Critiquing and Developing Benchmarking Tools for Sustainability

An Interactive Qualifying Project
submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
degree of Bachelor of Science

By
Jacob Berman-Jolton
Alexander Kuros
Krishna Madhurkar
Alexander Rockcress

Date:
14th December, 2017

Report Submitted to:

Dr. Heather Barrett
Katy Boom
The University of Worcester

Professor Robert Krueger
Worcester Polytechnic Institute

Abstract

The University of Worcester, located in Worcester, England, is a public research institution that is very focused on improving its sustainability. Over the last couple years, the university has used a variety of different tools to critique their sustainability practices in order to help them improve. As of now, the tools being used are either outdated or not giving the information they are looking for. The purpose of this project was to create a custom tool that can be used by the University of Worcester, or any other institution, to assess the sustainability content in the undergraduate curriculum as well as the on campus research being conducted. This custom tool was created by researching and analyzing a multitude of existing tools. From here, specific aspects were taken from a few different tools, then were compiled and modified to create a comprehensive graded questionnaire. The implementation of this questionnaire would outline key areas in the undergraduate curriculum and on campus research that could be improved.

Acknowledgements

We would like to personally thank our sponsor, Dr. Heather Barrett, for her diligence and guidance in the creation of our IQP project and in the assistance of creating our new custom tool for the University of Worcester and their Sustainability department. It has been a tremendous pleasure working under Dr. Barrett's guidance, and we hope that it remains a sentiment for the projects to come.

Next, we would like to thank another project link, Katy Boom for her continuous enthusiasm and interest of our own new metrics for the sustainability Department of Worcester. Her interest in the project never shifted and always remained good and reliable resource for our group.

Next, we would like to thank our project advisor, Professor Robert Krueger, for his guidance in our project for the past semester. For always keeping us on track and pushing to be the best we can be, Professor Kruger has never once let us down nor has he failed to assist us in any way he can for the purpose of having a well outlined project, and a rewarding IQP experience.

Finally, we would like to thank the University of Worcester for hosting our IQP group in facilities and its resources. It has been a very comfortable and welcoming experience for us, and we hope that what we have created will prove beneficial to the University's mission and goals.

Executive Summary

The University of Worcester is a public research institution located in Worcester, England. The university is on the forefront of sustainable development, and has been ranked 4th out of 150 higher education institutions across the United Kingdom in this area. The university prides itself on where it stands relative to other institutions across the United Kingdom, but despite this impressive accomplishment it is constantly trying to make positive steps forward. The university currently uses a couple different benchmarking tools to try and gather information and see which areas could use improvement; however the tools that are being used are quickly becoming outdated or are not displaying information that is useful to the university anymore.

The goal of this project was to analyze how the university is currently benchmarking their sustainability content, and create a custom benchmarking tool that can be applied not only at the University of Worcester, but at any university looking to improve their sustainability practices. With this in mind, we set out a few objectives to help us achieve the goal. We needed to research existing sustainability benchmarking tools used around the world to get an idea of what were we working with. Then, we needed to analyze relevant tools and break them down into individual components. And from there, we needed to create a custom tool by combining and modifying components from the researched tools. After all of this was completed we knew we would need to engage the stakeholders and modify the created tool based on their input.

The bulk of the work needed to complete this project can be broken down into three main phases: the research, organization, and creation. In the research phase we examined all the existing benchmarking tools that are used today around the world. From there we began to make note of the ones that would be relevant to our project and sponsor goals. Once we shortlisted methodologies that could be useful to our project, we began to analyze them and break them down into the different metrics each of the existing benchmarking methodologies used to grade the institution in question. In the organization phase, we created a database to store the different metrics we identified across all relevant methodologies. In the creation phase we began to take the desired metrics from the methodologies in our database, and piece them together to create a tool that can be used to analyze a variety of different categories. Our tool examined areas like transportation, waste management, curriculum, building efficiency, etc. Once we determined the areas our tool would analyze, we brought it to our project sponsor for input. We were directed to

focus primarily on two categories: undergraduate curriculum and faculty. After this, we created short, direct, questionnaires for the categories we were going to focus on. Once the questionnaires were created, we developed a grading system that can be used by a university to compare itself to the other institutions that apply this custom tool. Due to time constraints we were not able to apply our tool, so we recommend the University of Worcester passes it to another group to implement. The implementation of this custom tool would outline key areas in the undergraduate curriculum and on campus research that could be improved.

Authorship

Abstract: Alexander Kuros

    Edited by Jacob Berman-Jolton, Krishna Madhurkar, and Alexander Rockcress

Acknowledgments: Alexander Rockcress

    Edited by Jacob Berman-Jolton, Alexander Kuros, and Krishna Madhurkar

Executive Summary: Alexander Kuros

    Edited by Jacob Berman-Jolton, Krishna Madhurkar, and Alexander Rockcress

Introduction: Alexander Rockcress

    Edited by: Jacob Berman-Jolton, Alexander Kuros, and Krishna Madhurkar

Literature Review:

    Understanding Benchmarking: Alexander Kuros

    Edited by Jacob Berman-Jolton, Krishna Madhurkar, and Alexander Rockcress

    Benchmarking at the University of Worcester: Alexander Kuros

    Edited by Jacob Berman-Jolton, Krishna Madhurkar, and Alexander Rockcress

    Existing Benchmarking Tools: Jacob Berman-Jolton

    Edited by: Alexander Kuros, Krishna Madhurkar, and Alexander Rockcress

    Custom Benchmarking Tool: Alexander Kuros

    Edited by Jacob Berman-Jolton, Krishna Madhurkar, and Alexander Rockcress

    Understanding the Objectives: Alexander Rockcress

    Edited by: Jacob Berman-Jolton, Alexander Kuros, and Krishna Madhurkar

Methodology: Alexander Kuros

    Edited by Jacob Berman-Jolton, Krishna Madhurkar, and Alexander Rockcress

Findings:

Benchmarking Tools for Specific Populations: Krishna Madhurkar

Edited by Jacob Berman-Jolton, Alexander Kuros, and Alexander Rockcress

Characteristics of Benchmarking Tools: Krishna Madhurkar

Edited by Jacob Berman-Jolton, Alexander Kuros, and Alexander Rockcress

Definitions of Benchmarking Tools: Alexander Rockcress

Edited by Jacob Berman-Jolton, Alexander Kuros, and Krishna Madhurkar

Developing the Custom Tool: Jacob Berman-Jolton

Edited by: Alexander Kuros, Krishna Madhurkar, and Alexander Rockcress

Conclusions and Recommendations: Krishna Madhurkar

Edited by Jacob Berman-Jolton, Alexander Kuros, and Alexander Rockcress

Table of Contents

Contents

1. Introduction

Energy resources are becoming scarcer and with the environment being changed at an alarming rate, world leaders are heavily pushing sustainability practices on every country (White, 2013; Wright, 2005). As stated from the United Nations: "[...] [T]here is a call for each country to do their own part in keeping up [...]" (UN 2030 Agenda). While some countries are in better standing than others, everyone needs to come together to solve this problem. There are many factors that lead to not taking sustainability practices seriously and one of the main reasons is the situational push from external forces, yet the need for actual change remains ever high and rising.

Higher education promoting the growth of sustainability research and development in began in the early 1970s with the creation of the Declaration on the Human Environment (Brundtland Report). As stated by the United Nations:

> Economic and social development is essential for ensuring a favorable living and working environment for man and for creating conditions on earth that are necessary for the improvement of the quality of life. (United Nations, 1972).

Higher education institutions have recognized that they must play a role in the sustainable development push, as they have the resources that are needed to meet their part. This push for sustainability in technology, research and social practices is best being answered by higher education institutions.

As universities conduct many research projects from both students and professors, universities can become one of the foremost researchers of sustainable development with the combined efforts from the university and innovative minds.

The University of Worcester, located in Worcester, England, is the ranked the fourth most sustainable university in the United Kingdom through its heavy emphasis on sustainability research and awareness (People and Planet, 2017). "The University has a long-standing commitment to act in a sustainable and environmentally responsible manner [...]" (Annual Sustainability Report: 2014-2015) The University is involved with many projects related to the topic of sustainability. "The Sustainability department works to increase the environmental awareness of staff and students and contributes to sustainable development in all areas of the

University" (University of Worcester, 2017). As of right now, the university is working with WPI students to sponsor sustainability-oriented projects called: Energize Worcester, Go Green Week and Critiquing Sustainability Benchmarking Tools. Through the collaboration of the department Head of Environmental Sustainability, Katy Boom, and the associate head of ISE (Institute for Sustainable Environment) at University of Worcester, Dr. Heather Barrett, the University of Worcester pioneers many external projects related to sustainability. Some of these projects include the Bike Loan Scheme (winner of the Facilities and Services category of the Green Gown Awards, 2014); a Green Apple Environment Award for a Sustainability Campaign; and the Skills for Tomorrow Event for student communication.

There are many institutions that recognize the need to benchmark their sustainability practices. Having a system that benchmarks sustainability practices would help institutions better analyze themselves in their sustainability practices and be able to better themselves with minimal intervention from external sources. In the context of this project, benchmarking is identified by the continuous updating of a university's sustainability inclination through the use of a new benchmarking tool.

The goal of this project was to analyze several existing sustainability benchmarking tools from institutions around the world, putting the most beneficial attributes from the various methodologies into a database, and apply it to the University of Worcester. However, few sustainability benchmarking tools are entirely applicable to a university. Many of them are either too complicated to understand or do not display appropriate information. It is our hope that we alleviate this strain. The university has a very good reputation in the context of sustainability, as it ranked the fourth most sustainable university in the United Kingdom and would like to keep the reputation alive. We hope that with the help of our sponsor and her goals, that we provide a new and comprehensive methodology that can be improved upon in the future.

2. Literature Review

This chapter provides the background information to understand our project's aims. First, it is essential to understand what benchmarking is and what information can be gathered by applying it. Similarly, it is important to understand the different benchmarking tools that are used, and how they can be applied to variety of different situations and organizations. From here, we examine how benchmarking techniques can be applied to critique and improve sustainable development. We will then look at benchmarking tools at University of Worcester specifically, to see what they have previously implemented as well as the information it gave them. After that, we briefly describe a variety of existing benchmarking tools that influenced the creation of our custom benchmarking tool. With this in mind, we describe our custom tool and the effect it may have on the University of Worcester. Finally, we outline the objectives for this project and describe the importance they had in the creation of our custom benchmarking tool.

2.1 Understanding Benchmarking

Benchmarking is a unique tool that is typically used by businesses and other corporate organizations. It can best be described as, "The comparison of method and process in an effort to improve the process in an organization or project…" (Elbarkouky, 2016). In other words, benchmarking is used to determine where a process is lacking in the hopes that improvements can be made to that area.

Benchmarking tools are well known in the business world to streamline processes. Many can be successfully modified and implemented to analyze sustainable development. With this being said, benchmarking tools are becoming increasingly prevalent when looking at sustainable development. An example of this is the creation of STARS, which now has

> [...] [M]ore than 650 participants on six continents, AASHE's STARS program is the most widely recognized framework in the world for publicly reporting comprehensive information related to a college or university's sustainability performance (Villanova University, 2015)

Since its creation in 2010, STARS has grown rapidly signifying the importance of a comprehensive benchmarking tool for higher education institutions. Another reason why benchmarking tools are becoming more prevalent is due to the fact that,

> [...] [R]ating systems are continuously evolving – an adaptation that is conditioned and occurring in parallel with advances made in understanding the dynamism of sustainability – to improve sustainability performance assessment and reporting practices. (Elbarkouky, 2016).

There has been a big issue with the inability to assess sustainable practices, but this is slowly being resolved with the increasing use of benchmarking tools for this application. Universities and other higher education institutions around the world are beginning to implement benchmarking tools to analyze a multitude of different processes. One university in particular, the University of Worcester, has implemented benchmarking tools in the past with the goal of improving the sustainability practices.

2.2 Benchmarking at the University of Worcester

The University of Worcester is very focused on improving their sustainability profile in all aspects. One of the ways they have attempted to achieve this is by implementing benchmarking tools to outline which areas need improvement. This is a step is the right direction because, "Several studies over the years have pointed to the fact that simply measuring the progress an institution has made in the field of sustainability leads to an increase in their effectiveness" (Lozano, 2006). This is simply because the process of benchmarking brings the areas of weakness to the forefront of people's minds, so naturally they will begin to improve. Benchmarking tools are important because they are "... a valuable tool for universities and colleges to identify efficiencies, control costs and learn from areas of good practice. It enables them to focus on priorities and make better use of scarce resources" (HEFCE, 2015). The implementation of these tools can save resources like time, money, as well as improve the standing of a university. These tools are also beneficial for a higher education institutions because it can lead to, "The identification of staff with sustainability interests with the purpose of

starting a process that will bring attention to interesting sustainability researchers...”(Halama et al 2017). Not only will these benchmarking tools outline areas of weakness at the university, but they can display the areas that are thriving.

Over the last couple years, the University of Worcester has implemented a few different benchmarking tools. These tools have proven to be either outdated at this point, or are not displaying information the university needs to make improvements. The university tried to implement a benchmarking tool called STAUNCH. This tool analyzed undergraduate curriculum to determine which classes contained sustainable content. This problem with this is that the tool did not include specific enough criteria and missed a lot of classes that contained sustainable content. Another tool the University of Worcester tried to implement was the Kingston Methodology. This issue with this tool is that it only produced information which the university would have to analyze themselves, and it did not have its own grading scale.

In order to try and combat this problem, we did research into a variety of existing methodologies. From there, we took pieces from different methodologies with the goal to have our custom tool display information that was more helpful to the university. Our tools aims to produce measurable results the university can use to make significant improvements.

2.3 Existing Benchmarking Tools

Through our research we found a multitude of various benchmarking tools developed for institutions around the world. Each tool was unique to some degree, as most were created for a specific function in mind. Despite any differences, every tool examined influenced the direction of the custom tool to some degree. Some in a direct manner, such as using specified parameters of measurement, while other were utilized in a more abstract form, like being examined as a cautionary measure for what path not to take.

2.3.1 Sustainability Tracking Assessment and Rating System (STARS)

The largest and most widely-scoped benchmarking tool is STARS, a tool developed by The Association for the Advancement of Sustainability in Higher Education (AASHE) in 2010 for use at American institutions, but later was expanded for use in the international community. It is comprised of 19 metrics sorted into four categories: academics, engagement, operations, and planning & administration. With these, STARS attempts to be flexible in its grading, allowing institutions to discount metrics that are not applicable to them and still be measured at a uniform standard. AASHE intended STARS to not only be a benchmarking tool, but also a way of garnering interest in sustainability.

> Some institutions use STARS as a tool to engage staff, students and faculty and help build a culture of sustainability on campus. For institutions that use STARS this way, the process can be as important as the results, therefore it may take a full year complete a STARS submission. (AASHE, 2017)

STARS is also unique in that it is a database of all participating organizations and their scores. Over 400 participating higher-education institution have their reports publicly available. AASHE allows this data to be used externally in research, benchmarking, and other publications. As of this report, STARS has gone through five iterations: 1.0, 1.1 1.2, 2.0, and 2.1. Subsequently information retrieved from it will be only from versions 2.0 and 2.1, as 1.x has been deemed no longer relevant by AASHE.

2.3.2 College Sustainability Report Card (CSRC)

The CSRC was created in 2007 by the Sustainable Endowments Institute in an effort to comparatively evaluate higher-education institutions in the United States and Canada on their sustainability practices. It consists of a survey that primarily focuses on policies and practices utilized by the institution. "A school's overall grade is calculated from the grades received in nine equally weighted categories. A total of 52 indicators are used to evaluate performance within the categories." (CSRC 2011). Over 300 colleges and universities from Canada & the United States were included in these reports. In 2012, the CSRC was suspended, however all the information gathered by the tool over the five years is still available to the public.

2.3.3 Sustainability Tool for Auditing UNiversity Curricula in Higher-Education (STAUNCH)

STAUNCH was developed by Rodrigo Lozano in collaboration with Cardiff University. Its goal was to help universities systematically audit their courses, degrees, and school contribution to sustainable development by auditing the institution's class offerings. "[STAUNCH] is aimed at helping universities systematically audit their courses, degrees and school contribution to Sustainable Development. It facilitates the audit of a large quantity of courses." (Lozano 2007) This was as a two-step process. First class descriptions were examined for sustainability keywords, then added to an interactive Microsoft Excel document based on what specific keywords were found. Several iterations of STAUNCH were developed, however Lozano has since stopped supporting the tool in favor of providing himself as a sustainability-content consultant.

2.3.4 Sustainability Assessment Questionnaire (SAQ)

The SAQ was designed by the University Leaders for a Sustainable Future (ULSF) in 2001 for the purpose of providing a qualitative questionnaire for colleges and university that functioned as both an assessment instrument and a teaching tool. The SAQ puts emphasis on the importance of properly defining sustainability in higher education, both to add clarity in their evaluation, and to promote the user to self-examine what they perceive to be sustainable. Due to this nature, there is no formalized "score" that an institution receives. Instead, by answering the questions truthfully, an idea of self-awareness is formed, and this in turns help the user promote a discussion on the next steps the institution can take in making themselves more sustainable. "In addition, addressing the issues highlighted in this SAQ can help you identify efficiencies, realize cost savings and productivity benefits, and set the stage for product innovation." (SAQ, Ceres) Because of its qualitative nature and not needing to be updated with new metrics, the SAQ is still actively supported by the ULSF.

2.3.5 Program Sustainability Assessment Tool (PSAT)

The PSAT, also known as Sustain Tool, is a 40 item self-assessment utility developed by the Center for Public Health Systems Science (CPHSS) as a means for staff, managers, funders, and evaluators to both measure their program's sustainability, and produce feedback on ways it can be improved. "Responses will identify sustainability strengths and challenges. Results can then help guide sustainability action planning for a program."(PSAT, Washington University, St Louis MO) It was designed originally for public health programs, but has since been expanded to be applicable to almost any formally organized activities, such as a higher-education organization. The PSAT is currently still in use and is actively supported and encouraged by the CPHSS.

2.3.6 The Kingston Report

The Kingston Report is a customized guideline created by Kingston University's Victoria Hands and Richard Anderson in order to quantify a higher-education institution's faculty's inclination for sustainable efforts. "The aim of this study was to investigate the extent to which sustainable development research was already being carried out across a large university." (Kingston 2016) Rather than being a graded summary of tangible results, the Kingston Report provides an outline for obtaining a general idea of the sustainability research conducted at an institution. This was done primarily through keyword searches, "The analysis of sustainability content was defined through the use of keywords associated with sustainable development […]" (Kingston 2016). The report was published in 2016, and a year later Anderson released an update detailing results of its implementation.

2.3.7 Graphical Assessment for Sustainability in Universities (GASU)

The Graphical Assessment for Sustainability in Universities is a customized sustainability benchmarking tool that was created by the modification of another sustainability tool, the Global Reporting Initiative. The Graphical Assessment for Sustainability in Universities, as its name suggests, offers a condensed graphical assessment of the criteria of sustainability. This is meant to teach the skill of recognizing a picture and understanding where one stands.

We were able to use and extrapolate from much of the information that GASU presents. GASU is meant as a translator from the old version of the Global Reporting Initiative (GRI), and outlines how to go about translating one method to another, which is from where we guided ourselves on. As well, GASU outlines the different types of methodologies that can be made (unit-based, indicator based, etc.), and demonstrates how each works, even translating between each.

2.3.8 Unit-based Sustainability Assessment Tool (USAT)

USAT was developed for use in the Swedish/Africa International Training Programme (ITP) on 'Education for Sustainable Development in Higher Education.' It is part of an initiative which aims to resource African universities to mainstream environment and sustainability into their scopes.

> Though the USAT is designed to be used at departmental/institutional unit level, the results representing the performance of various departments can be averaged to get the overall performance of the institution. Not all the teaching departments or institutional units at a university need necessarily be included in the survey though it is important to have all faculties represented if the results are to represent overall university sustainability performance. However, individual departments / units can also assess their own sustainability performance using the tool and benchmark themselves over time or compare themselves against other departments. (USAT, page 8)

USAT was created in 2009, and updated in 2014. It has proven useful by playing a significant role in improving the sustainability awareness of many African universities.

2.3.9 UI GreenMetric World University Ranking

GreenMetric was created in 2010 as an initiative of Universitas Indonesia to raise its international sustainability standing and to bring awareness to perceived shortcoming in existing benchmarking tools, as well as a created a global sustainability ranking among higher-education institutions. To this end, GreenMetric standardized its criteria to be applicable to any institution around the world. GreenMetric broke down its assessment into six metrics: Setting & Infrastructure, Energy & Climate Change, Waste, Water, Transportation, and Education. Upon

its creation, thousands of universities were invited to participate. As of their 2017 ranking, 619 school and universities have participated in their tool (GreenMetric UL, 2017)

2.4 Custom Benchmarking Tool

There has been a push to implement a custom benchmarking tool that encompasses aspects from the researched tools. This is especially important because, "The University of Worcester's Strategic Plan 2013-2018 includes an area of distinction that seeks to continuously promote principles of sustainability in their broadest sense" (University of Worcester, 2017). The university is continuously striving to improve its sustainability profile, and in order to do so it must implement tools that display information that is different from what the current ones do. The custom tool we created takes pieces from an assortment of different tools in order to give the university information that the other tools cannot give alone. The custom tool has been design with stakeholder engagement to ensure it meets the specific needs for the University of Worcester. In order to achieve this it took multiple iterations of developing the tool, bringing it to our project sponsor, and modifying it based on her input. The finalized tool, when implemented, will give the University of Worcester a different perspective on the standing of their sustainability profile than the previously used tools did. Through this, we hope to help the university make positive steps forward and improve as a whole.

2.5 Understanding the Objectives

The importance of researching and analyzing a wide range of sustainability benchmarking tools is so we may be able to understand how different organizations approached its way to measure one area in sustainability in higher education and what they found most important. Without the background knowledge on how each method works, there is a large amount of confusion on how multiple tools fit together.

There can be a large amount of confusion when reading between two different methods without either copious amounts of time or an abridged version that can compare two methodologies. With this in mind, our group conducted an in depth analysis to each tool. From the analysis, one can find the most important approaches of each method to apply to one custom tool.

The identification of the most important details for each method allowed us to create bridges between any two aspects that may have been previously not been linked. From each methodology we came to understand what focal points are most important in sustainability research. In some areas we found that the approach to sustainability benchmarking lies upon the evaluation of the curriculum and each course's own syllabus, while there are areas that focus solely on professor/researcher online profiles.

The creation of a hybrid methodology is important to the project because it will take the most important variables from all other methods into one that effectively makes ours more versatile of a method. With the idea of a large and diverse selection of methods, we can synthesize a more effective and more encompassing method. This new method would also allow for some of the shortcomings of other methods to be accounted for and alleviated. The application of the new tool will give the university their own all around methodology that utilizes all best aspects from the array of tools.

When creating a new tool for a specific institution, it is important to know what the stakeholders want to see out of the project. The input from our project sponsor allowed us to narrow the focus of the tool to the areas that needed to be focused on. For our project, our project sponsor wanted us to focus on the areas of undergraduate curriculum and research.

3. Methodology

This chapter details what we set out to do, the information we collected, why this information was important, and how we got it. The goal of this project was to analyze how the university is currently benchmarking their sustainability practices, and create a custom benchmarking tool that can be applied not only at the University of Worcester, but at any university looking to improve their sustainability practices. This project can be broken down into three main phases: the gathering, organization, and creation phases. In the gathering phase, we examined all existing benchmarking tools from around the world, and shortlisted ones we wanted to further investigate. We began to analyze these tools and break them down into their individual grading metrics. In the organization phase, we created a database to store the different metrics we identified across all the methodologies. In the creation phase we developed categories that our custom tool would use to analyze the University of Worcester. We created a variety of categories to focus on, we engaged with our project sponsor and modified the areas our tool would analyze based off of her feedback. Through the different phases of development, along with stakeholder engagement, we were able to piece together two comprehensive graded questionnaires that can be used to analyze specifically curriculum and faculty research. Once the questionnaires were created, we developed a grading system that can be used by a university to compare itself to the other institutions that apply this custom tool. The implementation of these questionnaires would outline key areas in the undergraduate curriculum and on campus research that could be improved.

3.1 The Gathering Phase

The gathering phase proved to be the most time consuming portion of this project, lasting about three weeks in length. In this time, we conducted a significant amount of background research to familiarize ourselves with the existing tools that are currently being implemented around the world. In this research we soon realized that there were a large number of tools to go through. We examined as many of these tools as we could, and shortlisted a variety of them which were applicable to our project. A tool was determined applicable if it met the following

criteria: it was used to analyze some aspect of higher education institutions it had been successfully run at a substantial number of institutions, it had an effective way to grade and display the results, and it was publicly available. We took the list of relevant tools and began to analyze how they each graded the institution in question. We examined each tool in detail to give us a better understanding of how existing tools work, as well as how our tool could be designed. There were many different styles of grading among the tools. Some of them used a singular set of questions that gave qualitative results, but more often than not, the tool was broken down into specific grading metrics that were separated into categories like student involvement, waste management, energy efficiency, etc. In order to give us a more robust understanding of how they operated, each member of the group chose a few tools to further analyze. All of the information we gathered would be useless to us, unless we created a way to organize it so it was easier for us to understand and manipulate.

3.2 The Organization Phase

The organization phase of our project consisted of developing a system to make all the information we collected easier to work with. We discussed a variety of different options to store all the information, and decided to create an excel database. This was the most convenient format because it allowed us to import and expert information very easily. In the early stages of this database, we simply put in the name of each benchmarking tool we analyzed along with a description of how it worked. In order to understand how each tool was organized, we began to outline the different grading categories each of them contained. We decided to organize the information this way because we noticed that a lot of the categories across the different tools were either repeated or were very similar. This made it possible to look at a tool in our database, locate one of the categories with specific metrics you were interested in, and then go to a document with links to each tool. To break things down even further, we linked a document to each tool with complete list of all the questions that a tool asked as well as the way its grading score was determined. Creating this database saved us a lot of time, and once things were set up this way it made it much easier to navigate through all the information we collected in our research.

3.3 The Creation Phase

The creation phase of our project was when we began to piece together our custom tool. Using the created database, we brainstormed categories we wanted to incorporate into our custom tool. Based upon the overlapping areas between the categories in our database we came up with the following list of areas our tool would analyze: Administration, Financial, Energy & Pollution, Workforce, Research, Curriculum, Building Design, Water Management, Waste Management, Transportation, and Student/ Campus Involvement. Deciding how the pieces from each of the researched tools fit into the categories we created was a strenuous process. For example, the Financial category we created was made to encompass many of the categories from the researched tools such as: Funding Sustainability, Endowment Transparency, Investment Priorities, etc. Each of the categories we created grouped categories from existing tools by similarity. This was important because it allowed us to have a large quantity of different grading questions that we could pull from all of the researched tools that were grouped together.

Our sponsor, from the University of Worcester, reviewed our tool in progress and gave us input on the direction they wanted us to take it. We were directed to focus primarily on two of the categories we created- research and undergraduate curriculum. We began to look through the list of possible questions under each of those categories in our database. This gave us a good idea of which types of questions we were going to use.

We determined that our tool was going to have a mix of yes/ no questions as well as gradient questions, which are questions that have a range of answers. Most successful existing tools we researched did not have very many questions for each category. Knowing this, we limited our tool to 10 questions per category, totaling 20 questions between both categories. This allowed our tool to be very short and direct. Questions were chosen very carefully to try and determine which of them would give us the most thorough analysis for each category. We aimed to choose a group of questions that worked well with each other to analyze as much of the category as possible. Our project sponsor reviewed our tool and made a few suggestions based on differences in language between the United States and England. This was difficult at first

because we use different words to describe the same things, but we modified our tool to be better suited for the United Kingdom.

In order to quantify the information our tool is going to display, we needed to develop a grading scale. We decided to give each question in our tool equal weight with a maximum score of 5 points. This kept things simple, and helped avoid bias when determining the weighted importance of each question. For the yes/ no questions, a yes is worth 5 points and a no is worth 0; in the gradient questions, depending on the answer to the question, it is worth between 0 and 5 points. In order for our tool to be easily implementable, we decided to create a grading key. This grading key details the department, building, or area of the university website where the information can be found need to answer each question. The grading key, as found Appendices D&E, was created to make it as easy as possible for anyone to pick up our custom tool and be able to implement it. Our tool, much like every existing tool, has its limitations, and it is important to understand them. The final score our custom tool will display once it is graded may not carry much weight until it is able to be compared to scores from other universities. While this may be a factor, the university implementing our tool will still see which areas they score low on indicating improvement is necessary.

4. Findings

The course of our project was shaped from time to time based of new findings and developing stakeholder expectations. The process of creation of a new benchmarking tool often involves extensive research and analysis of relevant parameters. Not only is it critical to understand the importance of such a tool but it is also vital to grasp the attributes that combine to formulate an effective benchmarking tool (Miles, 2015). In our research process revolving around the characteristics of such an efficient benchmarking tool, our research team was able to draw three strong conclusions. These conclusions are that benchmarking tools are created and developed specific populations or specific institutions, different benchmarking tools have distinctive styles of operation and every benchmarking tool has its own unique grading strategy. Building a custom tool based of these findings gave is scope to optimize our tool to be applied at any institution. We also found that our stakeholders played a significant role in restructuring and further designing our custom benchmarking tool based of their requirements and relevance.

4.1. Benchmarking Tools for Specific Populations

In the early stages of research, we found that there was a vast quantity of existing benchmarking tools for higher-education institutions around the world. To be efficient, it is essential to establish a strong understanding in the field of sustainability and assessment tools. In order to do this, our research team had to carry out detailed analyses of multiple benchmarking tools. In this phase of researching and analyzing, we found that majority of these benchmarking tools that existed worldwide were custom-created, which means that these benchmarking tools were often found to have been developed for a specific continent, an individual country or a particular institution. A deeper analysis revealed that, every country had its own set of rules and regulations which play an important role in foundation of any such benchmarking tool.

> In the U.S., it generally takes four years to earn a bachelor's degree. However, undergraduate programs in a number of European countries are typically only three years long. The main difference is that U.S. programs include a lot of

general education courses that many European programs don't. (Kelly Mae Ross, US News, August 11, 2017).

Many existing benchmarking tools are tailored to American Universities and need to be adapted to be applied to universities in the United Kingdom in order for them to be graded like a school from the United States, and thus be able to be properly compared to other universities who took the same test(s). STARS, a tool developed by The Association for the Advancement of Sustainability in Higher Education (AASHE) in 2010 for American institutions. Not only was STARS built by abiding American laws and regulations, but was also created by taking into account the fact that all US education institutions include general education courses in their curriculum. We found that STARS used a grading system which graded institutions based on questions which were directly related to general education requirements. According to the AASHE database of schools who had used STARS as a benchmarking tool for the university it was found that on average, schools based in the United Kingdom did worse than the average of universities in the United States (AASHE). This is a direct consequence of the lack of general education courses in the U.K, which is a cornerstone for schooling in the U. S. Thus, benchmarking tools such as STARS would not be applicable in European countries that do not have mandatory general education courses in their education system.

Further analysis proved that different countries had contrasting sustainability needs. An interesting example of this was Unit-based Sustainability Assessment Tool, which is an assessment tool developed specifically to benchmark the sustainability inclination of African Universities. Since most countries of Africa are third world, their sustainability needs would be much different than a first world country as demonstrated in the paper outlining USAT:

> In Africa, a concern for sustainability is often reflected in contributions to sustainable development and poverty alleviation at community and national levels. Universities that show commitments to sustainable development often feature topics like globalization and sustainable development; environment and development; poverty reduction; appropriate technologies; land ethics, rural development and sustainable agriculture; urban ecology and social justice; population, women and development etc. in the curriculum. (Togo and Sisitka 2009; 4).

Thus a tool such as USAT would fail to legitimately illustrate sustainability standings if applied in a country like China, which has a completely different socioeconomic climate. In China,

> [E]conomic growth, poverty and environmental problems are interrelated, and the worst-case scenario is a vicious cycle: on the one hand, poverty alleviation requires economic development that puts further pressure on the fragile ecosystem; on the other hand, the environment and natural resources can be constraints on low-income regions as they attempt to emerge from poverty. (The Diplomat, Junjie Zhang, January 10, 2013).

Thus, a benchmarking tool being developed to combat such socio-economic conditions in China would grade its contents on a completely different scale than one being developed for higher-education institutions in the US. Therefore, benchmarking tools are custom created for specific populations taking into account their individual priorities, requirements and socio-economic conditions.

4.2 Characteristics of Benchmarking Tools

After further analysis, our research team categorized existing benchmarking tools. We were able to differentiate benchmarking tools based on their characteristics. They could each be put into two categories, Unit-based benchmarking tool and Indicator-based benchmarking tool. We also found that every benchmarking tool had its own format of assessment.

4.2.1 Unit-based Benchmarking Tool

A Unit-based benchmarking tool assess the current standing of an institution in terms of sustainable development. This type of benchmarking tool always generates quantitative scores as results. "Using a unit-based assessment tool, allows for 'building the picture' of the whole, as well as concentrating on specific units as required" (Togo and Sisitka, USAT, 2009). A unit based benchmarking tool can give us the whole picture of an institution in terms of its sustainable development. The benefits of a unit-based benchmarking tool are well explained in USAT, "Its major strength is that it is flexible, and easy to use, while giving a picture of progress being made towards sustainability. Data from assessments using the USAT are easy to represent, understand and compare, and can easily be discussed at for example staff meetings." (Togo and Sisitka, USAT, 2009).Thus, using such a tool would be suitable for identifying areas in an

institution that need attention for sustainability, but would not be capable of indicating if these areas are bound to improve or further degrade. That is, a Unit-based benchmarking tool would fail to predict if a highly scoring institution would suddenly collapse in terms of sustainability or improve significantly. This is where an Indicator-based benchmarking tool proved to be better equipped.

4.2.2 Indicator-based Benchmarking Tool

An Indicator-based benchmarking tool assesses an institution to outcome sustainability potential. Such a tool would identify areas that are doing well as well as areas that need immediate attention in terms of sustainable practices, along with providing suggestions and recommendations supported with reasoning to improve the same. An institution on executing such a tool would be able to identify their sustainability and would also be able to find out if they are progressing or regressing in terms of sustainable development.

> [...] [I]ndicator-based assessments offer higher levels of transparency, consistency and usefulness for decision-making. Indicator based assessments can also be easily measurable and comparable, making them more objective than accounts or narrative assessments [...] (GASU)

However, any unit based benchmarking tool could be converted into an indicator based tool if you took the test at two different times (Togo and Sisitka, 2009; Lozano, 'Elsevier,' 2005). "By comparing the chart from one year to the next the university leaders can observe the evolution of their efforts towards sustainability." (Lozano, 'Elsevier,' 2005). The use of two different data points is a practical way to see the progress that any institution makes throughout the course of the time lapse.

4.2.3 Unique Grading Format

Further research proved that individual benchmarking tools had their own unique grading approaches. Depending on the tool category and individual goals, every inspected benchmarking tool is structured with an exclusive style of grading system. These structures can either be in the

format of a questionnaire, excel files, a computer-based grading system or an interactive PDF. For example, benchmarking tools such as SAQ, USAT, PSAT and GreenMetric were in the form of a questionnaire. Benchmarking tools like STAUNCH existed in the form of a excel file. Whereas benchmarking tools such as STARS existed in the form of a computer-based grading system or an interactive PDF. We also found that there were multiple ways in which assessed information was graded in these individual benchmarking tools. Most tools assessed information criteria qualitatively or quantitatively as deemed necessary. However, benchmarking tools which used quantitative grades were found to be comparatively easier to execute and much more accurate in their grading processes. This can be shown in the comparison between the SAQ and USAT: where USAT uses entirely quantitative grading, which is very straight-forward and easy to see whereas the SAQ uses multiple choice questions which is more difficult to give a straight grade. Nonetheless there existed few instances where inclusion of both, qualitative and quantitative yielded better results. Further analysis revealed that benchmarking tools structured by computer based assessment systems were often more elaborate in their design yet failed to reap desired accuracy. We found that structures which existed in the form of lengthy questionnaires, complicated online PDFs, or in the form of a sophisticated computer assessment systems were not only less frequently used but were often outdated.

4.3 Differences in Definitions

In later stages of our research phase, we found that benchmarking tools had different definitions of composition. After further analyzing, our research team was able to find certain problems that arose from trying to translate between our various methodologies. This is to say that trying to translate one method to another is almost impossible without a bridge between each that allows easy navigation and interpretation of each method. In order to create that bridge between each method we used, we first had to go through every detail of each method to understand the mechanism of its operation. We found that there had been little overlap between some methods, while others shared a significant amount of data.

4.3.1 Grading Elements

Setting the background for how we went about translating between every method: we found that it was best to first know what we had for data. Each method measures the sustainability inclination of an institution, but do so in a variety of different approaches. One aspect that differs greatly is the calculation of the grade, this affects the way the tool displays its final results. Also it is important to take into account the weight of each question, which affects the final grade and shows how each method prioritizes its questions. The final aspect is differentiating between the primary focuses of each tool to find what they define as most important.

4.3.2 Grading Criteria

Further depth into the above-mentioned aspects reveals the nuances that make the comparison between individual tool definitions cause problems when put together without a common bridge. There is the fact that each tool has its own goals and will critique each institution based on what they want to see. This, too, makes the need for a bridge much more practical. An example of a discrepancy in how each tool defines itself is shown in the comparison of STAUNCH, GASU, and STARS. STAUNCH"[...] was designed to audit the education for sustainability and global citizenship content of higher education curricula." (Glover, Peters, Haslett 2010); STARS "[...] was developed in recognition of the fact that, while various charters give direction on the way in which higher education can contribute to sustainable development, they do not offer guidelines on what exactly needs to be done" (Togo and Sisitka, 2009); and GASU "[...] was designed to facilitate the analysis, longitudinal comparison and benchmarking of universities' sustainability efforts and achievement" (Togo and Sisitka, 2009). While each of these goals are similar in essence, the grade of each tools specific questions will mirror the goal of the tool. This is fixed by our thorough analysis and filtering of the questions to fit our goal and our format.

Another example of discrepancy between different sustainability benchmarking tools, is the weighting system of each question. While the calculation of grades from STARS, STAUNCH and CSRC, as some examples, had some highly weighted questions that contributed

to the final grade, other tools such as USAT had a uniform weighting of one (meaning that every question was worth one point of the final grade).

4.4 Developing the Custom Tool

In the process of creating our custom benchmarking tool, we analyzed our existing collection of tools to help decide on the format in which it would be presented. Of the tools we looked at, we found the most common delivery method to be that of a self-filled questionnaire, usually conducted by a member of the organization's sustainability department. Other methods included an interactive spreadsheet, such as STAUNCH, or were conducted through interviews with faculty, like the Kingston Report. We found that the questionnaire seemed to be the most ideal route for a number of reasons; the primary rationale being that it is significantly more straightforward than the other options. While the spreadsheet gives concrete numerical data, it requires an infeasible amount of time to create and execute, and conducting interviews to gather data runs the risk of inconsistencies based on how well the organization's staff communicate with one another. Additionally, these techniques are limited in the types of data that they can accurately analyze. For these reasons, we found that a questionnaire, filled out by a member of the institution, would be the ideal delivery method for our custom tool.

When determining how we were going to grade the results of our tool, we felt it was necessary to find a standard by which to measure each question. This process required a database of pre-existing information for a significant quantity of institutions' sustainability practices, and more importantly, related directly to the questions we were posing. This would allow for the creation of a scale that would be based on results and averages and therefore be a fair and accurate tool for assessment. We decided to use AASHE's database of STARS reports for creating these metrics. This was done for a variety of reasons. For one, the AASHE database is by far the largest and most in-depth collection of sustainability assessments on colleges & universities that are publically available. As of this report, "875 institutions have registered to use the STARS Reporting Tool." (AASHE 2017) Additionally, STARS itself was one of the most extensive benchmarking tools we found, with 19 individual sustainability categories made up of over 80 sub-sections. Due to this, many of the questions found in our custom tool were

derived or inspired by STARS. This ended up making creating standards from their database relatively simple.

       With a source for our grading metrics found, it became a matter of determining three things: What are the types of questions included, what is the range of possible scores for each question, and what is the scale for those ranges? For the types of questions, we found that all the metrics we intended to measure could be simplified into two categories for scoring purposes: gradient and yes/no. Gradient scoring provides a range of possible outcomes and organizes them into clusters that can be assigned to a particular value. For example, 0% to 20% might equal 1, 21% to 40% is 2, and so on. This provides a means of simplifying percentage or numerical values into a system that allows questions to be related to one another. Yes/no questions are fairly self-explanatory. A value is given if the answer is yes, and not if it is no. We believed that keeping the questions limited to these two types would keep our tool easy to use, while still having enough flexibility to accurately assess sustainability factors. Once a desired set of questions were obtained, it came down to how large or small the possible range of scoring should be. We found that many of the current benchmarking tools lacked uniform scoring, with each set of questions having their own scales. This led us to the idea of giving each question the same range, with gradient questions starting at a minimum score and ending at a maximum score, and yes/no questions following suit, so a 'yes' answer would be equal to that same maximum score, and 'no' would be equal to that same minimum score, thus keeping all the questions in the same point range. Finally, to make sure we created a fair and responsible benchmarking tool, the gradient-style questions needed to be outfitted with a standardized range of values. For this task, we examined the AASHE database results for the questions that could be related back to questions from STARS, and for each individual question, we found the best way to obtain an adequately accurate range was to find the minimum, median, maximum, and average scoring results. Generally, the minimum would be used for the lowest range of values, the maximum for the highest, and the average and median would be compared to find the middle range. From there, any intermediate scoring ranges would be determined by bisecting the minimum and the median or the maximum and the median.

5. Conclusions & Recommendations

Our team was able to provide a custom benchmarking tool to the University of Worcester which was capable of assessing the university's undergraduate curriculum and on campus research fields in terms of sustainable development. The tool was created by researching, analyzing, shortlisting, organizing and comparing numerous different benchmarking tools that valuated institutions for sustainable development. Relevant data from all these existing methodologies was taken apart, remodeled and compiled into a format of a smart questionnaire which comprises our custom tool. Major conclusions that shaped the creation of our custom benchmarking tool were as follows.

1. Even though discovered benchmarking tools were significantly differently and developed for specific populations, they all proved to have overlapping categories that were relevant to our project.
2. There are many differing formats to present the data that we have collected and compiled, one of the most effective has proven to be the comprehensive questionnaire.
3. The data collected can only be as good as the grading system that assesses it, therefore it is important to have a simple, fair, yet comprehensive grading system relevant to our project.
4. Stakeholder engagement was crucial in the creation of our final project because it allowed us to tailor the custom tool to meet the University of Worcester's specific needs.

Unfortunately due to time constrictions, our research team was not able to fully execute our custom benchmarking tool to the University of Worcester. Thus after further data collection and discussion we concluded that it would be best if work on our benchmarking tool was continued by other research teams. The following recommendations are addressed to any future team that would further better our custom benchmarking tool.

5.1 Apply the tool

Our first and most important recommendation would be to actually apply the custom benchmarking tool to the University of Worcester. The successful application of this would showcase our tool's authenticity or display areas that need improvement. In both these scenarios the end outcome would only benefit our project sponsor and the University of Worcester. After putting our heads together we concluded on providing future teams with a guide (potential appendix) with information to aid them in this application process. The guide would comprise of relevant data and crucial contacts which are pivotal for a rewarding execution of this custom benchmarking tool. We also provide with on campus locations and university departments that are high potential resources to further aid incoming research teams. An additional recommendation in this section would be for the research team potentially arriving in Worcester in spring 2018 from WPI, we recommend that they start the application process as soon as possible because it may take them longer than generally assumed.

5.2 Re-analyze benchmarking tools list

Our next recommendation would be critique and re-analyze our list of researched benchmarking tools. This step is one that cannot be avoided because to alter or enhance the structure of any benchmarking tool, it is crucial to understand the pillars on which they stands. To aid in which we are providing with an appendix (Appendix C) that contains a concise list of benchmarking tools which were shortlisted after research and analysis of several different methodologies from across the globe. The appendix also contains relevant information about each individual benchmarking tool which would be sufficient for accessing and further analyzing them. Securing knowledge about these benchmarking tools would fully equip future teams to critique our custom tool. It also provides them with an opportunity to contradict or support our reasoning that was applied on every step of tool creation process, based of which the teams would then be capable of making edits as they deemed fit.

5.3 Update benchmarking tools

Our last recommendation to future research teams would be to thoroughly look into updated methodologies. These benchmarking tools are not only created based of demographic specific sustainability definitions which keep developing but are also created based on the definition of sustainability, which is constantly changing. As a result of which it is very normal to see multiple updated versions of these benchmarking tools being released frequently. Usually these tools show a trend of having yearly updates. We are convinced that Sustainability Tracking, Assessment & Rating System (STARS), which is one of our shortlisted benchmarking tool is releasing a new version in first quarter of 2018. It can be easily concluded that the validity of a benchmarking tool is compromised once a newer version of it is released. Therefore to preserve the authenticity of our custom benchmarking tool it is crucial to keep updating it after every release of a newer version of used benchmarking tool. We are confident that execution of this custom benchmarking tool would not prove constructive in evaluating the University of Worcester's undergraduate curriculum and on campus research, but would also improve the university's overall sustainability profile.

References

AASHE STARS. (n.d.). Retrieved December 13, 2017, from https://stars.aashe.org/

Annual Sustainability Report: 2014-2015 [PDF]

Annual Postgraduate Conference. (n.d.). Retrieved December 13, 2017, from
    https://10times.com/annual-postgraduate-conference

Cassidy, L., & Hamilton, J. (2016). A design science research approach to website
    benchmarking. Benchmarking: An International Journal, 23(5), 1054-1075.
    doi:10.1108/BIJ-07-2014-0064

Citation Machine™ automatically generates citations in MLA, APA, Chicago, Turabian, and
    thousands more! (n.d.). Retrieved December 13, 2017, from
    http://www.citationmachine.net/

College Sustainability Report Card - Suspended. (n.d.). Retrieved December 13, 2017, from
    http://www.greenreportcard.org/index.html

England, H. F. (n.d.). Benchmarking. Retrieved December 13, 2017, from
    http://www.hefce.ac.uk/funding/efficient/bench/

Furness, Austen, Melehov, John, Murphy, Philip, Veilleux, Michael. Business perceptions of the
    worcester region . 2001.

Glover, A., Peters, C., & Haslett, S. (n.d.). Education for sustainable The STAUNCH auditing
    tool ... Retrieved December 13, 2017, from
    http://www.bing.com/cr?IG=D7FD6A1C87594B4DAD4F53C7742544C6&CID=34E48
    DB5001C69F5102F86E201B36823&rd=1&h=ER9_5CHXJkgJlzcjnMn7uhlxg0J2S5S2Z
    C6jOawDRhQ&v=1&r=http%3a%2f%2fwww.sustainabilityexchange.ac.uk%2ffiles%2f
    esd_staunch_paper.pdf&p=DevEx,5067.1

Handbook of Theory and Practice of Sustainable Development in Higher Education. (n.d.).
    Retrieved December 13, 2017, from https://books.google.co.uk/books

Indicators. (n.d.). Retrieved December 13, 2017, from

http://www.greenreportcard.org/report-card-2011/indicators.html

Indicators of sustainable development. 3. ed., October 2007 ed. New York: United Nations; 2007.

Keeble BR. The brundtland report: 'Our common future'. Med War. 1988;4(1):17-25.

Krippendorff K. Content analysis: An introduction to its methodology. Beverly Hills: Sage Publications; 1980.

Lozano R. A tool for a graphical assessment of sustainability in universities (GASU). Journal of Cleaner Production. 2006;14(9):963-972. http://www.sciencedirect.com/science/article/pii/S0959652606000357. doi: //doi.org/10.1016/j.jclepro.2005.11.041.

Miles, S. (n.d.). Top Tips For Successful Benchmarking. Retrieved December 13, 2017, from https://businessanalystlearnings.com/blog/2015/3/30/top-tips-for-successful-benchmarking

Nadeau R, JSTOR eBooks. The environmental endgame: Mainstream economics, ecological disaster, and human survival. New Brunswick, N.J: Rutgers University Press; 2006.

Nederhof AJ. Bibliometric monitoring of research performance in the social sciences and the humanities: A review. Scientometrics. 2006;66(1):81-100. doi: 10.1007/s11192-006-0007-2.

Nunez VC, Macfarlane J, Halama S. Critiquing a sustainability research benchmarking tool. Worcester Polytechnic Institute. 2017:1-76.

Poveda CA, Elbarkouky MMG. Hybrid process-criterion benchmarking methodology framework to support sustainability performance assessment and reporting. International Journal of Sustainable Development & World Ecology. 2016;23(3):278-291. http://www.tandfonline.com/doi/abs/10.1080/13504509.2015.1115786. doi: 10.1080/13504509.2015.1115786.

Research development university of worcester. University of Worcester Web site. https://worcresearcherdevelopment.com. Accessed September 5, 2017.

Ross, K. M. (n.d.). How Bachelor's Degree Programs in the U.S. and Europe ... Retrieved

December 13, 2017, from https://www.bing.com

Sustainability Assessment Questionnaire (SAQ ... - ulsf.org. (n.d.). Retrieved December 13, 2017, from http://www.bing.com/cr?IG=06A61456F16143CDA4D3FB28D145A46A&CID=39965A22A3F46E403BE95175A25B6F64&rd=1&h=ct3naDlzCCRYj39VY1gzD-mQNWdodeWQ9inPR-0QPzY&v=1&r=http%3a%2f%2fulsf.org%2fwp-content%2fuploads%2f2015%2f06%2fSAQforHigherEd09.pdf&p=DevEx,5036.1

Togo, M., & Lotz-Sisitka, H. (1970, January 01). The Unit-Based Sustainability Assessment Tool and its use in the UNEP Mainstreaming Environment and Sustainability in African Universities Partnership. Retrieved December 13, 2017,

Ulkhaq M. Assessing campus sustainability: An ISO 14001 approach. International Journal of Advances in Agricultural & Environmental Engineering. 2016;3:245-248. Accessed Sep 24, 2017. doi: 10.15242/IJAAEE.U0516207.

United Nations Conference on the Human Environment. (n.d.). Declaration of the United Nations Conference on the Human Environment. Retrieved December 13, 2017, from http://www.un-documents.net/unchedec.htm

Villanova University Receives STARS Silver Rating for Sustainability Achievements. (n.d.). Retrieved December 13, 2017, from https://www1.villanova.edu/villanova/media/pressreleases/2015/0122.html

White, R. M. (2013). Sustainability research: A novel mode of knowledge generation to explore alternative ways for people and planet. () doi:10.4324/9780203101780

Wright TSA. Definitions and frameworks for environmental sustainability in higher education. High Educ Policy. 2002;15(2):105-120.

Zhang, J. (2013, January 10). Is Environmentally Sustainable Economic Growth Possible in China? Retrieved December 13, 2017, from https://thediplomat.com/2013/01/is-environmentally-sustainable-economic-growth-possible-in-china

Appendices

Appendix A

Acronyms:

SAQ- Sustainability Assessment Questionnaire.

CSRC- The College Sustainability Report Card

STARS- Sustainability Tracking Assessment and Rating System

STAUNCH- Sustainability Tool for Auditing UNiversity Curricula in Higher-Education

USAT- Unit-based Sustainability Assessment Tool

SUSTAIN TOOL- Program Sustainability Assessment Tool

SAQ- Sustainability Assessment Questionnaire

GASU- Graphical Assessment of Sustainability in Universities

Key Terms:

Module- the individual classes offered at the University of Worcester

Course- the different areas of study that students can choose from at the university

Category- the different areas a benchmarking tool looks at to analyze

Metric- grading questions each benchmarking tool uses to determine a score for each category

Indicator Based- a type of methodology that gives current potential of an institution, time-lapse estimate.

Unit Based- a type of methodology that gives the current standing of an in an institution, usually a numeric score

Benchmarking- Evaluating and understanding the current position of an organization

Database- In terms of this project, an excel file created that contains discovered benchmarking tools, their broken-down categories and general information.

Stakeholders- In terms of this project, our sponsor Dr. Heather Barrett, as well as Katy Boom and the University of Worcester.

Appendix B

This table of keywords was used to determine if a module, course, or academic department was deemed sustainability-oriented. If it contained one or more of these keywords it was we determined it to be

Table 1.C: Keywords derived from the UN Sustainable Development Goals

Goal 1 -- Poverty	Goal 10 -- Inequality
Poverty	Reduce inequality
Goal 2 -- Food	Inequality
Hunger	**Goal 11 -- Habitation**
Food security	Inclusive human settlements
Nutrition	Inclusive cities
Sustainable agriculture	Cities
Goal 3 -- Health	Human settlements
Healthy lives	**Goal 12 -- Consumption**
Well-being	Sustainable consumption
All ages--elderly	Consumption
Goal 4 -- Education	Production patterns
Equitable education	**Goal 13 -- Climate**
Inclusive education	Climate change

Opportunities for all	**Goal 14 -- Marine-ecosystems**
Goal 5 -- Women	Conserve oceans
Gender equality	Sustainably oceans
Empower women	Oceans
Women	Marine
Girls	Seas
Goal 6 -- Water	**Goal 15 -- Ecosystems**
Water	Terrestrial ecosystems
Sanitation	Ecosystems
Goal 7 -- Energy	Manage forests
Affordable energy	Desertification
Reliable energy	Land degradation
Sustainable energy	Land
Energy	Biodiversity
Goal 8 -- Economy	**Goal 16 -- Institutions**
Sustainable economic growth	Peaceful societies
Sustainable growth	Inclusive societies
Economic growth	Access to justice

Productive employment	Justice
Employment	Inclusive institutions
Decent work	Accountable institutions
Work	**Goal 17 -- Sustainability**
Goal 9 -- Infrastructure	Global Partnership for Sustainable Development
Resilient infrastructure	
Infrastructure	
Sustainable industrialization	
Industrialization	
Foster innovation	
Innovation	

Summarized from The United Nations, General Assembly, "Transforming Our World: The 2030 Agenda for Sustainable Development" 17 Sustainable Development Goals (United Nations 2015)

Appendix C

This table is copied from our database. This table outlines each of the different benchmarking tools we used, as well as the different categories they analyze.

STARS	Report Card (CSRC)	Sustain Tool (PSAT)	SAQ
Curriculum	Administrative	Environmental (Political) Support	Facility Information
Research	Climate Change & Energy	Funding Stability	Workforce Profile
Campus Engagement	Food and Recycling	Partnerships	Employment Relationship
Public Engagement	Green Building	Organizational Capacity	Management System and Training
Air & Climate	Student Involvement	Program Evaluation	Greenhouse Gas Emissions and Energy Usage
Buildings	Transportation	Program Adaptation	Air Emissions
Energy	Endowment Transparency	Communications	Water Management
Food & Dining	Investment Priorities	Strategic Planning	Waste Management
Grounds	Shareholder Engagement		Packaging
Purchasing			Pollution Prevention
Transportation			Other Raw Materials
Waste			Transportation
Water			Workplace Management
Coordination & Planning			Health & Safety
Diversity & Affordability			Forced Labor
Investment & Finance			Child Labor & Young Workers
Wellbeing & Work			Discrimination
Exemplary Practice			Freedom of Association & Collective Bargaining
Innovation			Harassment & Abuse
			Compensation
			Hours of Work
			Disclosure

GreenMetric	USAT	GASU
Setting and Infrastructure (SI)	Curriculum	Curriculum
Energy and Climate change (EC)	Teaching Approach	Research
Waste (WS)	Research & Scholarship Activities	Service
Water (WR)	Community Engagement	
Transportation (TR)	Examination (assessment) of sustainability topics	
Education (ED)	Staff Expertise & willingness to Participate	

Appendix D

This table is copied from the database we created. It outlines the different categories we wanted our tool to analyze. It also outlines the categories, and what they were called, from existing benchmarking tools that influenced the categories we created (in bold).

Transportation	Found in:	Waste Management	Found in:	Water Management	Found in:
Transportation	CSRC	Food/ Recycling	CSRC	Water	GASU
Transportation	GASU	Waste	GASU	Water Management	SAQ
Transportation	SAQ	Waste	SAQ	Water	STARS
Transportation	STARS	Food/Drink	STARS		

Student/Campus Involvement	Found in:	Administration	Found in:	Financial	Found in:
Student Involvement	CSRC	Administrative	CSRC	Investment Priorities	CSRC
Service	GASU	Organizational Capacity	PSAT	Shareholder Engagement	CSRC
Communications	PSAT	Program Adaptation	PSAT	Endowment Transparency	CSRC
Partnerships	PSAT	Program Evaluation	PSAT	Funding Sustainability	PSAT
Campus Engagement	STARS	Strategic Planning	PSAT	Disclosure	SAQ
Public Engagement	STARS	Management System/ Training	SAQ	Investment and Finance	STARS
Community Engagement	USAT	Coordination/ Planning	STARS	Purchasing	STARS
Student Involvement	USAT	Policy/ Written Statements	USAT		

Curriculum	Found in:	Research	Found in:	Building Design	Found in:
Curriculum	GASU	Research	GASU	Green Building	CSRC
Education	Green Metric	Research	STARS	Setting & Infrastructure	GASU
Curriculum	STARS	Research & Scholarship Activities	USAT	Facility Information	SAQ
Curriculum	USAT			Buildings	STARS
Teaching Approach	USAT			Grounds	STARS

Energy/ Pollution	Found in:	Workforce	Found in:	Uncategorized	Found in:

Climate Change	CSRC	Workplace Management	SAQ	Packaging	SAQ
Energy and Climate Change	Green Metric	Hours of Work	SAQ	Other Raw Materials	SAQ
Environmental Support	PSAT	Employment Relationship	SAQ	Exemplary Practice	STARS
Greenhouse Gas Emission and Energy Use	SAQ	Workforce Profile	SAQ	Examination	USAT
Air Emission	SAQ	Discrimination	SAQ		
Pollution Prevention	SAQ	Harassment/ Abuse	SAQ		
Energy	STARS	Compensation	SAQ		
Air and Climate	STARS	Health/ Safety	SAQ		
		Freedom of Association/ Collective Bargaining	SAQ		
		Diversity/ Affordability	STARS		
		Wellbeing/ Work	STARS		
		Staff Participation	USAT		

Appendix E

Grading Key

The information in this document is meant to help anyone applying our custom tool. Outlined below is the location to some of the information necessary to answer the questions on the questionnaires, as well as an explanation for the grading scale.

For the questions that include an asterisk (*) next to the number
We examined the STARS 2.0 & 2.1 database including over 500 higher education institutions. Based on this information we looked at universities that scored on the low and high end in each category, then gave each number 1-5 a percentage based on the median scores.

Curriculum

Question 1*
Number of courses that include sustainability related topics, themes, or modules, relative to the total number of undergraduate courses offered at the institution, as a percentage.
Location: University of Worcester website> Start Your Journey> A-Z of Courses. The courses are deemed sustainable if they contain one or more of the keywords from the United Nations 2030 agenda.
Median Score: 13.47%

Question 2*
Number of modules that include sustainability related topics or themes, relative to the total number of modules offered at the institution, as a percentage.
Location: Student section of the University of Worcester website> must get access from a professor or other member of faculty.
Median Score: 9.92%

Question 3*

Number of undergraduate students who have taken a sustainability-related module in relation to total number of students enrolled at the institution, as a percentage.

Location: University of Worcester Director of Sustainability Department

Median Score: 42.15%

Question 4*

Number of departments at the university that include sustainability in their curricula in relation to the total number of departments/colleges at the university, as a percentage.

Location: University of Worcester website> Discover Worcester> Academic Departments. Look at the courses under each department. The Department is deemed sustainable if they contain one or more sustainability oriented course (see question 1).

Median Score: 37.61%

Question 5

Does the institution contain one or more student organizations with a purpose directly related to sustainability?

Location: Student Union office located in the Hangar.

Grading: The answer is Yes if and only if it meets all of the following conditions.

1. The institution has existing sustainability oriented student organizations.
2. The student organization is active

Question 6

Does the institution maintain a regularly updated sustainability website?

Location: https://www.worcester.ac.uk/

Grading: The answer is Yes if and only if it meets all of the following conditions.

1. The institution has a web page.
2. The institute has an independent website dedicated to sustainability or a sub-domain in the institution website dedicated to sustainability.
3. The website is updated at least once a month.

Question 7

Does the institution's student union offer at least one university wide sustainability-focused educational program or event at least once a year?

Location: University of Worcester's website> Discover Worcester> Research> Discover Our Research> Research in Science & Environment

OR

Student Union office located in the Hangar

Grading: The answer is Yes if and only if it meets all of the following conditions.

1. There an existing annual sustainability themed informative program that brings community members from around the university together.

2. The program must be educational and teach about improving sustainability.

Question 8

Does the institution conduct an assessment of the sustainability literacy and knowledge of its students?

Location: The Director of Sustainability

Grading: The answer is Yes if and only if it meets all of the following conditions.

1. There is an assessment in place that determines sustainability literacy of students.

2. The assessment takes place AT LEAST once a year.

Question 9

Does the institution have an ongoing program that offers incentives for academic staff in multiple disciplines or departments to develop new sustainability modules and/or incorporate sustainability into existing departments?

Location: Professors from the Institute of Science and the Environment

Grading: The answer is Yes if and only if it meets all of the following conditions.

1. There is an existing incentive program to encourage faculty to incorporate sustainability ideals into existing modules.

Question 10

Is the institution utilizing its campus by having physical locations which specialize in the following areas of sustainability?

- *Air & Climate*
- *Buildings*
- *Energy*
- *Food & Dining*
- *Grounds*
- *Purchasing*
- *Transportation*
- *Waste*
- *Water*
- *Coordination &*
- *Planning*
- *Diversity & Affordability*
- *Investment & Finance*
- *Public Engagement*
- *Wellbeing & Work*

Location: University of Worcester's website> Discover Worcester> Find Us> Look under each campus

Grading: Points awarded based on number of existing buildings in the areas above. A maximum score of 5pts is awarded for the utilization of at least 12.

Research

Question 1

Amount of funding from grants and contracts specifying sustainability-related research, relative to the total funding from grants and contracts at the institution, as a percentage.

Location: Research School located in the Jenny Lind Building

Grading: We looked at data for the median amount of funds dedicated to research from every publicly available university in England. From this we determined that of all research conducted an amount of 10% of the funds dedicated to sustainability is more than an adequate amount.

Question 2
Number of published research articles with a focus on sustainability-related issues, relative to the total number of research publications in all areas, as a percentage.
Location: The Worcester Research and Publications (WRAP) database. Publications are deemed sustainability-oriented if they contain one or more of the keywords from the United Nations 2030 agenda.
University of Worcester's website> Discover Worcester> Research> WRAP
Grading: Researched average number of publications released from the University of Worcester. Of those released publications, we determined that the mean of sustainability themed publications was 5% so we established a range of scores based on that percentage as the median.

Question 3*
Number of the institution's academic staff that are currently engaged in sustainability research, relative to the total amount of academic staff who conduct research, as a percentage.
Location: University of Worcester Website> Discover Worcester> Research> Discover our research https://www.worcester.ac.uk/discover/discover-our-research.html
Median Score: 19.08%

Question 4*
Number of academic departments that include at least one academic staff member that conducts sustainability research compared to other areas of research, relative to the total number of academic departments, as a percentage.
Location: University of Worcester's website> Discover Worcester> Research> WRAP

     OR

Research School located in the Jenny Lind Building
Median Score: 37.14%

Question 5*

Does there exist one or more resource centres on campus providing sustainability-related research or services?

Location: University of Worcester's website> Discover Worcester> Research> Institute Research Pages https://www.worcester.ac.uk/discover/discover-our-research.html

Grading: The answer is Yes if and only if it meets all of the following conditions.

1. There is a centre on campus specifically dealing with sustainability research.
2. It is actively releasing scholarly publications

Question 6

Does the institution have an ongoing program to encourage students in multiple disciplines or academic programs to conduct research in sustainability?

Location: Research School located in the Jenny Lind Building

Grading: The answer is Yes if and only if it meets all of the following conditions.

1. There is a program in place which encourages students to get involved in sustainability research.
2. The program is actively seeking to expand its reach on campus.

Question 7

Does the institution have a program to encourage academic staff from multiple disciplines or academic programs to conduct research in sustainability topics? (To count, the program must provide faculty with incentives to research sustainability and specifically aim to increase faculty sustainability research)

Location: Research School located in the Jenny Lind Building

     OR

The University of Worcester Director of Sustainability

Grading: The answer is Yes if and only if it meets all of the following conditions.

1. There is an existing program which encourages faculty to conduct sustainability related research.
2. The program must provide incentives for the faculty conducting research.

Question 8

Has the institution published written policies and procedures that give positive recognition to interdisciplinary, transdisciplinary, and multidisciplinary research during faculty promotion and/or tenure decisions?

<u>Location</u>: University of Worcester Director of Undergraduate Curriculum

Grading: The answer is Yes if and only if it meets all of the following conditions.

1. There is a detailed published policy specifically regarding the recognition of faculty conducting cross-collaboration or multidisciplinary research.

Question 9

Does the institution have ongoing library support for sustainability research and learning in the form of research guides, materials selection policies and practices, curriculum development efforts, sustainability literacy promotion, and/or e-learning objects focused on sustainability?

<u>Location</u>: The Hive- City Campus

     OR

Research School located in Jenny Lind Building

     OR

The Worcester Research and Publications (WRAP) database

Grading: The answer is Yes if and only if it meets all of the following conditions.

1. There is a library on campus.
2. The library contains sustainability development resources.

Question 10

Does the institution provide financial incentives to support open access publishing, e.g., a publishing fund to support faculty members with article processing and other open access publication charges?

<u>Location</u>: Research School located in Jenny Lind Building

Grading: The answer is Yes if and only if it meets all of the following conditions.

1. The institution provides incentives for open publishing

HIGHER-ED SUSTAINABILITY EVALUATION: CURRICULUM

NAME OF INSTITUTION:

	CRITERIA	SCORING					
		0	1	2	3	4	5
C1	Number of courses that include sustainability related topics, themes, or modules, relative to the total number of undergraduate courses offered at the institution, as a percentage.	0%	1-5%	6-10%	11-15%	16-20%	>20%
C2	Number of modules that include sustainability related topics or themes, relative to the total number of modules offered at the institution, as a percentage.	0%	1-5%	6-10%	11-15%	16-20%	>20%
C3	Number of undergraduate students who have taken a sustainability-related module in relation to total number of students enrolled at the institution, as a percentage.	0%	1-20%	21-40%	41-60%	61-80%	>80%
C4	Number of departments at the university that include sustainability in their curricula in relation to the total number of departments/colleges at the university, as a percentage.	0%	1-20%	21-40%	41-60%	61-80%	>80%
C5	Does the institution contain one or more student organizations with a purpose directly related to sustainability?	No					Yes
C6	Does the institution maintain an regularly updated sustainability website?	No					Yes
C7	Does the institution's student union offer at least one university wide sustainability-focused educational program or event at least once a year?	No					Yes
C8	Does the institution conduct an assessment of the sustainability literacy and knowledge of its students?	No					Yes
C9	Does the institution have an ongoing program that offers incentives for academic staff in multiple disciplines or departments to develop new sustainability modules and/or incorporate sustainability into existing departments?	No					Yes
C10	Is the institution utilizing its campus by having physical locations which specialize in the following areas of sustainability? (count each area once)	0	1-3	4-6	7-8	9-11	12-14
	Air & Climate Buildings Energy Food & Dining	Grounds Purchasing Transportation Waste	Water Coordination & Planning Diversity & Affordability	Investment & Finance Public Engagement Wellbeing & Work				

Total Score	/ 50

Date:

Conducted by:

HIGHER-ED SUSTAINABILITY EVALUATION: RESEARCH

NAME OF INSTITUTION:

	CRITERIA	SCORING					
		0	1	2	3	4	5
R1	Amount of funding from grants and contracts specifying sustainability-related research, relative to the total funding from grants and contracts at the institution, as a percentage.	0%	<1%	1-3%	4-7%	8-10%	>10%
R2	Number of published research articles with a focus on sustainability-related issues, relative to the total number of research publications in all areas, as a percentage.	0%	<1%	1-3%	4-7%	8-10%	>10%
R3	Number of the institution's academic staff that are currently engaged in sustainability research, relative to the total amount of academic staff who conduct research, as a percentage.	0%	1-8%	9-16%	17-24%	25-31%	>31%
R4	Number of academic departments that include at least one academic staff member that conducts sustainability research compared to other areas of research, relative to the total number of academic departments, as a percentage.	0%	1-15%	16-30%	31-45%	46-60%	>60%
R5	Does there exist one or more resource centres on campus providing sustainability-related research or services?	No					Yes
R6	Does the institution have an ongoing program to encourage students in multiple disciplines or academic programs to conduct research in sustainability?	No					Yes
R7	Does the institution have a program to encourage academic staff from multiple disciplines or academic programs to conduct research in sustainability topics? (To count, the program must provide faculty with incentives to research sustainability and specifically aim to increase faculty sustainability research)	No					Yes
R8	Has the institution published written policies and procedures that give positive recognition to interdisciplinary, transdisciplinary, and multidisciplinary research during faculty promotion and/or tenure decisions?	No					Yes
R9	Does the institution have ongoing library support for sustainability research and learning in the form of research guides, materials selection policies and practices, curriculum development efforts, sustainability literacy promotion, and/or e-learning objects focused on sustainability?	No					Yes
R10	Does the institution provide financial incentives to support open access publishing, e.g., a publishing fund to support faculty members with article processing and other open access publication charges?	No					Yes

Total Score	/ 50

Date:

Conducted by: