators show the difference that can be observed between financial and non-financial aspects: The performance of financial aspects is represented through economic indicators that are all monetised and of quantitative nature while ecological, social or other types of indicators cannot always be quantified or monetised.

After the allocation of sustainability indicators to the specific decision levels, their thematic connections and the resulting information flows can be analysed. According to the presented concept of REM (see Figure 1), coordination processes can either be established horizontally on a specific decision level (see Section 3.1) or vertically between different levels (see Section 3.2).

3.1. Horizontal information flows

The horizontal integration of information is strongly influenced by the interdependence of economic, ecological and social aspects. Relevant indicators can support the prioritisation and weighting of different sustainability goals. Moreover, they allow for the controlling and assessment of impacts decisions have on the three pillars of sustainability. An example for the interdependence of indicators is represented by a subsequent thermal insulation of a building which ideally leads to a reduction of energy demand (ecological), thus to a reduction of energy costs (economic) as well as to an increase of thermal comfort (social). Another aspect to be considered is the possible representation of ecological, social and other non-financial qualities through aggregated indicators. Here, these indicators are called economic substitute indicators and they allow for a comprehensive integration of non-financial aspects into economic decision-making. Examples can be the overall technical quality of a building or the results of a LCA on a single building level.

The analysis of indicators suggested by the literature highlights another relevant aspect for horizontal integration: Generally, a clear relation between process- and object-oriented indicators can be observed. Process-oriented indicators, which are mostly qualitative, stand for the existence of managerial aspects with a supporting function for the implementation of object-oriented indicators, while the latter allow statements about the performance of companies, building-stocks and buildings in sustainability-related aspects. The existence of ecological risk assessments for a building for instance can be an indicator for the process quality, while the results of sustainability assessment methods describe the relative object-oriented indicators. In practice, the use of indicators needs to be adjusted to the company-specific organisation structure and the respective data strategy. The term "enterprise data strategy" stands for the integration of processes and data resources in order to serve corporate goals. There are relevant approaches for data organisation that consider the specific requirements of the real estate industry [18].

The general relation between process- and object-oriented indicators described above is given in Figure 2. The managerial function of process-oriented indicators becomes clear, while respective values of object-oriented indicators can be directly linked to the controlling of sustainability goals.

3.2. Vertical information flows

Additional to the horizontal coordination, both existing directions of vertical information flows in REM need to be considered:

- Top-down: Top-down information flows refer to the communication of goals and requirements to align normative, strategic, tactical and operational aspects. Indicators are supposed to reflect the level of abstraction on the specific decision level.
- Bottom-up: To evaluate existing goals and requirements that are communicated to the next lower level, decision makers rely on the reporting from

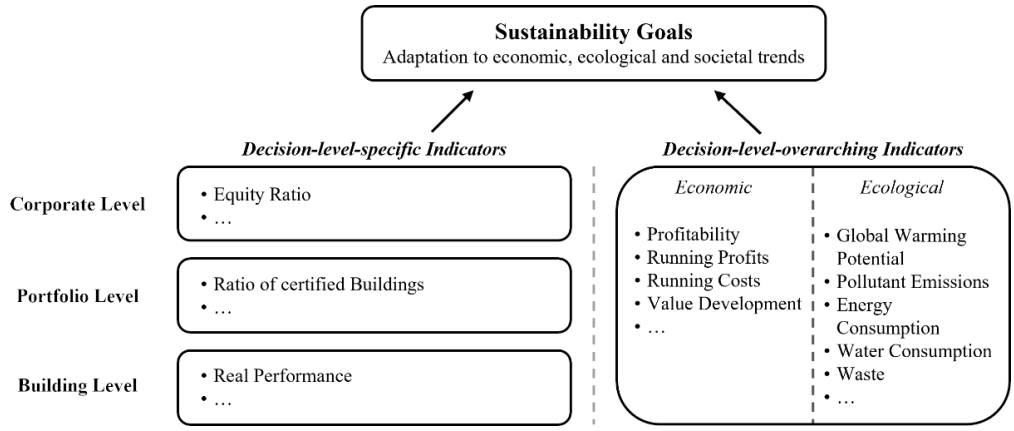

FIGURE 3. Decision-level specificity of indicators including selected examples.

Decision level	Goal	Object of assessment (includes system boundaries)	Measuring unit	Reference unit(s)
Corporate level	GHG neutral company	Company	t CO_2-equivalent	€sales/a €revenues/a
Portfolio level	GHG neutral building stock	Building stock	t CO_2-equivalent	m^2 building stock/a
Building level	GHG neutral building	Single building	t CO_2-equivalent	m^2 single building

TABLE 2. Indicator GHG emissions.

the respective lower level. Here, indicators can serve as a tool to communicate required information effectively, while their controlling function gets emphasised.

The specific role decision levels take in the top-down and bottom-up logic of REM gets reinforced by the system of sustainability indicators. Decisions on a corporate level are key for the identification of goals and requirements of the whole organisation. On the contrary, the capture of building-related information and effective communication through indicators emphasises the meaning of the single building level. In addition to that, the portfolio level takes in an intermediate role. In practice, there can be more decision levels or sub-levels like a distinction between Asset Management as a strategic object level and Property Management as an operational object level. This aspect will not be discussed in more detail here.

The addition of the vertical component to the system leads to manifold information flows through indicators between the decision levels. For a further elaboration, a comparison of quantitative object-oriented indicators in specific reveals additional insights. It becomes clear that there are several similarities between economic, ecological, social and other indicators from different decision levels. To identify these similarities, an analysis of the object of assessment, the reference unit and the system boundaries of a quantitative indicator reveals two main types: Decision-level-overarching indicators are named identically on different decision levels and they follow the same calculation method. They differ due to their object of assessment which leads to diverging reference units and to diverging system boundaries that need to be considered for a transparent specification (see Section 3.3). Decision-level-specific indicators are typical for a decision level since they deal with aspects that can only be specified on one decision level. However, decision-level-specific indicators can – similarly to decision-level-overarching indicators – follow similar economic, ecological or social strategic sustainability goals. The distinction between the different types of indicators is shown in Figure 3.

3.3. Example: the role of reference units and system boundaries

To illustrate the differentiation between the previously explained types of indicators, an example will be given for the indicator "GHG emissions". Due to the internally and externally motivated need to reduce GHG emissions, the indicator is relevant on all decision levels and thus can be classified as a decision-level-overarching indicator. Table 2 illustrates the differences for the calculation of GHG emissions on different levels but also emphasises the interdependencies that should be considered through vertical communication flows. Ideally, actions and decisions aim to support the long-term goal of "GHG neutrality" (sometimes also called climate neutrality or carbon neutrality) which translates into sub-goals for the decision levels. The slight difference between GHG neutrality and

		Construction Maintenance Demolition & Recycling	Operation & use	Direct GHG emissions of business: combustion, fleet	Indirect GHG emissions of business: energy consumption	Transport: Business travel, employee commuting	Production, procurement and disposal of used goods and services	Direct and indirect GHG emissions of leased assets
Assessment per year	Company	(x)	x	x	x	x	x	
	Building Stock	(x)	x					x
	Single building	(x)	x					x
Assessment per lifecycle (stage)	Single building	x	x					x

Table 3. System boundaries for GHG emissions.

"climate neutrality" that is often overlooked can be read in the literature, e.g. [19].

The complexity of information management and assessments of sustainability aspects in REM derives mainly from the heterogeneity of companies and the unique character of buildings. On the one hand this eventually complicates internal processes, on the other hand methods and principles are needed to make companies, building stocks and single buildings comparable to one another. Indicators that express information about sustainability-related aspects can serve as a tool in both cases. For this purpose, transparency about the included processes and objects of the measurement and calculation of an indicator is key. To reach this, the specification of system boundaries which an indicator is bound to on a specific decision level can be used. An example for system boundaries in the calculation of GHG emissions is given in Table 3. The attributes that are used for the definition of system boundaries are retrieved from sustainability reporting conventions [16, 17, 20]. In this sense, the classification of GHG emissions in scopes following the GHG protocol plays a relevant role to companies [20].

Table 3 shows two different perspectives on the measurement and calculation of an indicator: On the one hand, GHG emissions can be assessed yearly which serves in particular the fulfilment of sustainability reporting requirements. On the other hand, a lifecycle perspective for single buildings allows the assessment in a broader sense. The illustrated system boundaries are also relevant if GHG emissions are used for the calculation of the Global Warming Potential (GWP). The example emphasises the complexity of a corporate sustainability information management by illustrating the interdependencies between indicators. However, synergies of measurement and calculation methods can be used for the efficient coordination of tasks while indicators serve as a tool to exchange information between decision levels.

4. Conclusions

The contribution presents an approach that illustrates the possibilities of an allocation of sustainability indicators to the decision levels of REM. Relevant indicators need to be identified and defined so that they serve the goals and requirements of the relative decision level as well as the goals of the whole company. The analysis shows that indicators represent an effective aid to quantify, communicate and manage sustainability for companies, building stocks and buildings. The suggested horizontal and vertical integration of sustainability-related information following the definition of REM allows for a holistic system of indicators.

The presented system focuses on the representation of sustainability-related information through indicators as well as on the relevant information flows. Compared to existing reporting standards, benchmarks or certification systems the approach clearly introduces a distinction between sustainability aspects on different decision levels. Moreover, the approach does not represent a new sustainability assessment method but rather emphasises on the difference between managerial and object-oriented aspects which remains vague in many existing systems. In the first place, the proposed view on sustainability indicators addresses decision-makers in REM and belonging disciplines such as Portfolio Management or Asset Management. Future research in this field should include the examination of integration opportunities for indicators into existing controlling mechanisms and the development of standardised methods for measurements and calculations.

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