Leveraging Sustainability Reporting in Higher Education Institutions—A Multidimensional Research Agenda

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Abstract

Sustainability has become increasingly important to research and practice. In order to determine impacts, identify improvement potential and to disclose efforts towards sustainability, an organization needs appropriate reporting. Thus, sustainability reporting has become a topic of broader interest, for example, to assess own situations, enable benchmarking, communicate own efforts and improve trust. Although sustainability reporting is a complex issue, only limited research and guidelines for higher education institutions (HEI) are available. Accordingly, negative impacts occur such as regarding the standardization and, thus, the comparability of reports. This article describes and demonstrates how different approaches from research related to reporting (information systems research in particular) and sustainability can be transferred to the field of sustainability reporting in HEIs to leverage the applicability of such reports. As a result, classifications of existing indicators and methodical approaches are provided, which are based on the analysis of a campus management system and different reporting standards as well as reporting knowledge in general. These classifications indicate that financial aspects are often focused and environmental issues are neglected. Moreover, the findings emphasize the importance of further multidimensional research on different topics such as (re-)development of specific indicators for HEIs, (re-)design of campus management systems and extension of current reporting standards. Therfore, a research agenda—with 18 agenda items—that synthesizes the presented directions is proposed. This agenda can be used to position further research or to derive new and innovative research questions.

Keywords: Sustainability reporting, Sustainability indicators, Campus management systems, Higher education

1. Introduction

1.1 Situation Faced

The rapid deterioration of the natural environment as well as concerns over wealth disparity and corporate social responsibility present elementary issues for our society (Brundtland, 1987; Dao, Langella, & Carbo, 2011; Seidel, Recker, & vom Brocke, 2013; Schoormann, Behrens, Kolek, & Knackstedt, 2016). In order to contribute to these challenges, 'sustainability' has increasingly gained importance in research and practice (e.g., Abdelkafi & Täuscher, 2016; Melville, 2010; Ralph & Stubbs, 2014; Selvanathan, 2013). In addition, there is an increased cultural and legal pressure, which also leads to more recognition of sustainability in organizations (Seidel et al., 2013). Sustainable development is defined as "the development, which meets the needs of present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, p. 43). Because this definition is quite broad (Malhotra, Melville, & Watson, 2013; Selvanathan, 2013), it is usually divided into three dimensions, namely economic, environmental and social—for example: *Triple Bottom Line* and *Three Pillars* or *Triple Ps* (people, planet and profit) (e.g., Isaksson & Garvare, 2003; Pope, Annandale, & Morrison-Saunders, 2004). Beyond that, additional dimensions are suggested in the literature such as 'culture' (e.g., Nurse, 2006). However, sustainable development should attempt to integrate economic, environmental and social aspects (e.g., Do, Sadovykh, & Sundaram, 2017).

According to Brundtland (1987), sustainable development presumes changes in values and attitudes. Here, higher education institutions (HEI) play an essential role, for example, in spreading sustainability thinking and behavior into society by educating executives or entrepreneurs of the future (e.g., Ceulemans, Molderez, & Van Liedekerke, 2015; del Mar Alonso-Almeida, Marimon, Casani, & Rodriguez-Pomeda, 2015; Sims & Falkenberg, 2013). Furthermore,

like other organizations, HEIs should apply concepts of sustainability to their institution itself, for example, by reducing emissions (Cai, Olsen, & Campbell, 2012). To determine improvement potential and impacts as well as to disclose current efforts that contribute to economic, environmental and social issues, appropriate reporting is required. Hence, sustainability reporting has become a topic of broader interest and has rapidly grown into a relevant field. Numerous benefits such as linking financial and non-financial performance, enabling benchmarking and improving trust can be achieved (Ceulemans et al., 2015; Global Reporting Initiative [GRI], 2017; Shriberg, 2002). According to the common dimensions of sustainability, *sustainability reporting* describes reporting on economic, environmental and social impacts (Gray, 2006; GRI, 2017). Based on adequate reporting, organizations can assess their own situation and communicate efforts that are related to sustainability (Lozano & Peattie, 2011).

1.2 Problem Statement and Specific Aims

Implementing sustainability reporting in organizations is a complex process that requires the involvement of different fields, appropriate guidance and supporting tools (e.g., to enable saving, editing and analyzing data). Various—often heterogeneous—report components exist in research and practice (GRI, 2017; International Organization for Standardization [ISO] 14001, 2017; Organization for Economic Cooperation and Development [OECD], 2017; UN Global Impact, 2015). Nevertheless, only a few of them address HEIs specifically (e.g., Lozano, 2006)—mostly by adapting the general de facto standard GRI. Moreover, existing approaches for HEIs hardly support benchmarking, include comprehensible reporting components or provide calculation-specifications, which has negative effects on the use and (IT-)support as well as the comparability of reports (Shriberg, 2002). Due to insufficient guidelines and limited standards for higher education, many HEIs have developed their own tools for reporting, for example: indicator-lists, scorecards or ratings. Furthermore, the adaption of GRI—as it focuses on enterprises, government and NGOs—to the field of higher education has to be handled carefully because HEIs have specifics like the academic culture and, thus, need a particular set of HEI indicators for sustainability. However, booming popularity of this field and the application of various individual tools pose challenges such as synthesize existing knowledge, ensure comparability of reports, provide a common set of indicators and derive research directions.

In addition to specific approaches related to sustainability, on a methodical perspective, knowledge about how to support, design and conduct reports in general is available. Thus, we argue that the knowledge base related to sustainability and to reporting can be combined (reusability) to enable proper reporting in HEIs. Therefore, we apply knowledge of information systems (IS) research in particular because this also contributes to the administration of large amounts of data. The concept of reusing is already established in various research fields and can contribute to many benefits, for example: efficiency (e.g., reducing costs), effectiveness (e.g., reducing the design duration) and quality intensification (e.g., by providing best practice indicators) (e.g., Becker et al. 2007; vom Brocke and Buddendick 2006). Moreover, reusability may also increase the acceptance and leverage the probability of successful sustainability reporting in HEIs. Consequently, we address the following two research goals*:*

- (1) Determine and consolidate existing approaches for sustainability reporting in HEIs.
- (2) Derive and consolidate directions for further research.

Our contribution is a classification of existing indicators for sustainability in HEIs as well as methodical recommendations, which support the (re-)development of sustainability reporting. From a practical (HEI) view, this supports the selection of relevant indicators in reports and gives directions for extending reporting standards and campus management systems. For research, such classifications are a necessary foundation to develop advanced theories, which, for example, may explain how specific reporting components affect the performance or acceptance of use. To do so, sustainability reporting in general, in HEIs and the role of IS in this context is outlined first. Next, the methodology applied to identify the status quo and perspectives for further research is described. Based on this, an empirical overview of sustainability reporting—particularly by analyzing indicators from an established campus management system—is given. Afterwards, methodical approaches from IS research are analyzed and compared to existing reporting in order to derive potential for the future. Finally, our main findings, limitations and implications for research and practice are presented.

2. Sustainability Reporting and Its Application in Higher Education

2.1 Sustainability Reporting

Besides the approaches mentioned in the introduction, one of the most frequently applied ones is provided by GRI, which has become a global de facto standard of sustainability reporting (e.g., del Mar Alonso-Almeida et al., 2015). We follow their definition of reporting as "the practice of measuring, disclosing and being accountable to internal and external stakeholders for organizational performance towards the goal of sustainability" (GRI, 2017). The GRI

general standard disclosures are divided into six fields (strategy and analysis, organizational profile, identified material aspects and boundaries, stakeholder engagement, report profile, governance and ethics, and integrity), which consist of 58 indicators. The GRI-specific disclosures consider economic (e.g., flow of capitals), environmental (e.g., materials, energy and emissions) and social (e.g., human rights and product responsibility) dimensions. Overall, they have 84 indicators (GRI, 2017). However, these standards often do not address HEIs in particular (Ceulemans et al., 2015). Moreover, report components vary considerably, which has negative effects on the comparability.

2.2 Sustainability Reporting in Higher Education

Although sustainability reporting has the potential to assess and improve activities towards sustainability, only a limited amount of research focus on reporting among HEIs. Sustainability in HEIs first arose in 1990. In the following years, more declarations, charters and partnerships followed. Nevertheless, most of them have a deficit in assessment and reporting. Only the 'Global Higher Education for Sustainability Partnership' and the 'Declaration of Barcelona' address this field (Lozano, 2011). Sustainability in HEIs can have different roles, for example, (1) applying sustainability to the institution itself (e.g., saving water and electricity) or (2) educating other participants to act in a more sustainable way (Cai et al., 2012).

Most of the existing tools do not support HEI-specific sustainability reporting. Nonetheless, some tools are discussed in research and practice (Eco-Management and Audit Scheme [EMAS], 2017; Fonseca, Macdonald, Dandy, & Valenti, 2011; Lozano, 2006; Lozano & Peattie, 2011; Mendoza & Terpou, 2014; Shriberg, 2002; The Sustainability Tracking, Assessment & Rating System [STARS], 2017; United Nations Environment Programme [UNEP], 2017). However, GRI is one of the commonly applied approaches in HEIs although it does not focus on HEIs (del Mar Alonso-Almeida et al., 2015). Further tools adapts GRI and provides a set of indicators for HEIs. For example, GASU includes three educational categories: curriculum, research (e.g., grants) and service (e.g., community activity) (Ceulemans et al., 2015; Lozano, Lukman, Lozano, Huisingh, & Lambrechts, 2013).

Another approach is given by IRIS that is a catalog of generally accepted indicators, which are used to "measure social, environmental and financial performance" (IRIS, 2017). IRIS 4.0 consists of 558 indicators and is divided into sections, subsections and sectors. Besides typical sectors (e.g., energy and health), also education is addressed by 37 indicators such as school enrollment and dropout rates. Moreover, there is also an approach that aims to link GRI and IRIS (GRI, 2015). Nevertheless, existing approaches for measuring sustainability in HEIs have different weaknesses such as no mechanism for benchmarking, difficult to apply, comprehend, measure and aggregate as well as neglect decision making processes (Shriberg, 2002). Thus, adequate tools that support these needs are required.

2.3 Sustainability Reporting with Information Systems

As the task of sustainability reporting is complex and includes an large amount of data, IS may contribute (Hilpert, Kranz, & Schumann, 2014; Seidel et al., 2013). Moreover, the support of reusability is also supported by IS (Boudreau, Chen, & Huber, 2008). Here, an IS "is understood as a goal-oriented, socio-technical system serving the processing or the exchange of information" (vom Brocke, Sonnenberg, & Simons, 2009, p. 3). Applying IS is part of the highest stage of integrating sustainability into a HEI (Disterheft, Ferreira da Silva Caeiro, Ramos, & de Miranda Azeiteiro, 2012). In addition to general IS such as SAP ERP that supports reporting, some HEI-specific IS are available. According to a survey of more than 100 German HEIs (conducted by Ernst & Young), basically four IS were determined: 88% HISinOne, 74% SAP Student Lifecycle Management, 72% Campus Online and 70% CAS Campus (Carolla, 2015). Typically, the scope of these IS covers the entire student life cycle including administration, course planning, resource management and reporting (Alt & Auth, 2010)—mostly with modules such as 'business intelligence'. Business intelligence aims "to disseminate information to the various sections of any industrial, scientific or government organization" (Luhn, 1958, p. 314). It supports decision making on all levels of a HEI. If such IS are implemented, a HEI-wide standardized use of reporting is possible (Sprenger, Klages, & Breitner, 2010). Due to the complex structures of campus management, many HEIs need guidelines as to how processes can be carried out. Therefore, HISinOne—one of the most established campus management system (Carolla, 2015)—integrates a process reference model that provides (best practice) orientation of processes for HEIs. It is currently used by about 50 German HEIs (HIS eG, 2017). Thus, we include HISinOne in our study.

3. Method

Our research purpose can be structured by using a framework that is spanned by three dimensions (Figure 1). In this section, the foundations of these dimensions are outlined. Based on our framework, the status quo and an multidimensional agenda for sustainability reporting is derived that presents new opportunities for both research and practice, for example, an overview of relevant indicators, guidance of how to conduct reporting and

(re-)development of campus management systems to support sustainability reporting in HEIs.

Reusability analysis. First, because different approaches for sustainability reporting already exist in prior research and practice, this dimension aims to support reusability of these existing reporting components. Therefore, reporting components from a content perspective, which is based on applied indicators for sustainability and from a method perspective, which is based on theoretical approaches from reference modeling in particular, are analyzed and compared. Reference modeling is an established field in IS research that aims to support reusability of existing components (Wilde & Hess, 2007).

Artifact analysis. Second, reporting standards and a campus IS are selected as the artifacts to be analyzed (see Section 2). For campus IS, HISinOne is selected because it offers predefined samples of reports and indicators for HEIs as well as is an established campus management system in Germany.

Time analysis. Third, to derive a research agenda for sustainability reporting, two chronological aspects are distinguished in this study: (1) the status quo of contents and methods for sustainability reporting in HEIs to identify the current state, gaps and deficits as well as potential for further steps. Based on the results of the status quo, (2) a research agenda is derived, which provides multidimensional aspects for future developments (Section 4 and 5).

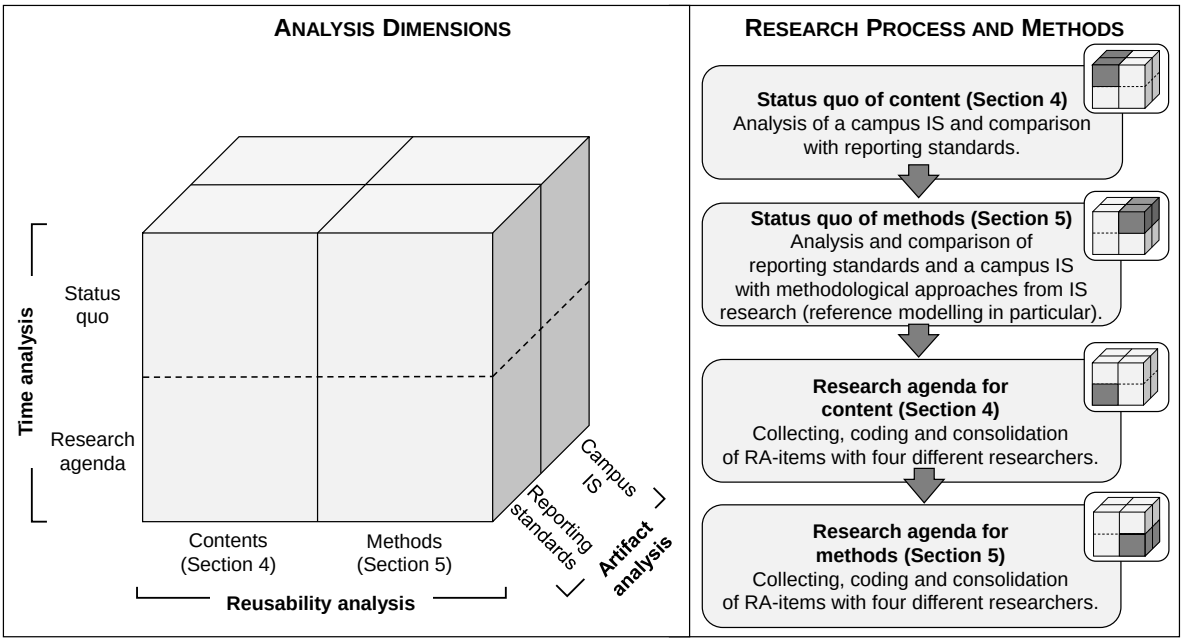


Figure 1. Analysis dimensions, research process and applied research methods

For analyzing these three dimensions, we carried out a research process, which consists of four different phases. The first two phases are related to the identification of the current state of sustainability reporting. Based on the results, the last two phases deal with deduction of possible research agenda aspects for this field.

Status quo of contents. In a first step, indicators from campus IS—HISinOne—are identified. These indicators are compared to existing reporting standards to verify, which indicators deal with sustainability. For the identification of relevant indicators, a qualitative content analysis is conducted (Mayring, 2014). Because of our specific research purpose, the business intelligence module of HISinOne is selected as a content-analytical unit—it provides indicators for reporting. For analyzing this, experts from the provider HIS eG participated in our study.

Status quo of methods. Next, applied methods in sustainability reporting are focused. Based on six rigorous, methodical approaches from IS research—theoretical-based approaches from reference modeling (Wilde & Hess, 2007) in particular—, a qualitative analysis (Mayring, 2014) is carried out to determine the degree of implementation of these approaches in the reporting standards and HISinOne. We argue that these methods are required to enable the support of IS, which may contribute to the acceptance and use of sustainability reporting in HEIs.

Research agenda for content. Afterwards, the results are independently explored with four different researchers. Therefore, the results of the status quo are coded and labeled by each researcher (Strauss & Corbin, 1994) to derive research agenda (RA)-items. In doing so, three different perspectives are taken during the coding process: (1) IS

research such as campus IS, (2) reporting research and (3) sustainability research. Afterwards, the RA-items collected are categorized and consolidated in a follow-up workshop with the same researchers. To provide tractability of our results, each RA-item is given a distinct identification that consists of 'RA' and a consecutive number.

Research agenda for methods. Finally, similar to the research agenda for content, the results for the methods perspective are independently explored, coded and consolidated to derive additional RA-items.

4. Contents for Sustainability Reporting

Regarding the content, the campus IS HISinOne is analyzed and compared to current reporting standards. For analyzing *HISinOne*, the business intelligence modules are considered in particular because these modules are strongly related to reporting. In total, HISinOne provides 70 indicators (Table 1), which are distinguished into the following ten categories:

- Graduates (e.g., number of graduates)
- Application (e.g., number of applications)
- Evaluation (e.g., regional jobs in %)
- Research (e.g., number of publications)
- Equalization (e.g., female graduates in %)
- Internationalization (e.g., number of semester abroad)
- Cost accounting (e.g., revenues)
- Staff (e.g., number of employees)
- Students (e.g., number of beginners)
- Economics (e.g., third-party funds)

As reporting standards, GRI and IRIS Educational as well as Ceulemans et al. (2015) who provide an overview of existing indicators for higher education (including, for example, the work of Lozano (2006) that focused on HEI-specifics) are selected (see Section 2). As GRI does not include an educational context, employees are seen as academics. For example, financial indicators such as revenue-streams are considered as fees or promotions of a HEI.

As a result, 37 of 70 (~52%) indicators from HISinOne match with indicators from the sustainability reporting standards selected. The indicators identified can be linked with 13 indicators from IRIS Education (~35%). Based on the indicators derived, seven categories are built manually. Furthermore, each indicator is assigned to a dimension of sustainability. Therefore, in a first step, four different researchers carried out the assignment independently. Afterwards, the results are matched and disagreements are discussed in a follow-up workshop to determine a consensus. In Table 1, it is highlighted that 72% are related to economic aspects, 67% to social aspects and only 5% to environmental aspects.

Table 1. Comparison of HISinOne indicators to sustainability reporting standards

Category / HISinOne indicator		Artifact			Sustainability		
		GRI	IRIS Education	Ceulemans	Economic	Social	Environmental
Application	No. of enrollment-places	-	PI2389	-	○	●	-
	No. of applications	-	PI2389	-	○	●	-
	Admission quota	-	PI2389	-	○	●	-
Dropouts	Dropout quota	-	PI9910	-	○	●	-
	No. of dropouts per semester	-	PI9910	-	○	●	-
	No. of changes per semester	-	PI4924	-	○	●	-
Employees	Female assistant lecturer quota (equality)	LA1	OI5896	-	-	●	-
	Female professors quota (equality)	LA1	OI5896	-	-	●	-
	No. of stays abroad of professors	LA1	OI5896	-	-	●	-
	No. of foreign professors (equality)	LA1	OI5896	-	-	●	-
	No. of foreign research assistants (equality)	LA1	OI5896	-	-	●	-
	No. of employees with a temporary contract	LA1	-	-	●	○	-
	No. of employees with a permanent contract	LA1	-	-	●	-	-
	No. of assistant lecturers	-	OI5896	●	●	-	-
	No. of employees in total	LA1	OI5896	●	●	○	-
	No. of professors in total	LA1	-	●	●	○	-
Finances	Revenues	EC1	PI2718	●	●	-	-
	Third-party funds	EC1	-	-	●	-	-
	Costs	EC1	-	●	●	-	-
	Costs per student in €	EC1	PI2389	-	●	-	-
	Costs of teachings per year in €	EC1	-	-	●	-	-
	Costs of investments in material assets	EC1	-	-	●	-	-
Research	No. of professors in a sabbatical term	LA3	-		-	●	-
	No. of completed PhDs	-	PI1902	●	●	●	-
	No. of publications	-	PI7871	●	●	-	-
	Research activities in hours	-	PI7871	●	●	○	-
Students	Female student quota (equality)	-	PI1081	-	-	●	-
	No. of students in total	-	PI2389	●	●	○	-
	Female alumni quota (equality)	-	PI1081	-	-	●	-
	Success rate to 6th semester (No.)	-	PI8372	-	●	-	-
	No. of students with transactions to master	-	PI4924	-	●	●	-
	No. of foreign students (equality)	-	PI7774	-	●	●	-
	No. of successful passed exams	-	PI8372	-	●	○	-
Other	Professor-students quota	-	PI5110	-	○	●	-
	No. of course of studies	-	PD9759	●	○	●	-
	Resource consumption (materials)	G4	-	-	○	-	●
	Degree of capacity use of lecture rooms	-	PI5501	-	●	-	○

Description: ● = completely met; ○ = partially met; - = not met

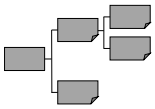
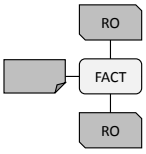
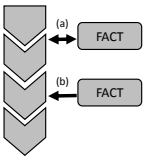
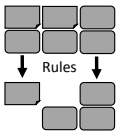
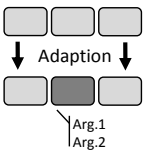
Overall, the status quo of applied indicators confirms that economic and social (e.g., related to students and employees) areas are more focused in current reporting than environmental aspects. Hence, the first item derived for the research agenda deals with the enhancement of indicators towards environmental sustainability for HEIs (*RA1*). Therefore, second, general indicators—without HEI-specifics—can be investigated regarding their applicability in HEIs (*RA2*). For example, GRI provides various environmental aspects such as "percentage of recycled input", "percentage of non-renewable materials" and "consumption of electricity" (see indicators G4-EN1 to G4-EN34). However, because universities have many differences (e.g., academic culture) compared to organizations such as enterprises, the adaptability (e.g., of sustainability indicators) has to be evaluated in further research regarding reporting. Third, some indicators are supported in particular by the reporting standards—thus, these can be adopted from campus IS such as HISinOne to enhance their modules (*RA3*). Only 35% of the indicators provided by IRIS Education matched with HISinOne. Further indicators may also relevant for campus IS, for example: "community engagement", "hours offered per week", "student transportation" or "percentage of students who were placed in full-jobs" (IRIS, 2017). Fourth, in contrast, some indicators, which are provided by HISinOne are not included in the reporting standards selected—thus, their applicability in standards can be investigated as well (*RA4*). For example, "number of foreign students", "number of female freshman quota" and "number of employees with third-party funds" might be important for sustainability. Moreover, some indicators need to be combined to get a HISinOne indicator, for example: "costs per student = costs/total enrollment". This should also be researched to enhance current reporting standards.

5. Methods for Sustainability Reporting

5.1 Overview

Regarding the methodical perspective, six established approaches from IS research in particular are selected. These are compared to the artifacts analyzed. In Table 2, the results of the methodical analysis are summarized. In the following subsections, the results are described in detail and examples related to HEIs are given. Based on the methodical analysis, research directions can be derived, which contribute, for example, to the enabling of IS in sustainability reporting.

Table 2. Overview of the methodical analysis of sustainability reporting

Approach	**References**	**Method Analysis**			
		GRI	IRIS	Ceul.	HISinOne
(I) Indicator description  Title and systematic description of indicators	Shavelson (1991, p. 5)	●	●	○	●
(II) Indicator system  Indicator systems to specify (a) mathematic relations and (b) factual relations between indicators	Preissler, (1995); Reichmann, (2001); Holten and Knackstedt (1999); (Shavelson, 1991, p. 3): "*how the individual components work together"; "calculable", comparable"*	○	●	○	○
(III) Reference object system  Specify, which reference objects (RO) and dimensions of RO-hierarchies can be related to an indicator (e.g., emissions by time and region)	Riebel (1994); Holten, (1999); Holten & Knackstedt (1999, p. 7): „*relation between reference-objects and indicator is called fact*"	○	●	-	●
(IV) Business process integration  Specify processes to (a) determine measurement points, sources, actors and IT-systems as well as (b) define processes, which can be affected by the data	Scheer & Brabänder (2010); Becker and Schütte (2004); von Ahsen (2006); Rosemann & De Bruin (2005, p. 4): „*how process performance can be improved rather than just reporting on outcome* "	-	-	-	●
(V) Configuration  Specify configuration rules and parameters to create sustainability-relevant report variants for HEIs	vom Brocke (2007); Becker, Delfmann, & Knackstedt (2004, p. 28): *„generating a specific model out of a reference model via configuration-rules"*	-	○	-	○
(VI) Argumentation-based adaption  Integrate arguments which led to a certain element (indicator) to support the creation and interpretation of a report	Ouerdane, Maudet, & Tsoukiàs (2010); Knackstedt, Heddier, & Becker (2014); Jin & Geslin (2010, p. 36): *"influencing each other's understanding of the problem, knowledge, perspective"*	○	-	-	●

Disciption: ● = completely met; ○ = partially met; - = not met

Overall, the method analysis indicates that calculations for a single indicator as well as relations between indicators (II), specifications of reference objects (III), integration of business processes (IV) and configurative reports (V) are not supported well. Nevertheless, HISinOne provides most of the methodical approaches, except configuration. Hence, further research should deal with the transfer of these approaches to standards for sustainability reporting (*RA5*) as well as to campus IS (*RA6*), for example, to contribute to the applicability of reporting in HEIs.

5.2 Indicator Description (I)

Most of the artifacts analyzed have a title and a systematic description. GRI has acronyms such as "G4-EC1", which relate to a category. IRIS and HISinOne also provide names for their indicators. GRI includes a short description with—in part—measuring units (e.g., G4-EN3 in joules or watt-hours). IRIS characterizes each indicator and HISinOne provides some details that are relevant for measuring sustainability. Overall, the concepts are fulfilled.

5.3 Indicator System (II)

Indicators can be distinguished in absolute and relative numbers (Staehle, 1969). Due to the fact that single indicators mostly do not provide useful information, an explicit description of the relations is required (e.g., Shavelson, 1991). A systematic approach for linking indicators and specifying the relation is given by indicator systems. Such a system aims to measure, control and regulate operative and strategic processes (Martin & Sauvergot, 2011). Commonly two types of indicator systems are distinguished: mathematical systems (a), which define calculation options regarding a single indicator and between indicators (e.g., DuPont-System; Almazari, 2012) and factual systems (b), which classify indicators into certain categories related to their topics (e.g., Holten & Knackstedt, 1999; Reichmann, 2001).

GRI specifies a structure of indicators, which is divided into three categories (economic, environmental and social). Each category has aspects (subtopics) that include concrete indicators. For example, economic has four aspects (performance, market presence, indirect economic impacts and procurement practices), which include indicators G4-EC1 to G4-EC9. GRI mostly has factual classifications. HISinOne has also ten factual categories (see Section 4)—some recommendations regarding how to calculate are integrated but a mathematical system is not described. (Ceulemans et al., 2015) draw up categories of HEI core activities but do not specify any relations in detail. IRIS structures their indicators in ten sectors such as education and environment. Some of these indicators (11/37) contained a calculation with mathematical formula, for example: "Teacher Attendance Rate" can be calculated by "*1- [(No. of days teachers were absent) / (No. of working days * teachers employed))]*".

Overall, we argue that it is necessary to specify mathematical structures to provide guidance on how a report can be calculated. Current reports structure indicators by providing classifications that are often very heterogeneous, which has negative impacts (e.g., on the comparison and benchmarking). We argue that both mathematical systems (*RA7*) and factual systems (*RA8*) are important because these will contribute to enable IS which, for example, allows navigating through such systems. Also in IS only a few tools that support both types are available. There is more research related to reference object systems (see Section 5.4). Therefore, also IS need to develop further approaches and tools (*RA9*).

5.4 Reference Object System (III)

Indicators need referenced objects (e.g., Shavelson, 1991) to derive information that is useable in certain contexts and decisions. According to common reporting systems (e.g., Online Analytical Processing) a factum is the information that arises from the combination of indicator and reference objects (Holten, 1999; Riebel, 1994). For example, the indicator 'emission' becomes useful if it is combined with further objects such as specific HEI-locations, courses or consumption types (e.g., electricity or water). The hierarchical relations within these objects are called 'dimensions'. For example, the object 'HEI-location' should be specified with possible hierarchy level such as building, floor and room to define, which levels can be used in a report. Usually, indicators are combined with different objects—thus, it becomes complex and should be supported (Holten & Knackstedt, 1999; Preissler, 1995).

GRI partially address suitable dimensions, for example, G4-EC1 is applicable for reports at "country, regional or market level" (GRI, 2017). However, reference object systems are not described in detail. (Ceulemans et al., 2015) include limited information about objects and HISinOne mostly specifies only one dimension, for example, "costs per student". A total list of combinations is not available. IRIS specifies a reference to a section (e.g., product impact), a quantity type (stock or flow), metric level (product, service and organization) and reporting format (e.g., date or text). Further information is not considered.

Overall, in order to transform existing indicators (systems) into campus management systems, explicit information about referenced objects and hierarchy-level is required. We suggest that current reporting standards should adapt methodical approaches of reference object systems (*RA5*). An adequate modeling of sustainability indicators and guidance on how indicators are related to other objects need to be provided (*RA10*).

5.5 Business Process Integration (IV)

Process engineering is an established research field in IS that provides practice-oriented contributions. In essence, a process describes a sequence of activities (Becker & Schütte, 2004). Common modeling techniques for visualizing

processes are, for example, Unified Modeling Language (UML) (OMG, 2015), Business Process Model and Notation (BPMN) (OMG, 2011) and Petri Nets (Petri, 1962). Some approaches already consider sustainability assessment (e.g., Houy, Reiter, Fettke, & Loos, 2010; von Ahsen, 2006). The integration of sustainability reporting into operational processes requires a plan of concrete actions (e.g., del Mar Alonso-Almeida et al., 2015; Shriberg, 2002). In addition, some approaches for combining indicators and processes are discussed (Knackstedt, Stein, & Becker, 2009).

HISinOne provides a process reference model that describes typical—mostly best practice—business processes for the domain of HEIs (Bührig, Schoormann, & Knackstedt, 2018). In doing so, this model supports different aspects, for example: the assignment of measurement sources (e.g., components of campus processes), responsible actors, IS/IT-systems and the target of data to indicate, which processes can be affected. In contrast, GRI does not provide any business processes and IRIS only give some limited hints on what should be considered during the measurement.

Overall, guidance on how to integrate measurements into operative processes is only given by HISinOne. Hence, we recommend adapting existing methods to the current reporting standards (*RA5*). First, business processes for specifying data sources and measurements (*RA11*) can be developed. Process modeling supports this by representing sources of indicators, activities for measuring, responsible actors and IT. Moreover, campus IS supports to determine sources and save data consistently (e.g., by using databases). Second, processes can be developed to specify where data collected can be applied (*RA12*). This might help to define relations between the measured data and an actual objective, for example, which decisions can be supported by the data collected? Finally, we argue that results of reporting may enable the reengineering current business processes towards more sustainable practices.

5.6 Configuration (V)

Configuration aims to reuse and join existing components for the creation of context-specific variants (Becker et al., 2007; Fettke & Loos, 2003). In order to configure a report, rules need to be defined on which mechanisms are able to transform general reports into specific ones (vom Brocke, 2007). Typically, a designer has to find, collect and adapt these components. Therefore, catalogues available enable systematic access to existing components (Fettke, 2006). Numerous benefits such as efficiency and effectiveness can be achieved (Becker et al., 2007).

GRI and IRIS provide configuration parameters partially. The categories in IRIS are related to different fields such as education, energy or health, which provide (limited) information about domain-specific settings. GRI provides pre-defined templates for different dimensions such as economic and environment, which partly supports aggregation of data. However, these examples enable only limited potential of what is possible by configuration approaches. HISinOne does not provide any preconfigured report variants. However, from project manager experiences differences between universities of applied science, art and music academies and pedagogical universities can be derived, which are important for the development of specific reports (*RA13*). For example, regarding the application process, pedagogical HEIs are consistent with HISinOne, HEIs of applied science include further selection criteria, and art/music HEIs have a completely different process with new activities. Consequently, university-type-specific configurations can be determined.

Overall, we assume that other companies may have report components that can be adapted and reused in reporting standards (*RA5*) and campus IS (*RA6*). Thus, we recommend to extend or create catalogues of existing report components for HEIs (RA14), specify, which components are reusable (*RA15*) and develop interfaces, which allow the integration of different components (*RA16*). Inversely, HEIs may have components and reference processes, which can be adapted by companies (*RA17*)—hence, modules should be accessible for all stakeholders.

5.7 Argumentation-based Adaption (VI)

Stakeholders of reports such as managers or process executors should know the rationale behind a certain report component or decision. Therefore, the chain of reasoning should be traceable and explicated. Argumentation-based approaches aim to integrate these reasons into reports (Jin & Geslin, 2010; Karacapilidis & Papadias, 2001). Only HISinOne supports the tractability of causes by integrating essential reasons that led to a specific component.

Overall, limited systematic integration of reasons is available. Thus, we argue that argumentation-based adaption should be considered in reporting standards (*RA5*) to contribute the comprehensibility (*RA18*). This may help to understand why components are specified and applied in a certain way.

6. Discussion, Implications and Conclusion

6.1 Discussion

We argue for enhancing sustainability reporting in HEIs by applying existing knowledge about relevant indicators and reporting in general. Based on the analysis of current reporting standards and campus IS, we provide a consolidated list of research agenda items (*RA1-RA18*), which highlights opportunities for further research to leverage reporting in HEIs, gives guidance in this field and may serve as a source for further inspiration, development and idea generation (Table 3).

Table 3. Overview of consolidated research agenda items

RA	Description	Appearance in section
RA1	Developing new indicators for sustainability in HEIs	Section 4
RA2	Adapting general indicators to HEIs	Section 4
RA3	Adapting current reporting standards to campus IS	Section 4
RA4	Adapting indicators from campus IS to reporting standards	Section 4
RA5	Adapting methodical approaches to reporting standards	Section 5.1
RA6	Adapting methodical approaches to campus IS	Section 5.1
RA7	Developing mathematical indicator systems	Section 5.3
RA8	Developing factual indicator systems (topic-oriented)	Section 5.3
RA9	Extending indicator systems research in IS	Section 5.3
RA10	Specifying indicators and their referenced objects	Section 5.4
RA11	Specifying how to collect and measure relevant data	Section 5.5
RA12	Specifying which processes might be affected	Section 5.5
RA13	Deriving specifics of HEI types (e.g., university vs. applied science)	Section 5.6
RA14	Creating catalogues of reusable report components for HEIs	Section 5.6
RA15	Specifying reusable components of reports for HEIs	Section 5.6
RA16	Specifying interfaces to put report components for HEIs together	Section 5.6
RA17	Providing HEI-components to enable adaption by further intuitions	Section 5.6
RA18	Providing rationales behind a certain report or decision for HEIs	Section 5.7

In addition to the previous stated contributions (see Section 4 and Section 5), a main finding of our study is that campus IS already supports most of the methodical approaches, which can be adapted by reporting standards. In contrast, sustainability-specific information is provided by reporting standards, which can be adapted by campus IS. Furthermore, our research agenda is useful for the development of (new) IS architectures and methods—therefore, it provides a basis for future studies. Moreover, it is expected that besides the obvious benefits for reporting, IS will also benefit when reflecting the findings on its methods.

Although we derived helpful insights for sustainability reporting, our study is not free of *limitations*. Our investigation of relevant indicators is limited to the sources selected (reporting standards and HISinOne)—thus, further research can expand the sample to other campus IS providers. Furthermore, a different research design can be applied to determine the status quo of reporting, for example, an argumentative-deductive analysis (Wilde & Hess, 2007) or a Delphi study. The research agenda is based on methodical approaches, which support reporting as well as reusability of existing components and are in our estimation suitable for this field. However, other methodical approaches can be analyzed such as meta modeling or multiperspective modeling (e.g., Knackstedt et al., 2014).

6.2 Implications

Our contribution is an overview of relevant indicators for sustainability, which support the consideration and selection of indicators during the design of (new) reports as well as directions for further development of reporting standards and campus IS. *From a practice perspective*, IS can benefit from the content related to sustainability, which is provided by well-researched reporting standards. Second, most of the HEI-specific indicators focus on economic and social aspects—thus, these have to be extended in order to address environmental aspects, too. Third, we assume that sustainability reporting can be more applicable and leveraged by using IS or IT-tools, which provide

guidelines and templates as well as support the managing of large amounts of data. Moreover, with the use of IS, typical adjustments and requirements during the application of a certain report can be saved and used to improve current reporting standards. Hence, we argue for integrating and combining the potentials form each field to contribute to sustainability reporting. *From a research perspective*, classifications can be used, for example, as a foundation for advanced theories—for example, attempt to explain how specific methods and campus IS affect the performance of sustainability reporting in HEIs (Gregor, 2006).

6.3 Conclusion

Overall, the proposed research agenda in particular can be used by academics and practitioners, for example, to derive new research questions (e.g., how to contribute to the standardization of indicators?), build theories to explain different phenomena (e.g., which reporting components affect the performance?), explore new fields of application and position their own research. As the status quo indicates, the artifacts analyzed have different strengths and may benefit from each other. Nevertheless, it is important to evaluate the approaches and aspects determined to investigate, which ones are suitable in different contexts of HEIs (e.g., Gemino & Wand, 2004). In addition, Ceulemans et al., (2015) encourages the applicability and usability by claiming that depth studies on the validity of tools and indicators are required. Initially, we suggest to evaluate the applicability of the methods selected the combinability of these methods, the complexity of approaches (which degree of complexity is manageable in reports?) and practicability of indicators. Furthermore, the dissemination of sustainability indicators can be evaluated to identify, which ones are common (e.g., towards a standard).

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