



# Sustainability assessment tools for higher education: An empirical comparative analysis

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## ABSTRACT

Sustainability assessment tools are currently influencing sustainability strategies and activities in higher educational institutions. Thus, in this paper a short overview of sustainability in universities will be provided, which will then be followed by a study of different existing approaches to assess this issue. The paper will also include previous analyses that theoretically compare these tools. A practical case study in which different tools are applied is the main goal of this article. A sustainability diagnosis and a proposal to analyze the results in order to create an action plan, based on cost-efficient measures, will be developed considering different tool's approaches. Advantages and differences between tools are highlighted according to the results. Finally, this article will conclude that an absolute improvement between 20% and 40% in the overall sustainability score can be reached in the medium term.

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## 1. Introduction

Higher Education Institutions (HEIs) have a critical role regarding sustainability and its development, but it remains controversial over what issues these institutions should address in order to be deemed a sustainable university (Lambrechts, 2015). Sustainability is not a single element, but a complex new paradigm affecting all areas and activities (Lee et al., 2013). HEIs should lead by example, integrating these principles within education, research, campus operations and community outreach (Lozano et al., 2013). Therefore, it can be said that sustainability in HEIs encompasses the classic three dimensions of any organization (social, environmental and economic), also including its main activity: curricular or academic sustainability (Amaral et al., 2015).

Lozano et al. (2015) made a survey of 70 HEIs worldwide regarding sustainability in universities. They conclude that efforts and measures towards sustainability were not fully integrated in HEIs' strategies. It would be necessary for sustainability assessment and reports to be integrated in decision-making by top tiers of management, in order to create strategies that consider sustainability as an essential

component. A strong link between commitment and real sustainability implementation was found.

In this sense, it is essential to consider all stakeholders for integrating, assessing and reporting sustainability (Quist and Tukker, 2013). Participatory processes are valuable for a paradigm shift by contributing towards the discussion of how to integrate sustainability into the university (Disterheft et al., 2016).

In order to enable the path towards sustainability, Sustainability Assessment Tools (SATs) have become a crucial element (Lambrechts, 2015). SATs play an essential role in HEIs and thus, they allow the creation of strategies and planning towards a sustainable university. These approaches are facilitators of change, but researchers have not paid much attention to what these tools conclude about what is or should be a sustainable university. Henceforth, they are becoming an informal standard to follow (Fischer et al., 2015). Indeed, Lozano et al. (2015) stated that sustainability assessment and reporting in HEIs is lagging behind.

Sustainability reporting in Higher Education is a voluntary activity derived from a sustainability assessment. The Global Reporting Initiative (GRI) defined it as: "the practice of measuring, disclosing, and being accountable to internal and external stakeholders for organizational performance towards the goal of sustainable development" (GRI, 2011: 3). A recent study (Ceulemans et al., 2015) showed that in 2014 only 35 universities from around the world published their sustainability reports, compared with the total number of HEIs, estimated at over 20,000 worldwide. Hence, its applicability is still slow and a literature review is needed in order to study sustainability assessments and existing SATs, beyond reports which are currently available.

**List of abbreviations:** ESD, Education for Sustainable Development; HEIs, Higher Education Institutions; SATs, Sustainability Assessment Tools; GRI, Global Reporting Initiative; UEM, Universidad Europea de Madrid

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Education, research, operations and community engagement are the four key areas for almost every SAT (Stephens et al., 2008). A diverse number of SATs and approaches have emerged in the past decade (Caeiro et al. eds., 2013). They have different purposes: for monitoring, to draw comparisons, and to establish internal strategies towards sustainability (Jenssen, 2012). Since these approaches are actually influencing activities in HEIs (Yarime and Tanaka, 2012), to know what these tools are assessing, turns out to be a critical issue for ESD. Shriberg (2002) analysed 11 sustainability assessment tools, Cole (2003) reviewed 13 tools, Yarime and Tanaka (2012) developed the third comprehensive comparative analysis of 16 approaches, and the most recent study (Fischer et al., 2015) provided the last existing study of 12 sustainability assessment tools. In these studies, different tools are compared theoretically by analysing indicators and criteria. Following on from this, a qualitative assessment is conducted of what is understood as a sustainable university based on each tool and manual. Table 1 summarizes previous studies referenced, their scope and main findings.

Caeiro et al. (eds., 2013) have analysed the technicality of current sustainability practices with a specialized focus on assessment and reporting tools developed for HEIs. Certain tools are analysed, such as AISHE (Auditing Instrument for Sustainability in Higher Education; Lambrechts and Ceulemans, 2013), GASU (Graphical Assessment of Sustainability in Universities tool; Lozano et al., 2013), USAT (Unit-based Sustainability Assessment Tool; Togo and Lotz-Sisitka, 2013) and STAUNCH (Sustainability Tool for Auditing Universities Curricula in Higher Education; Lozano and Watson, 2013).

Some SATs are focused on curricula and educational areas. STAUNCH created by BRASS Research Center at Cardiff University (Lozano, 2011), and AUA (Alternative Universal Appraisal, Prospernet, 2010) are a good example of these. Other tools use campus-based approaches. Indeed, this is the case with some programs, such as the Campus Sustainability Assessment Framework (CSAF) developed by Sierra Youth Coalition (Cole, 2003), which is more oriented to operations on the campus.

The tool with the most specific quantitative indicators, which is mainly used in the USA, is STARS, with real multiple case studies and a worthy practical application (eg. Richardson and Kachler, 2016). STARS provides a framework that recognises relative progress towards sustainability as an integral quantitative and qualitative tool, used in diagnosis but also to rate effort and progress (Martins and Borges, 2015). However, most common SATs are qualitative indicator-based. In this sense USAT tries to establish the status of ESD by facilitating a quick assessment of the integration level of sustainability issues in university functions and operations (Caeiro et al., 2013). The AISHE tool is also qualitative and it has proven to be a reliable tool, giving a qualitative approach for a sustainable assessment and reporting. Lambrechts and Ceulemans (2013) made a deep SWOT analysis of this tool. AISHE is one of the most complete and complex tools to address sustainability focused on education, but with less interest in environmental management or research (Martins and Borges, 2015), and the new version AISHE 2.0 tackles this deficit (Roorda et al., 2009). SAQ tool (Sustainability Assessment Questionnaire) was developed by University Leaders for a Sustainable Future (ULFS, 2009). It is a qualitative tool designed for the evaluation of the various objectives of universities: to raise awareness about the sustainable development, to encourage debate on what sustainability in HEIs means, to give a picture of the state of sustainability in the institution, and to discuss about next steps towards sustainability. SustainTool (Program Sustainability Assessment Tool) was developed by Washington University (2013) and focused on program. Yet it has a vague concept of these program, since it integrates indicators and criteria of the whole institution in different contexts, taking into account the concept of program, generically considering different areas.

Following the experience in the industrial sector, GRI is the most common sustainability reporting tool for companies, allowing comparison and benchmarking. Therefore Lozano et al. (2012) proposed the GASU tool (Graphical Assessment of Sustainability in Universities) by adapting the GRI framework to universities, finally ap-

**Table 1**  
Previous analysis of Sustainability Assessment Tools.

	Fischer et al., 2015	Yarime and Tanaka, 2012	Cole, 2003	Shriberg, 2002
Number of tools analysed	12	16	8	11
Methodological approach	Mixed-method of both qualitative and quantitative measures: indicators and criteria; and descriptive passages analysis.	Mixed-method of both qualitative and quantitative measures: indicators and criteria; and analysis of the content of individual indicators	Analysis and review of 8 tools and its literature related. Qualitative assessment.	Analysis and review of 11 tools and its literature related. Based on purpose, scope, function and state of development, with a strength and weakness assessment.
Tools assessed	AISHE, AUA, CITE AMB, CRUE, CSAF, DUK, GM, GMID, GP, P&P, SAQ, STARS	Campus Ecology, Environmental Workbook and Report, SAQ, Environmental Management System Self-Assessment Checklist, Penn State Indicator Report, AISHE, National Wildlife Federation's State of the Campus Environment, Campus Sustainability Selected Indicators Snapshot, CSARP, CSAF, HEPS, Good Company's Sustainable Pathways Toolkit, GRI modified for Universities, STARS, CSAF Core, College Sustainability Report Card.	CSARP, Good Company's Sustainable Pathways Toolkit, National Wildlife Federation's State of the Campus Environment, SAQ, AISHE, Penn State Indicator Report, Maclean's Magazine Annual Guide to Canadian Universities, Canadian Center for Policies Alternatives Missing Pieces.	National Wildlife Federation's State of the Campus Environment, SAQ, AISHE, Higher Education 21's Sustainability Indicators, Environmental Workbook and Report, Greening Campuses, Campus Ecology, Environmental Performance Survey, Indicators Snapshot guide, Grey Pinstripes with Green Ties, EMS Self-Assessment.
Results	Tools focused on operations (67%) and education (18%). Physical resources and institutionalization are the elements with higher number of indicators. Secondly there are education/curricular, human resources and research.	Tools focused on operations (44%), governance (39%), and education (8%). Policies, vision, transport, resources management, curriculum, involving local community and research projects based on sustainability are the key elements found.	Descriptive about different approaches, strengths and weaknesses, scopes.	Elements where all tools converge: reduction of consumptions; systemic progress, education for sustainable development, transversal scope (education, research, operations and service), and action beyond the institution.

plying it to 12 universities. They conclude that universities are still in the early stages compared with business organisations. There are also multiple ad-hoc proposals to fit singular cases (eg. Kamal and Asmuss, 2013).

In the reviewed literature, the analysis of different SATs in the same real case study is not found. This would be necessary to understand how the same university can have different ratings and responses, according to the tool that has been applied. Moreover, it would be very interesting to know not only the diagnosis from one university through different approaches, but also how the efforts towards sustainability of a real strategic plan are measured and rated through these tools. In this direction, Ramos and Pires (2013) state that the contribution of sustainability assessment to structural organizational change in HEIs needs more research and this article will try to contribute towards this.

## 2. Scope and objectives

In previous literature review, comparative studies related with SATs were based on desk research and not on the practical application of different tools in one case. In this study, the main goal is to analyze the sustainability of universities from different approaches in a single case. To do so, some objectives were sought:

- To apply SATs to a single case study.
- To analyze the diagnosis of the case study in terms of sustainability from different approaches.
- To analyze the capacity for the development of sustainability action plans from SAT's results by creating a plan of prioritization and measuring efforts to optimize the final sustainability score.

From the long list of SATs, some criteria have been applied to select different sustainability assessment approaches:

- Replicability. Tools that are applicable in a singular region or nation are not considered.
- Integration. Tools must consider the university or institution as a whole (education, environment, economic and social dimensions, but also education, research, operations and community outreach).
- Qualitative-based indicators. To allow comparison of final results, qualitative approaches are considered in this study.
- Applicability. Some case study must be published previously and they have to be currently in use.
- Internal strategies. Approaches must be based on the purpose of establishing internal strategies towards sustainability, while monitoring and drawing comparisons between universities are out of the scope of this study.

In this sense, four SATs are selected: AISHE (version 1.2), SAQ, USAT and SustainTool. AISHE and SAQ are the two most commonly used tools in previous studies (as seen in Table 1). From a sustainable development approach, indicators and criteria from these tools are classified according to the four dimensions of sustainability: Economic, Environmental, Social and Educational/Curricular. The distribution of relative weight allocated to each dimension is shown in Fig. 1.

The areas and themes in which criteria and indicators have been grouped are also important. In Table 2 the scope of the four SATs considered are shown. The stakeholder's participation is needed following the implementation of these tools and the subsequent literature reviewed. In this sense, the integration of top tiers of management in the action plan is needed for a real application.

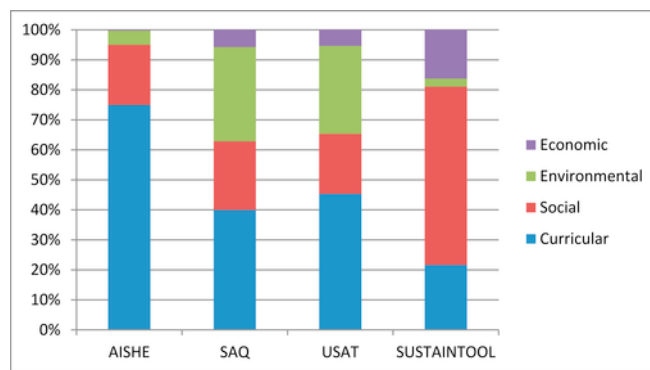


Fig. 1. Relative weight allocated by the tools for sustainability dimensions.

Table 2  
Scope of the different sustainability tools analysis.

Areas		AISHE	SAQ	USAT	Sustain Tool
Social	Vision and Mision	X	X	X	X
	Dissemination/Communication	X	X	X	
	Hiring			X	X
	Working conditions				X
	Public participation				X
	Commitment to the community			X	X
	Revision mechanisms and evaluation	X			
Curricular	Syllabus	X	X	X	X
	Pedagogic approach	X		X	
	Research and scholarships	X	X	X	X
	Internships and participation programs	X	X	X	
Environmental	Training teaching staff	X	X	X	
	Greenhouse emissions	X	X	X	
	Waste, Recycling	X	X	X	X
	Water	X	X	X	X
	Energy	X	X	X	X
	Transport	X	X	X	X
	Biodiversity and landscape	X	X	X	X
Economic	Services	X	X	X	X
	Building	X	X	X	
	Funding and investment				X
	Purchases	X	X	X	X
	Indirect impacts				X

## 3. Methodology

The methodology to achieve the objectives has been based on the use of a case study of a single HEI. The selected case is Universidad Europea de Madrid (UEM) in Spain. It is a private university, a leader in Spain with the number of students which stands at around 16,000 students (compared with other private institutions) and is a member of the worldwide university network, Laureate International Universities. UEM has been linked with ESD for more than seven years and has a great interest in these issues, being a member of the CADEP/CRUE (Conference of Rectors of Spanish Universities) group of Sustainability Curriculum in the Spanish context since 2012. It had also approved the Sustainability Curriculum Plan for the entire university of the years 2012–2016. In this context, UEM has organized the first and second meeting of curricular sustainability in both 2013 and 2014. Since 2013, there has also been a volunteer program linked with the International and National Service-Learning, being part of the National Observatory of University Cooperation for

Development, led also by CRUE. Since 2010, there has been an important commitment reporting sustainability issues using Corporate Social Responsibility following the GRI standard. In 2014 it started the carbon footprint calculation and initiated its continuous actualization since then. Research projects related with ESD have also been promoted in the last four years. Thus, UEM provides an interesting case at hand for this study.

For applying the four SATs to this case study, the manuals of different approaches are used. In this sense, two strategies are followed. First an integration of SAQ, SustainTool, and USAT in a singular survey is made, integrating all questions and indicators in the same survey in order to respond to all issues just once. A group of 14 experts is created, and 11 areas were selected (Table 3). One coordinator per area is allocated. Surveys have been segmented according to each area of knowledge (eg. questions about procurement criteria to the purchasing department; research topics to research and doctoral vice-rectorate and researchers). First, the survey was sent to the coordinator of the area (department or unit), and a month was given for them to work on it, a personal interview with him/her and the team was organized in order to solve questions and to retrieve results. The survey and interview period was developed between September–October 2014. Results from the integrated survey were broken down again in each tool in order to obtain the overall qualification.

Additionally, in order to apply AISHE tool, a consensus must be reached between all experts. A personal expert meeting has been developed considering the same areas that appear on Table 1, by previously sending them the results of the initial integrated survey. On 20th of November 2014, all results in every AISHE indicators were discussed following the methodology proposed by Roorda (2001). A final consensus on the evaluation of every indicator and criteria was reached.

After assessing the case study by these four SATs, a report was developed to obtain a specific diagnosis but also to improve the score of the university in the medium and long term. This was also done illustratively to compare the effects that certain measures would have on the score of each particular tool and the most cost-efficient way to raise the score significantly. It was sought to prioritize specific measures that allowed the greatest contribution to the overall rating.

Since indicators are mainly qualitative, a measure is based on the entire compliance of a specific criteria or indicator, so its effectiveness is measured by the points that each indicator has. Therefore, an efficient measure would be so defined when its related indicator is efficient (i.e. the indicator or criteria has a great rating contribution). This would vary from one tool to another. In this way, the most efficient measures for each tool are prioritized from 1 to 10, 1 being the most efficient measure for one specific tool.

The cost-effectiveness of each measure is also analysed in a qualitative way, considering those measures that have the greatest impact

on sustainability scoring, while being easy to implement. Measures and cost-effectiveness analysis were presented, discussed and validated in a final meeting in March 2015 with the expert group.

#### 4. Results

The results obtained for the UEM case study from the SATs are as follows:

- AISHE: the areas with the greatest results are vision, policy and assessments. Out of expertise, educational goals and methodology, educational contents are poorly rated (Fig. 2). The AISHE score depends on stages of development of sustainability policies and actions within the organization, and varies from an activity oriented (1) to a society oriented (5) approach. The overall average result does not reach stage 2, which indicates that a process-oriented approach is used for implementing sustainability measures.
- USAT: The analysis of the results by area shows that the area of operations and management environment (Part B) and the area of policy and written statements (Part D) are those with the highest average score using the USAT tool. On the contrary, teaching and student commitment (A and C) are the areas with the lowest overall score (Fig. 2).
- SAQ: by using this tool 40% of the questions can be satisfactorily answered including the areas of curriculum, research, operations and campus, human resources, dissemination and service to the community, students, and policy, vision and mission. Considering all questions as being equally important, this percentage can be considered as the overall score of the UEM, despite the fact, that the tool itself does not have any kind of score.
- Sustain Tool: The areas with the highest score are environmental support and organizational capacity as well as program evaluation and adaptation. The maximum value reached is 4/7, a medium performance in sustainability terms. Fig. 2 shows the obtained results.

The results obtained for the UEM are indicative of the need to analyze areas of improvement and to set up measures to improve the score towards sustainability. Measures will have different impacts on SAT's scores. In general terms, the overall rating is almost similar, but not in the specific ratings per area or criteria.

To be thorough, a score of 100% in every tool would be desirable, but that would mean initiating a wide range of measures. Therefore, some measures are proposed to be implemented in the short term which would in turn have a positive impact on the score of the UEM. They are considered achievable and would allow development and evaluation within the short to medium term (1–4 years). Table 4 shows the proposed measures for each aspect based on different SATs and UEM results as the starting point (they are selected according to possible actions that garner more points following different approaches).

The potential sustainability improvement for each measure was calculated taking into account the relative weight of indicators improved by each measure, considering that these indicators will obtain the highest score after the action's achievement. This data can provide information about the relative importance of each criteria for each specific tool. It can be especially useful for policy-makers when choosing the suitability of actions to take, when looking for improvement in one or another tool. It should be noted that these measures only make sense after the evaluation of the university, as the improvement margin depends highly on the score initially obtained in each area.

**Table 3**

List of areas and departments of which the experts of the UEM panel are from.

Departments or Units	Number of people involved
Senior management – University management	1
Development Cooperation Office	1
Student body	2
Teaching coordinator	1
Department director	1
R & D manager	1
HR manager	1
Student service office (GOE)	1
Teaching staff	2
Environmental Manager	2
Purchasing department	1

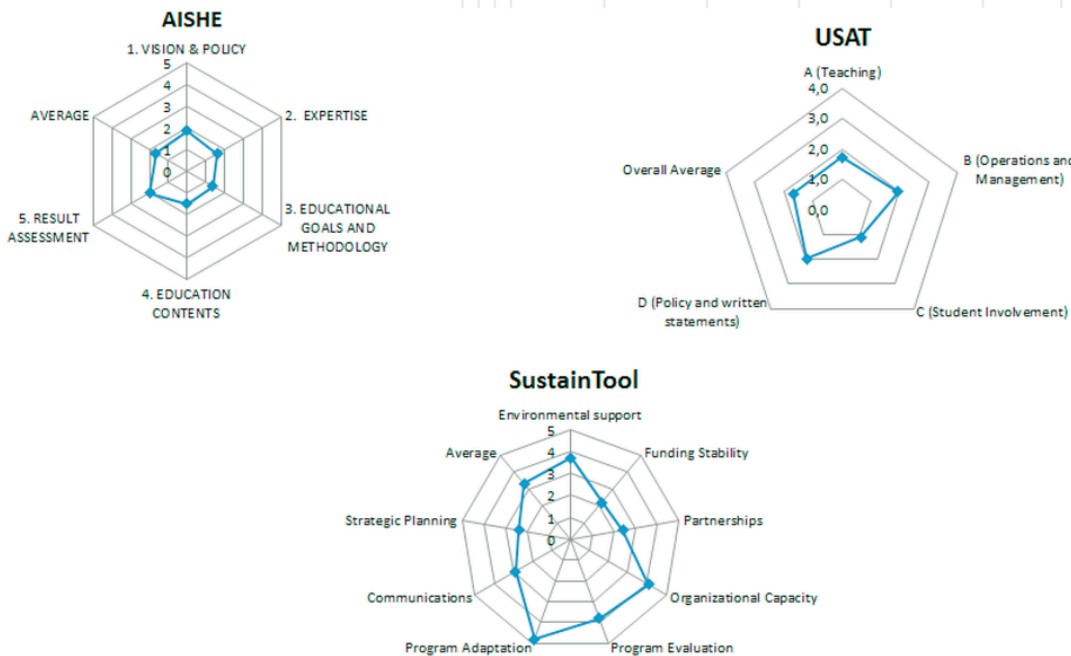


Fig. 2. Results of the UEM applying AISHE, USAT and SustainTool.

Table 4  
Measures proposed by sustainability aspects (dimensions).

Dimensions	Proposed measures
Environmental	1.1 To organize a sustainable and efficient transport system: - New mobility plan - Promotion of flexible working hours - Incentives for the use of sustainable transport  <b>Operations</b> 2.1 To buy organic and local food, to include in new contracts (eg. Restaurant or cafeteria)  <b>Operations/Community Outreach</b> 3.1 To promote student involvement in sustainable development: - Student associations on sustainability issues  <b>Community Outreach/Operations</b> 4.1 To improve the sustainability offer: - Entire courses - New degrees and masters  <b>Education</b>
Economic	1.2 To integrate pest management in green spaces, to replace chemical substances  <b>Operations</b> 2.2 To create a financial plan of sustainability actions: - Stable internal funding - To obtain financial resources  <b>Operations</b> 3.2 To improve communication on sustainability: - To raise awareness - To create a discussion forum  <b>Community Outreach</b> 4.2 To promote research on sustainability issues: - To increase the number of researchers - To improve teacher training - To collaborate with expert groups - To attend at seminars  <b>Research</b>
Social	1.3 To involve students in sustainability actions: - Competitions of energy, water and waste management projects - Conferences on participation in environmental tasks  <b>Operations/Education</b>  3.3 To include new challenges in written policies for local and global sustainability  <b>Community Outreach</b>
Curricular	

Fig. 3 shows the potential improvement of applying the initial ten measures proposed by sustainable development dimensions (environmental, economic, social and educational).

As shown in these figures, the areas with the greatest potential for improvement with the proposed measures are the social and educational areas, although these margins are very dependent on the weight that each tool assigns to each area, and on the score UEM has obtained. The tool with the greatest potential for improvement by ap-

plying the ten measures described above is the SustainTool with a growth of 43%, followed by SAQ with 33%; USAT with 27% and AISHE with 19%.

Table 5 shows the most efficient measures, i.e. the ones which can increase the UEM score to a higher degree. Priority was given to measures with the highest potential improvement within the same tool (from 1, with the highest contribution to the overall rating, to 10 with the lowest contribution).

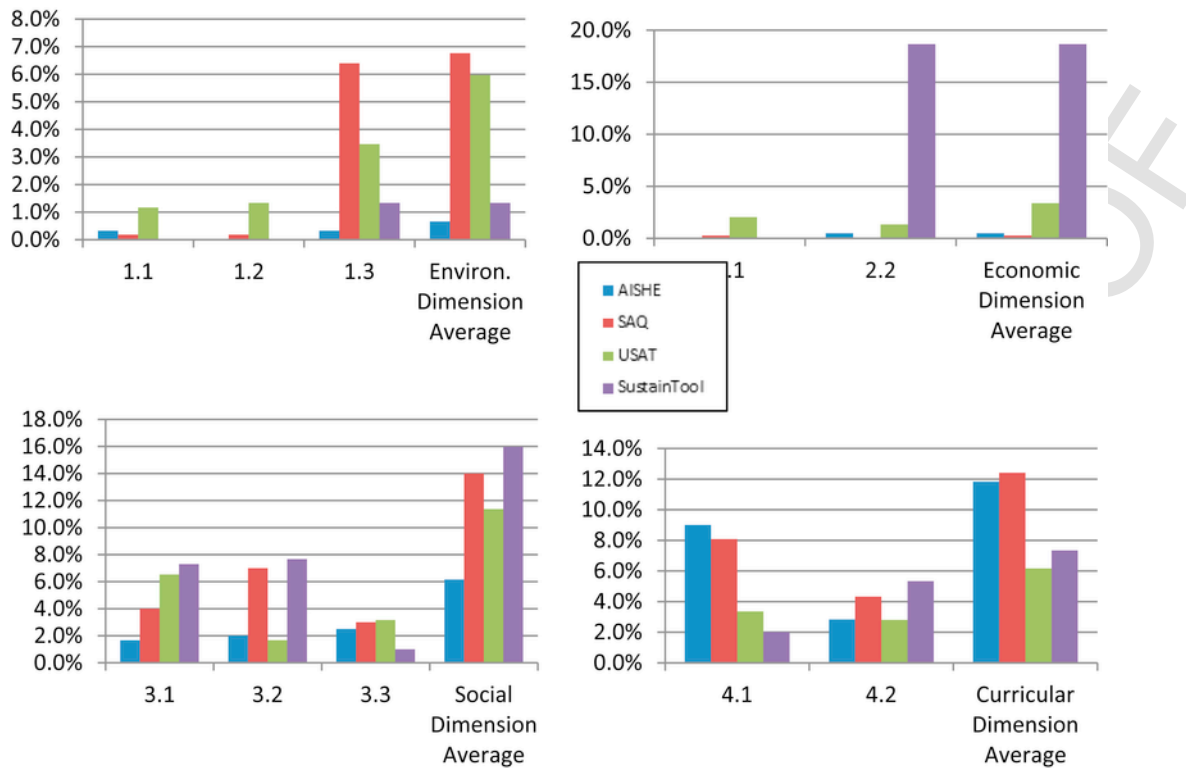


Fig. 3. Potential improvement of the measures proposed in the sustainability dimensions according with SATS' results.

Table 5 Potential for improvement and prioritization of the proposed actions for the analysed tools.

Action	Potential improvement				Overall average	Order of priority				Overall
	AISHE	SAQ	USAT	Sustain Tool		AISHE	SAQ	USAT	Sustain Tool	
1.1	0.3%	0.2%	1.2%	0.0%	0.42%	7	8	10	10	9
1.2	0.0%	0.2%	1.3%	0.0%	0.38%	10	8	8	10	10
1.3	0.3%	6.4%	3.5%	1.3%	2.88%	7	3	2	6	5
2.1	0.0%	0.3%	2.0%	0.0%	0.55%	10	7	6	10	8
2.2	0.5%	0.0%	1.3%	18.7%	5.13%	6	10	8	1	7
3.1	1.7%	4.0%	6.5%	7.3%	4.88%	5	5	1	3	2
3.2	2.0%	7.0%	1.7%	7.7%	4.58%	4	2	7	2	3
3.3	2.5%	3.0%	3.2%	1.0%	2.42%	3	6	4	7	6
4.1	9.0%	8.1%	3.4%	2.0%	5.61%	1	1	3	5	1
4.2	2.8%	4.3%	2.8%	5.3%	3.83%	2	4	5	4	4
Overall	19.2%	33.5%	26.8%	43.3%	30.68%					

Table 5 shows the unequal effect caused by the measures regarding different approaches. There are cases such as 2.2 measure that cause a great effect in SustainTool (almost half of the improvement with this tool is obtained from just this one measure), while it does not significantly affect the score of the others (SAQ, USAT, AISHE). For this reason, the overall prioritization has not been done according to the average of the potential improvement, but to the average of priority measures for each tool. In this way, 4.1 measure has a great improvement in AISHE (almost half of total improvement) and in SAQ (25% of total improvement). While important, this is more discreet in the others.

Taking these results into account, the measures towards sustainability that are recommended after a prioritization according to its significant contribution are: 4.1 To improve the offer of sustainability courses; 3.1 To encourage student involvement in sustainable development; and 3.2 To improve communication on sustainability.

In the expert group, it was suggested that theoretically studying a specific cost-effectiveness qualitative-based measure to determine whether the costs (or efforts) linked to one measure can be justified by the results in terms of sustainability improvement would be beneficial. In this study the cost of all measures has been rated on a scale from 1 to 10, being 1 the easiest (or cheapest) measure to be implemented. The measures that have been considered easier to apply after the valuation with the expert panel are: 2.1 to create a program to buy organic and locally sourced food; 3.1 to promote student involvement in sustainable development; and 3.3 to include new challenges in the written policies.

Table 6 shows the prioritization of improvements according to potential improvement, its cost (effort or ease for implementation), and a combination of both (cost-efficiency) for each tool using the mean of potential improvement and cost priority with the same weight.



**Table 6**  
Improvements according to efficiency, prioritization and cost of actions in the tools.

Action	Potential improvement prioritization (from Table 5)				Cost prioritization	Cost-efficiency prioritization				Overall
	AISHE	SAQ	USAT	Sustain Tool		\$	AISHE	SAQ	USAT	
1.1	7	8	10	10	<b>10</b>	10	10	10	10	<b>10</b>
1.2	10	8	8	10	<b>5</b>	9	8	7	9	<b>9</b>
1.3	7	3	2	6	<b>4</b>	5	1	2	3	<b>4</b>
2.1	10	7	6	10	<b>2</b>	6	5	4	8	<b>5</b>
2.2	6	10	8	1	<b>8</b>	8	10	8	3	<b>8</b>
3.1	5	5	1	3	<b>3</b>	3	4	1	1	<b>1</b>
3.2	4	2	7	2	<b>9</b>	7	6	8	5	<b>7</b>
3.3	3	6	4	7	<b>1</b>	1	2	2	2	<b>2</b>
4.1	1	1	3	5	<b>6</b>	2	2	5	5	<b>3</b>
4.2	2	4	5	4	<b>7</b>	4	6	6	5	<b>6</b>

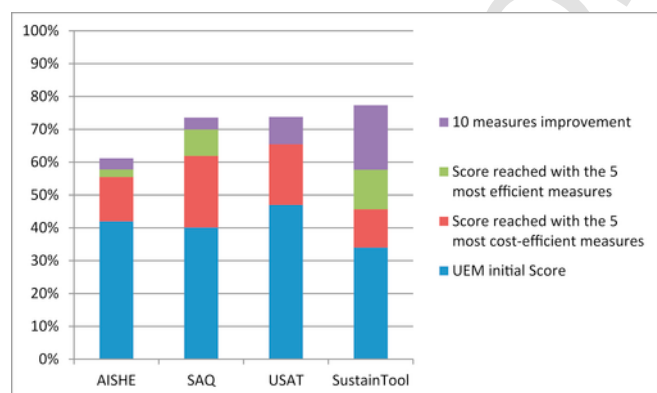
Considering both criteria, it can be observed that the greatest cost-efficiency measure in AISHE is 3.3 To include new challenges in written policies; in SAQ 1.3 To promote student involvement in sustainable development; and in the USAT and SustainTool 3.1 to encourage student involvement in sustainable development. This emphasizes, that according to the tool used for assessing sustainability, the strategy would vary considerably.

However in this case, the overall measures that are the most cost-effective, considering all tools, are the following:

- 3.1: To encourage student implication in sustainable development
- 3.3: To include new challenges in the written policies
- 4.1: To improve the offer of sustainability courses
- 1.3: To include students in sustainability actions promoted by the operations area
- 2.1 To create a program to buy local and organic food

The measure 4.1, calls for attention, since it is the one with the highest improvement margin for the UEM, and yet given its high relative cost (recruitment, promotion of new courses and degrees) it is in the fourth position according to the cost-efficiency criteria.

Finally, Fig. 4 shows the final score that could be achieved with the five most cost-efficient measures, and also includes the five measures with the highest potential improvement alongside the ten measures that were initially proposed. The five most cost-efficient measures could cause a significant relative increase in the score (between 65 and 70% of the initial score which would be an effect of the implementation of the ten measures) for all tools except the SustainTool. This fact highlights the importance of prior evaluation of the measures and their prioritization before applying them.



**Fig. 4.** Improvements produced by the most cost efficient, most efficient and all proposed measures.

## 5. Discussion

This study began from specific statements in literature. Firstly, strategies towards sustainability must be created in a participative and integrated manner, since commitment and real implementation has a singular connection (Lozano et al., 2015). In this sense, participation of different stakeholders in the diagnosis, assessment and sustainability action plans is considered following SATs manuals. It legitimizes the proposal and initiates changes in the areas where leaders are already involved. Participation of different stakeholders in such an effort is essential as Alshuwaikhat and Abubakar (2008) and Disterheft et al. (2015) also state. The sample of surveyed people is reduced, but it can be considered enough to have between ten to fifteen people in the panel as sustainability experts (eg. Roorda, 2001; Roorda et al., 2009). Secondly, SATs have a positive influence for creating specific plans in education, research, outreach and campus operations. In this article it has been shown as a practical case study in its application and creation of specific measures to contribute to a more sustainable university. SATs make sustainability easier and comparable, but they have also been criticised because of their reductionist approaches (Bond and Morrison-Saunders, 2011), with some risks of moving the interests towards market than to societal needs by focusing on competitive benchmarking. It should not be a control system but stimulation for reflection and change (Disterheft et al., 2016).

There are previous studies related to comprehensive comparisons between SATs. They are a step forward in the theoretical comparison between these tools, but the originality of the present study is to apply some of them to the same real case study, measuring the efforts to reach a greater rating of sustainability based on different approaches. The selection of the four tools applied has been done based on the consideration of the ability for replication transnationally, the consideration of all areas (education, research, community outreach and operations), and selecting those with qualitative-based indicators. The combination of different tools in one questionnaire might bias results. The four tools have different approaches, scopes and weights for each area. In this sense, different results have been obtained, but the overall score has been similar in the four applied tools. It must be considered that tools as AISHE have been applied on the level of HEI, while it is meant to be used on the level of a study program or at most a faculty or department.

The most important dimension came from environmental sustainability, followed by educational, giving less importance to indicators from an economic nature. Martins and Borges (2015) state that most approaches are focused on operational eco-efficiency, similar to Fischer et al. (2015), whose main findings were that more than half of

the possible points came from operations and, more specifically, from physical resource management. Tools applied are not for comparing purposes, but for improvements within universities (Roorda et al., 2009).

SAQ was one of the first questionnaires that emerged on the international scene. As such, its aim is to establish a starting point, to initiate a process towards sustainability (ULFS, 2009). This first step can be achieved with the questionnaire, but given the proposals and developments in the field some improvements would be needed. In our experience, SAQ questions have served to start the debate with those involved, who are not typically involved in sustainability issues. The main weaknesses are those related with open-ended questions, not establishing a final score so it is difficult to apply it as a tracking tool.

SustainTool is not suitable for the evaluation of universities as a whole. However, it is a valid tool for assessing and reporting specific plans and programs inside the institution, while considering different parts and activities of the organization.

The indicators of USAT are evaluated subjectively from 1 to 5 depending on the appreciation of university stakeholders. This form of qualification, which in our experience has been simple to apply, nonetheless complicates comparisons and benchmarking, since it depends in part on the sample chosen. There are not any mechanisms to standardize the interviewee and the evaluator (eg. guidance on how to qualify, examples of good practices, requirements to award a certain level, and so on).

AISHE promotes the existence of a group of professionals involved in sustainability. This approach works as long as the participants come from different departments and sections within the organization and are not constituted as a specialized group, apart from the rest. Sustainability must be integrated for all stakeholders and not only in the expert group created for the diagnosis and the action plan. The engagement of the entire organization is necessary to obtain the highest score. The existence of clear criteria and an expert group, which has to agree on the assessment, seeks to avoid subjectivity. In addition, AISHE is the tool where the curricular area is best represented, henceforth the tool that places more importance on the specific activities of any university.

Quantitative tools (out of the scope of this study), such as STARS with specific indicators that seek to atomise the evaluation escape the bias created by qualitative assessment. Their weak point is the required effort for reaching all the information needed, and the specificity of these indicators. It would be, however, an interesting area of research in the future to integrate STARS in an empirical comparative analysis. It might be interesting to assess a singular case also based on the other discarded tools in order to check and discuss the results, and to simultaneously develop an interesting benchmark. However, the way SATs are applied can impact the results in a wide manner (Stough et al., 2017). There are SATs whose indicators are measuring ESD integration (e.g. AISHE) and others whose indicators are focused on identifying the presence of a list of ESD elements (for example, in STARS, USAT, SUSTAINTOOL). Further research is needed to develop meaningful assessment approaches for HEIs. SATs must to choose whether their indicators are measuring ESD integration or the mere presence of ESD elements, distinguishing between integration via inputs and outputs, as Stough et al. (2017) also stated.

## 6. Conclusion

Sustainability of universities from different approaches is shown by the application of four tools to a single practical case. As shown

already in the results, pursuing the maximum score for one tool does not assure a good score in the others. This result could be useful for HEIs that already use one of the analysed tools in order to realise what sustainability issues are left aside. Therefore, prior consensus in any HEI about what is understood as sustainability is needed before making a diagnosis and a strategic proposal. A deep understanding of existing SATs is highly recommended in order to establish the correct goals towards sustainability.

From what has been shown above, a fairly comprehensive assessment of university sustainability can be reached. By implementing several evaluations in the same university implies a considerable effort in terms of time and cost, but assures a better diagnosis and specific measures towards sustainability, avoiding the singular approach of an individual tool. After having this experience, it is considered feasible to use more than one tool when making a diagnosis and an accurate plan.

To generate sustainability plans from the diagnosis, based on different tools and approaches, and the prioritization focused on a sustainability score, potential improvement and in cost-effectiveness is a contribution in itself. It can be replicated in different contexts in any other institution. Measures proposed in this paper have served to demonstrate that, if properly prioritized, increasing the sustainability of universities does not have to come with a high economic cost but quite the opposite. Of course, these measures are theoretical proposals that will have to be carried out, checked and then evaluated regarding effectiveness and efficiency provided herein. This line of research, with a precise economic quantification, and following the implementation, and its end result will be interesting for future knowledge in this research area. Based on this assessment, a strategic plan is easier to develop towards a sustainable university. The results demonstrate that it is not necessary to make a great financial effort to achieve a substantial improvement on sustainability; it "only" requires a previous evaluation and planning of sustainability issues according to each SAT and to prioritize those measures towards a more sustainable university. For the proposed measures in this case study, absolute improvements between 20 and 40% in the overall sustainable score can be reached. To begin understanding one's own institution better and to have a more accurate diagnosis of the current situation of the university is essential towards an ESD. This descriptive study is an example that any HEI could follow as a first step towards a more sustainable university.

## Uncited references

Fernández-Sánchez et al., 2014; Fischer, 2011; Lidgren et al., 2006; Tierney et al., 2015; Van Weenen, 2000.

## References

- Amaral, L.P., Martins, N., Gouveia, J.B., 2015. Quest for a sustainable university: a review. *Int. J. Sustain. High. Educ.* 16 (2), 155–172.
- Caeiro, S., Leal Filho, W., Jabbour, C., Azeiteiro, U.M., 2013. *Sustainability Assessment Tools in Higher Education Institutions, Mapping Trends and Good Practices Around the World*. Springer.
- Ceulemans, K., Molderez, I., Van Liedekerke, L., 2015. Sustainability reporting in higher education: a comprehensive review of the recent literature and paths for further research. *J. Clean. Prod.* 106, 127–143.
- Cole, L., 2003. *Assessing Sustainability on Canadian University Campuses: Development of a Campus Sustainability Assessment Framework*. Master of Arts in Environment and Management Master Royal Roads University, Victoria.
- Disterheft, A., Caeiro, S., Azeiteiro, U.M., Leal Filho, W., 2015. Sustainable Universities – a case study of critical success factors for participatory approaches. *J. Clean. Prod.* 106, 11–21.
- Disterheft, A., Caeiro, S.S., Leal Filho, W., Azeiteiro, U.M., 2016. The INDI-CARE-model-measuring and caring about participation in higher education's sustainability assessment. *Ecol. Indic.* 63, 172–186.



- Fernández-Sánchez, G., Bernaldo, M.O., Castillejo, A., Manzanero, A.M., Esteban, J., 2014. Proposal of theoretical competence-based model in a civil engineering degree. *J. Prof. Issues Eng. Educ. Pract.* 141 (2), C4014001.
- Fischer, D., 2011. 'Monitoring educational organizations' culture of sustainable consumption: initiating and evaluating cultural change in schools and universities. *J. Soc. Sci.* 7 (1), 66–78.
- Fischer, D., Jenssen, S., Tappeser, V., 2015. Getting an empirical hold of the sustainable university: a comparative analysis of evaluation frameworks across 12 contemporary sustainability assessment tools. *Assess. Eval. High. Educ.* 40 (6), 785–800.
- Jenssen, S., 2012. Sustainability at Universities: an Explorative Research on Assessment Methods and Tools for Sustainability Implementation at Universities. Master-Thesis International Centre for Integrated Assessment and Sustainable Development (ICIS), University of Maastricht.
- Kamal, A.S., Asmuss, M., 2013. Benchmarking tools for assessing and tracking sustainability in higher education institutions identifying and effective tool for the University of Saskatchewan. *Int. J. Sustain. High. Educ.* 14 (4), 449–465.
- Lambrechts, W., 2015. The contribution of sustainability assessment to policy development in higher education. *Assess. Eval. High. Educ.* 40 (6), 801–816.
- Lambrechts, W., Ceulemans, K., 2013. Sustainability assessment in higher education. Evaluating the use of the auditing instrument for sustainability in higher education (AISHE) in Belgium. In: Caeiro, S., Leal Filho, W., Jabbour, C., Azeiteiro, U. (Eds.), *Sustainability Assessment Tools in Higher Education Institutions. Mapping Trends and Good Practice Around the World*. Springer, pp. 157–174.
- Lee, K., Barker, M., Mouasher, A., 2013. Is it even espoused? An exploratory study of commitment to sustainability as evidenced in vision, mission and graduate attribute statements in Australian universities. *J. Clean. Prod.* 48, 20–28. <http://dx.doi.org/10.1016/j.jclepro.2013.01.007>.
- Lidgren, A., Rodhe, H., Huisingsh, D., 2006. A systemic approach to incorporate sustainability into university courses and curricula. *J. Clean. Prod.* 14 (9–11), 797–809. <http://dx.doi.org/10.1016/j.jclepro.2005.12.011>.
- Lozano, R., 2011. The state of sustainability reporting in universities. *Int. J. Sustain. High. Educ.* 12 (1), 67–78.
- Lozano, R., Watson, M.K., 2013. Assessing sustainability in university curricula: case studies from the university of leeds and the Georgia institute of technology. In: Caeiro, S., Leal Filho, W., Jabbour, C., Azeiteiro, U. (Eds.), *Sustainability Assessment Tools in Higher Education Institutions*. Springer International Publishing, pp. 359–373.
- Lozano, R., Lukman, R., Lozano, F.J., Huisingsh, D., Lambrechts, W., 2013. Declarations for sustainability in higher education: becoming better leaders, through addressing the university system. *J. Clean. Prod.* 48, 10–19.
- Lozano, R., Ceulemans, K., Alonso-Almeida, M., Huisingsh, D., Lozano, F.J., Waas, T., Lambrechts, W., Lukman, R., Hüge, J., 2015. A review of commitment and implementation of sustainable development in higher education: results from a worldwide survey. *J. Clean. Prod.* 108, 1–18.
- Martins, N., Borges, Gouveia J., 2015. Quest for a sustainable university: a review. *Int. J. Sustain. High. Educ.* 16 (2), 155–172.
- Quist, J., Tukker, A., 2013. Knowledge collaboration and learning for sustainable innovation and consumption: introduction to the ERS CP portion of this special volume. *J. Clean. Prod.* 48, 167–175. <http://dx.doi.org/10.1016/j.jclepro.2013.03.051>.
- Richardson, A.J., Kachler, M.D., 2016. University sustainability reporting: a review of the literature and development of a model. In: Arevalo, J.A., Mitchell, S. (Eds.), *Handbook on Sustainability in Management Education*. Edward Elgar Publishing, Canada. <http://scholar.uwindsor.ca/odettepub/101>.
- Roorda, 2001. Auditing Instrument for Sustainability in Higher Education. DHO Nederland, Amsterdam.
- Roorda, N., Rammel, C., Waara, S., Fra Paleo, U., 2009. AISHE 2.0 Manual: Assessment Instrument for Sustainability in Higher Education, Edition 2.0. Second Draft. available at: [app.box.com/s/0dglhugzyyza4kkfb83](http://app.box.com/s/0dglhugzyyza4kkfb83) <https://www.box.net/s/0dglhugzyyza4kkfb83> (last access 21/06/2014).
- Shriberg, M., 2002. Institutional assessment tools for sustainability in higher education: strengths, weaknesses, and implications for practice and theory. *Int. J. Sustain. High. Educ.* 3 (3), 254–270.
- Stephens, J., Hernandez, M., Román, M., Graham, A., Scholz, R., 2008. Higher Education as a change agent for sustainability in different cultures and contexts. *Int. J. Sustain. High. Educ.* 9 (3), 317–338.
- Stough, T., Ceulemans, K., Lambrechts, W., Cappuyns, V., 2017. Assessing sustainability in higher education curricula: a critical reflection on validity issues. *J. Clean. Prod.* (in press).
- Tierney, A., Tweddell, H., Willmore, C., 2015. Measuring education for sustainable development. Experiences from the University of Bristol. *Int. J. Sustain. High. Educ.* 16 (4), 507–522.
- Togo, M., Lotz-Sisitka, H., 2013. The unit-based sustainability assessment tool and its use in the UNEP mainstreaming environment and sustainability in african universities partnership. In: Caeiro, S., Leal Filho, W., Jabbour, C., Azeiteiro, U. (Eds.), *Sustainability Assessment Tools in Higher Education Institutions*. Springer International Publishing, pp. 259–288.
- ULFS, 2009. Sustainability Assessment Questionnaire (SAQ) for Colleges and Universities. Association of University Leaders for a Sustainable Future, Wayland USA.
- Washington University, 2013. The Program Sustainability Assessment Tool V2. Washington University, St Louis, MO. Available at: <http://www.sustaintool.org> (last 06/05/2014).
- Van Weenen, H., 2000. Towards a vision of a sustainable university. *Int. J. Sustain. High. Educ.* 1 (1), 20–34. <http://dx.doi.org/10.1108/1467630010307075>.
- Yarime, M., Tanaka, Y., 2012. The issues and methodologies in sustainability assessment tools for higher education institutions: a review of recent trends and future challenges. *J. Educ. Sustain. Dev.* 6 (1), 63–77.