Implementing and Critiquing the Higher-Ed. Sustainability Evaluation Tool

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

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Abstract

Sponsored by The University of Worcester, this project critiqued and implemented the recently developed Higher-Ed Sustainability Evaluation to assess the University's engagement of sustainability in curriculum and research. To do this, an initial analysis, faculty interviews, and pilot implementation were completed. The University received 41/50 on the curriculum tool and 44/50 on the research tool. We suggest developing another tool focusing on students to ensure the University is producing sustainability literate graduates.

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Executive Summary

This project aims to critique and implement a custom sustainability benchmarking tool (the Higher-Ed Sustainability Evaluation) created by a previous project team to assess the engagement of sustainability in the curriculum and research at the University of Worcester. To fulfill this goal, the following steps were taken:

- Perform an initial analysis of the tool's utility
- Investigate the faculty's opinion of the tool
- Carry out a pilot implementation of the Higher-Ed Sustainability Evaluation at the University of Worcester
- Evaluate the results of the implementation
- Compare the tool and its results to the existing benchmark tool, STAUNCH

Methods

The first step of the project was to understand the goals our sponsor had for both the project and the assessment tool, so that we could assure their prominence in the final tool, followed by an initial analysis to evaluate its content and usability. As a part of this process, Dr. Heather Barrett was asked to provide contact information for relevant faculty members (professors and administrators) that would be beneficial to interview. At the conclusion of these interviews the implementation of the revised tool was conducted at the University of Worcester. The results of this implementation were then taken to faculty and administrators for follow up interviews. Each of these major steps were directly followed with an update/revision of the tool based on the newly acquired information, when necessary. With the short amount of time left, a brief comparison was made to the previously implemented STAUNCH tool results for the University of Worcester in 2013.

Results

The results of our project include not only the implementation results of the Higher-Ed Sustainability Evaluation, but also the outcomes of the faculty interviews pre- and post-implementation, the changes made to the tools, the changes made to the implementation guide, and a comparison to the STAUNCH implementation previously done at the University of Worcester.

Faculty Interviews

In the opinion of four faculty, the primary factors inhibiting the integration of sustainability into curriculum was lack of time and resources. A common theme between our interviewees was that they wanted to integrate sustainability into their modules, but they lacked the time and the money to do so. None of the faculty members we interviewed were aware of any incentive programs for curriculum in sustainability, despite the existence of the "Learning for Responsible Futures Award", which is an incentive program that gives a cash prize for those who integrate sustainability into curriculum and research. This reveals a potential issue with question C9, which is that even though a university might have an incentive program (and thus be able to answer yes to C9 and get full points), if the existence of an incentive program is not widely known about by faculty members it will not be utilized and thus, effectively be like one does not exist. As a final thought, some of the interviewees felt that not all the questions held the same importance to their respective tools. With this in mind, they thought that some of the questions should be worth more or less points to reflect how important they are. An example of this is question C8 on the curriculum tool. This question relates to the university performing an assessment of sustainability literacy and knowledge of its students. The interviewees felt that this was the most important question, as students understanding what they are learning about sustainability and going into the world with that knowledge of sustainability should be the University's true goal.

Curriculum Tool

The University of Worcester scored strongly on the curriculum tool, only losing points on three of the questions. For reference, each question is worth up to five points. Questions C1, C2, C3, C4, and C10 are graded on a gradient and can be worth any integer from zero to five and the remaining questions are yes or no answers being worth five or zero points, respectively. For the 10 question, 50 point tool, the total score was 41 out of a possible 50 points. The University lost points on questions C2, C3, and C8.

The SustainabiliTool was originally created to answer question C2, but was extended to help answer question R2 as well. This piece of software uses the University of Worcester's module catalog webpage to get the information about each module the university offers. Part of the SustainabiliTool was created in the form of a Firefox extension. When installed, it creates a

pop-up when the user navigates to the module database page, asking if the user would like it to run. If allowed, it then gets the information about each module from the university's web page and searches for the relevant keywords. Any module with a keyword in either the title or the description will be displayed on the webpage, along with information about the search.

Research Tool

The University of Worcester scored strongly on the research tool, only losing points on 2 of the questions. For reference, each question is worth up to five points. Questions R1, R2, R3, and R4 are graded on a gradient and can be worth any integer from zero to five and the remaining questions are yes or no answers being worth five or zero points, respectively. For the 10 question, 50 point tool, the total score was 44 out of a possible 50 points. The University lost points on questions R3 and R8. Furthermore, the other part the SustainabiliTool was written to decrease the required time to search and find research articles needed throughout the research tool. This tool automated the key word searches so we did not have to personally go through every individual research article or abstract.

Comparison to STAUNCH

The University of Worcester has implemented a sustainability benchmarking tool in the past called Sustainability Tool for Auditing University Curricula in Higher-Education (STAUNCH). The STAUNCH tool is more exhaustive than the Higher-Ed Sustainability Evaluation, but is much more focused. The STAUNCH tool focuses specifically on curriculum, and even more specifically individual modules and what institute those modules fall under. A straight comparison cannot truly be made between the two tools accurately for several reasons. First, the STAUNCH tool does not use the same methodology in which to determine whether a module is related to sustainability or not. The Higher-Ed Sustainability Evaluation utilized a simple keyword search while the STAUNCH tool uses specialized software to analyze module descriptions. This difference in methodologies would give rise to different results. There are also varying definitions and understandings of sustainability, which could be another reason for different results in defining whether a module is related to sustainability. While STAUNCH and the Higher-Ed Sustainability Evaluation are both sustainability benchmarking tools, they are vastly different with different methodology. Therefore, comparing results from the two tools will

not be an accurate representation of progress the University of Worcester has made toward incorporating sustainability into its curriculum.

Conclusion and Recommendations

Overall, the team believes that the project was a success. The curriculum and research benchmarking tools were both implemented, and based on the feedback from faculty that we received, the scores appear to accurately reflect the University of Worcester's attainment of sustainability in their respective categories. It is apparent that, while the University of Worcester is already doing well in regard to sustainability integration, there is a strong interest among faculty members to increase these efforts even further. This interest is why having a way to easily benchmark progress is important; being able to gauge progress in this manner makes assessing continuous improvement easier.

During our pre-implementation interviews, we found that many of the participating faculty were under the opinion that, while benchmarking sustainability is a great way to measure progress, it is also important to ensure that the students leaving the school retain the sustainable ideas that they are exposed to during their time at the university. There are several different ways that this can be done, but most require a large amount of time. An example would be to administer a sustainability literacy test at a set interval of time, and comparing the scores of graduating students to their scores in the past. This could serve multiple purposes: it would give an idea as to the amount of sustainability knowledge that students have when entering the school, which is an indicator as to whether potential student applicants view the university as "green" or not. It will also gauge how much students learn about sustainability throughout their education, and whether they have a good grasp of sustainable ideas that they can apply to their jobs and community after they graduate.

Being able to benchmark how well the university is focusing on and implementing sustainability is important, but it is more important to measure how much is being retained by the students. What they learn and implement in their careers is what will further future sustainability advancement on a global scale. While it is important to measure the university's actions to ensure a continually increasing focus on sustainability, it is more important to ensure students' retention of the knowledge. For this reason, future groups working on this project should not

only focus on answering the existing Higher-Ed Sustainability Evaluation, but also compose a new portion that evaluates student knowledge of sustainability during their time as students, which will allow the university to see if they are producing sustainability literate graduates.

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1 Introduction

In the 21st century, humanity faces a multitude of different global problems, including wealth inequality and environmental degradation. An emerging consensus is that sustainable development, or “development that promotes prosperity and economic opportunity, greater social well-being, and protection of the environment", offers the best path forward for improving the lives of people everywhere. (United Nations, n.d.). True sustainability balances social, environmental, and economic concerns in a manner that allows for long-term success. Due to sustainability having such a wide range of topics, measuring it becomes difficult and cumbersome. However, when selecting specific topics under the umbrella of sustainability, benchmarking becomes more viable. Sponsored by the University of Worcester, this project focuses on benchmarking the sustainability of the University’s research and curriculum. This project is an ongoing initiative, with a previous team having developed a custom benchmarking tool (The Higher-Ed Sustainability Evaluation). Our project critiques and implements this custom tool to ensure that it will provide the University of Worcester with results that are both useful and valid.

The following outlines the background knowledge important to understanding this project. The first step is to obtain an understanding of what sustainability entails and how to measure it. People often mistake sustainability for just environmental sustainability. However, as mentioned above, sustainability involves many different facets that go far beyond environmental factors. It is also important to understand methods of measuring sustainability. Furthermore, information about the University of Worcester will help provide an understanding of the Higher-Ed Sustainability Evaluation and its context. Finally, benchmarking and methods of evaluating benchmarking tools are the core components of this project. This project critiques the Higher-Ed Sustainability Evaluation developed by a previous research team based on their analysis of existing sustainability benchmarking tools, specifically the STARS tool. The Higher-Ed Sustainability Evaluation attempts to analyze and benchmark sustainability by utilizing two short questionnaire style assessments, one for curriculum and one for research. The goal of developing a custom tool was to provide feedback to the University of Worcester based on their current performance that could be used to provide improvements for the future.

This project performs an analysis of the Higher-Ed Sustainability Evaluation utilizing the following steps:

- Perform an initial analysis of the tool's utility
- Investigate the faculty's opinion of the tool
- Carry out a pilot implementation of the Higher-Ed Sustainability Evaluation at the University of Worcester
- Evaluate the results of the implementation
- Compare the tool and its results to the existing benchmark tool, STAUNCH

These steps are organized so that we can analyze and revise the tool before implementation in order to maximize the quality of the tool and its results, as well as to give us time to analyze the results and make further improvements.

This report introduces important background information for a deeper understanding of the project, explains the benchmarking tool developed by a previous project team, outlines the methods that we will utilized throughout this project, and provides the results of the steps listed above and the conclusions and recommendations that have been drawn from the results. Our goal is to critique and implement the tool to assess the engagement of sustainability in the curriculum and research at the University of Worcester.

2 Literature Review

This section provides the information helpful to gain an understanding of the goals and aims of this project, the focal point of which being sustainability in higher education. It is important to have a well-founded background on this topic to ensure the focus of the benchmark is directed correctly. An understanding of the University of Worcester is also important as they are the sponsor of this project. Understanding existing benchmarking tools, including the one that will be implemented, is important to this research so that a better understanding of benchmarking as a subject can be had. This information will provide a base of knowledge on the components of a good benchmark, which will be used to evaluate the implementation and results of the existing instrument.

2.1 Sustainability

Sustainable development focuses on developing prosperity, economic opportunity, and environmental preservation to improve the lives of the global population (United Nations, n.d.). In general this is a global effort, but individual countries and even specific communities can apply the process of sustainable development to increase their quality of life and inspire others to think about sustainability as well. In recent years many parts of the world have started to look more in depth into many aspects of sustainability and to take action based on the findings. At the forefront of this research and action is the United Nations and the work they have put together for the 2030 agenda. In 2015 this agenda was adopted on the basis of 17 Sustainable Development Goals (SDGs). There are many different topics that should be analyzed to measure sustainability. These goals group them into 17 broad categories to encompass as many topics as possible. This allows for easier navigation and understanding of the many areas that should constantly progress. Not only do these goals include well known topics such as poverty, hunger, energy, and climate, but they also include sustainability actions for gender equality, industry, peace, and partnership. The United Nations adoption of these 17 SDGs is, however, not enough for substantial progress to be made in regard to sustainability. Education about these sustainability goals is an important part of making progress. This idea can be seen in goal 4.7, which recommends that students are given the knowledge and skills to promote sustainable development (United Nations, 2015). If we educate the next generations about the importance of

sustainability, we increase the likelihood that they take the problem seriously, and will continue working towards the sustainability goals. In order for the SDGs to have any meaningful results, what is known about the topics must be taught and further research into them must be done. This is where universities come in, by incorporating this knowledge into their curriculum and providing research opportunities for sustainability to graduate students and faculty members.

While these areas of sustainability are being taught, one key area that must be included is how they involve one another. This must be included so that a balance between all areas of sustainability (Economic, Social, and Environmental) can be kept. These areas make up the three pillars of sustainability, and meeting each of these individually or in pairs are only stepping stones to true sustainability (Kates, Parris, & Leiserowitz, 2016). The 17 SDGs, which include a list of 169 targets to be achieved by the year 2030, and actions to be taken in order to reach these targets and goals act in parallel to the three pillars in this way (Costanza, et al., 2016). Even though they are grouped into 17 different goals, they are still entangled and addressing one will undoubtedly have an impact on another, either directly or indirectly. This can be used as either a positive influence, helping one area benefit another, or a negative influence, causing another area to fall behind. The World Commission on Environmental Development states in *Our Common Future* that "Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs." (World Commission on Environment and Development, 1987, p. 16). The goal of sustainability is to ensure future generations have access to all the resources needed to support themselves. Without a focus on sustainability now, future generations will not have this ability. This is why benchmarking sustainability is so important. It provides society an instrument with which to avoid this by measuring sustainable progress.

2.1.1 Measuring Sustainable Progress

Currently, progress in most nations and societies is measured using Gross Domestic Product (GDP). While this mode of progress indication is effective at keeping track of the economic growth of a society throughout many years, it is not a sustainable way to measure overall progress. True sustainability is measured on the three key pillars of sustainability, which do not just include the economy (Kates, et. al., 2016). For an accurate measurement of sustainability, these three pillars should be considered equally. GDP only takes into account the

economic pillar, usually at the detriment of the other two. It is important to look at other possible, and more sustainable, methods of measuring progress, including the Genuine Progress Indicator (GPI), Human Development Index (HDI), and Happy Planet Index (HPI).

Similar to the measurements of GDP, GPI includes the monetary aspects but goes beyond that, also considering different topics that are not economically measured. These include things such as the social wellbeing of an area and the prosperity in the environment. This tool is much more effective at determining the real advancements of a society because it can take into account all the pillars of sustainability. Because of this, one area cannot be focused on while neglecting the others (Costanza, Fioramonti, & Kubiszewski, 2016). While GPI looks at all three pillars, HDI and HPI specialize in two of these areas. HDI focuses mainly on the growth and sustainability of a society. It takes into account the monetary aspect of Gross National Income (GNI), but goes beyond just economics and looks at the growth in education and life expectancy as well. While HDI does not look into the environmental side of sustainability directly, its growth in the other two areas will help the ability to advance in the environmental aspect (United Nations Development Program, n.d.). Meanwhile, HPI takes into account the social sustainability. This includes life expectancy and goes beyond that with how the people feel life is in their society. HPI diverges from HDI because the former does not consider any economic sustainability directly, and replaces this part of the latter with a factor of how large the environmental footprint of the society is. This allows the ability to measure the environmental sustainability alongside a society's development and see how striving to advance one area can be detrimental to the other (Happy Planet Index, n.d.).

All of these instruments can be seen as types of benchmarking tools. They all measure a subset of data in a society and use that data to rate and compare societies to one another, as well as themselves in previous years. Even though all of these measurements are doing essentially the same thing (measuring progress) none of them can be seen as the best in every circumstance. Each of these tools focus on different indicators and are each better at measuring their main focus. For this reason, it is important to employ more than one of these instruments and look at all the results to have a more comprehensive understanding of the society, overall and in these tools' areas of focus.

The use of these multiple metrics can also be applied to tools for benchmarking the engagement of sustainability at universities, such as STARS (Sustainability Tracking Assessment and Rating System) and the one used at Kingston University. STARS would be an example of a benchmarking instrument that encompasses a wide variety of sustainability categories and is a very time and resource intensive process. This would be good if the university wants an overall sustainability analysis done, however other tools can specialize in just one area and be done much faster. The Kingston University method focuses only on the faculty at the university and tries to measure how sustainability focused they are, making it a viable choice if that is the only area of concern for the university. (Bermin-Jolton, Kuros, Madhurkar & Rockcress, 2017). These two tools, along with many others, have different areas that they specialize in. For this reason it is important to know what you desire to have measured and to not just arbitrarily choose a tool but find one that aligns with their goal.

2.2 The University of Worcester

The University of Worcester is one of the "greenest" universities in the United Kingdom. It was ranked 4th out of 154 universities ranked in the 2017 People and Planet University League. The University of Worcester is important to this project, as they are our sponsor. If the university is not receptive to the Higher-Ed Sustainability Evaluation and does not make changes based on the tool's results, the tool will not be successful. The university is the only higher education institution in Worcestershire. The student population was 10,747 in the 2016-17 academic year, in which 83.5% were enrolled in the undergraduate program. The university is organized into seven different academic institutions. The largest of which is the Institute of Health and Society with 34% of students being enrolled there. The department that is most closely related to sustainability, the Institute of Science and the Environment, is the second smallest of the departments at the university with only 6% of students being enrolled in it (University, 2017). This could lead to the belief that the university would not have as much of a focus on sustainability, but this is not the case. As mentioned above, the University was ranked as the 4th "greenest" university in the United Kingdom. Thirteen different areas of sustainability were ranked at each university, on a percentage scale. The University of Worcester received a 100% ranking in five of the thirteen areas. These five areas were environmental policy, auditing & management systems, carbon management, education, and energy sources. The two lowest

ranking areas were in carbon reduction and workers' rights, which were 10% and 15%, respectively. The University was also one of the first to be awarded the status of EcoCampus Platinum in June 2010 (University, 2017). This, along with their sponsoring of our project, demonstrates that the university wants to advance sustainability and we hope that this project will assist them.

To better gauge these sustainability efforts and measure their progress over time, the University of Worcester has attempted to implement two established benchmarking tools. They tried using a tool named STAUNCH (Sustainability Tool for Auditing for University Curricula in Higher-Education), but found that it did not account for all their classes that contained sustainable content. They also tried to use an assessment tool named The Kingston Methodology, but they found that this tool only produced information, and did not provide a way to analyze and interpret it. In an attempt to overcome these issues, a research team working with the University decided to create a custom benchmarking tool (The Higher-Ed Sustainability Evaluation) (Bermin-Jolton et al., 2017). The Higher-Ed Sustainability Evaluation, and the existing sustainability benchmarks that influenced its creation, are discussed in the next section.

2.3 Benchmarking

2.3.1 The Idea of Benchmarking

Benchmarking, at its core, is not a complex idea. Essentially, it is a name given to the process of tracking changes of a specific area of interest. The goal of benchmarking is to assess a particular feature or aspect of an organization by comparing it to a similar aspect of a different organization. Once the assessment has been done then the organization will know where improvements can be made. Additionally, the feature or aspect being compared is arbitrary, it can range from an industrial process to a business practice. In almost all cases the comparison is made because it is difficult to measure objectively, and the best way to determine its quality is through this comparison (Patterson, 1995). In the context of this project, we know what is being compared; the engagement of sustainability in a university's curriculum and research. Knowing this, we can define a benchmarking tool as an instrument that allows a university to compare its focus on sustainability to other universities, or even to themselves over time. In 2002, M.

Shriberg defined this idea using the term “Cross-institutional assessment tool”, but the term benchmarking tool has since been used to describe the same idea (Shriberg, 2002).

Since there is no single quantifiable measurement for sustainability, benchmarking provides a viable manner with which to create feasible goals. The idea of sustainability is not a specific one, and it can be interpreted in many different ways. Universities vary widely in culture and practices, so they will have different goals for their own sustainability, prioritizing certain aspects over others. In order to be sure that their sustainability efforts are not being wasted, or worse, taking them down the wrong path, a university must have a way to measure this idea that is inherently un-measurable (Shriberg, 2002). One way to do this is with a benchmarking tool. As described above, a benchmarking tool gives a university a system that allows them to compare themselves to other universities. It does this by asking objective questions about the university, such as the percentage of classes that discuss sustainability, or the percentage of scholarly articles focusing on sustainability published by the university each year. These questions, by themselves, do not mean much. However, the results of a number of questions in this style can be used as a comparison for the university. This comparison can then be used as a measurement of relative effectiveness in their sustainability practices when compared to other universities, or to track their own progress over time. This relative measurement, while not ideal, gives the university a way to critique and possibly improve their performance in relation to sustainability.

2.3.2 Benchmarking Curriculum and Research

Although benchmarking sustainability is a relatively new concept, a number of universities and organizations have already set out to benchmark curriculum and research. As a result, a variety of tools currently exist. All of these assessments were created to fulfill specific goals, so they contain differences in the methods by which they benchmark. While the methods contain differences, most existing tools contain similar base concepts that can be drawn upon and considered in this project, including the utilization of questionnaires, a numerical ranking, interviews, systematic implementation, and an in-depth analysis. Many previously implemented assessments are in the form of questionnaires, because they provide a way to organize the indicators that are considered, ensure all indicators are accounted for in the tool, and give straightforward feedback (Bankel et al., 2005). Our project will also utilize questionnaires for

these same reasons. Questionnaires typically utilize numerical rankings, as this allows for easy comparison between universities and to a university's progress using the results of the tool (Haddawy, Hassan, Abbey, & Lee, 2017). This strategy is found in tools such as the Global Research Benchmarking System (GRBS) (Haddawy et al., 2017) and the Conceive Design Implement Operate (CDIO) tool (Bankel et al., 2005). Benchmarking requires the ability to compare results between multiple implementations. Therefore, our project will also use a numerical ranking approach.

Assessments often utilize interviews as a form of feedback. This specific strategy can be seen in the Roanoke Valley methodology (Shelly, 2000). While the Roanoke Valley methodology cannot be directly related to the development of the Higher-Ed Sustainability Evaluation, the strategy of utilizing interviews can be related to the development. Receiving such feedback allows the tool's administrator to understand how well the instrument fits the university as which it is being implemented. As mentioned above, each assessment is designed to fulfill specific goals, and that may cause it to be less relevant in certain places (Shelly, 2000). Our project will utilize faculty feedback regarding the Higher-Ed Sustainability Evaluation to help ensure it is highly relevant to the University of Worcester. Organizations should systematically implement benchmarking measures, otherwise it can be difficult to identify progress. Therefore, a plan to implement a tool systematically, such as using it annually, improves the efficacy of the benchmark (Shelly, 2000). Our instrument will be designed to be implemented systematically to ensure the University of Worcester can effectively benchmark the growth of involvement of sustainability in its curriculum and research.

2.3.3 STAUNCH

STAUNCH is the tool that the University of Worcester has implemented twice in the past, once in 2010 and again in 2013. STAUNCH aims to systematically evaluate the modules and courses offered by a university and whether they relate to sustainability or not. STAUNCH uses 36 different criteria that are each grouped into the three areas of sustainability (economic, social, and environmental) and "cross-cutting aspects," which are criteria that may cover more than one of the areas of sustainability. The STAUNCH tool evaluates each module offered by a university using all 36 criteria and assigns "strengths" to how strongly the module relates to each area of sustainability. Once STAUNCH has been implemented, the university receives a report

that provides these strengths of each module broken down by department and an overall evaluation regarding what percentage of modules relate to sustainability and what areas of sustainability they most relate to (Lozano, 2008). While STAUNCH does perform an exhaustive evaluation of modules at a university, it does not consider other portions of curriculum at a university, such as student experience, or research at the university. The lack of these areas of assessment led the University of Worcester to want something more out of a sustainability benchmarking tool.

2.3.4 The Higher-Ed Sustainability Evaluation

Due to the issues with previously implemented instruments at the University of Worcester, the university requested a custom tool be designed for their use by a previous research team. he previous team started by researching existing benchmarking tools. They discovered a number of instruments, and outlined nine that they thought were the most relevant to the Higher-Ed Sustainability Evaluation that they wanted to create, a list of which can be found in **Appendix 1**. After researching these instruments, they came to three conclusions. They found that each benchmarking tool was created with a specific community in mind, that each had different methods and focuses for comparing the universities, and that each had a unique system for grading and evaluating the universities (Bermin-Jolton et al., 2017).

When the previous team started creating the Higher-Ed Sustainability Evaluation, it was decided that a questionnaire style was the most common and sensible delivery method for the Higher-Ed Sustainability Evaluation. They found other methods, such as an interactive spreadsheet or a series of interviews, but decided against using these options. They found that a questionnaire style was the best because it is "significantly more straightforward than other options", while the interactive spreadsheet would take too much time to create and use, interviews would produce inconsistencies from staff communication, and both were limited in what data they could analyze (Bermin-Jolton et al., 2017, p. 22). They also decided to use two simple types of questions on the Higher-Ed Sustainability Evaluation; gradient questions and yes/no questions. A gradient question is one that has a non-discrete answer, and so the answers must be grouped and ranked. For their tool, they had six ratings, 0-5. For example, one question they had is about the percentage of undergraduate students that have taken a course related to sustainability, with 0% earning a rating of 0, 1%-20% earning a rating of 1, 21%-30% earning a

rating of 2, etc. They made sure to normalize the grade scale between each question, because they wanted to ensure that a score of 3 would be an average score. To do this, they used the STARS database and found the range of potential answers to the questions they had, and used this information to adjust the grouping of the gradient questions (Bermin-Jolton et al., 2017, p. 22-23).

From their analysis of the existing sustainability tools, they came up with a list of eleven categories that the custom tool could investigate. The University of Worcester asked them to focus specifically on two categories; research and undergraduate curriculum. To create the questions for their tool, they looked at questions from the other tools that fell into the relevant categories. Their goal in picking questions was to analyze as much of the category as possible with only 10 questions. They chose to have 10 questions for each category because they found that the most successful benchmarking tools did not have many questions for each category. They wanted their tool to be succinct and easier to administer than other assessment tools (Bermin-Jolton et al., 2017, p. 14-15). They also included a guide to help with the administration of the Higher-Ed Sustainability Evaluation. This guide lists each question and provides a location, either digitally or physically, were the answer for each question can be found. This guide is somewhat specific to the University of Worcester, and thus will not be as useful for applying the Higher-Ed Sustainability Evaluation at other universities.

2.4 Evaluating a Benchmarking Tool

A large section of the work that will be completed will be a comprehensive evaluation of the existing benchmarking tool. Because "there are different types of benchmarking and a plethora of benchmarking process models" (Anand & Kodali, 2008, p. 257), it is important to compare the existing tool to ones that have similar benchmarking goals. Benchmarking can be described as "[an] ongoing, systematic process for measuring and comparing the work processes of one organization to those of another, by bringing an external focus to internal activities, functions, or operations" (Kempner, 1993, p. 22). This definition puts emphasis on the examination of processes instead of a specific quantitative metric (Bers, 2006). The benchmark should provide comparable results, and "[it is] not implied that assessment tools must be exclusively quantitative" (Shriberg, 2002, p.256). While it is important to have some form of a

quantitative metric to allow for the benchmark to be used universally, sustainability as an idea is complex and difficult to quantify. Therefore, a benchmark that allows a university to compare itself to other universities in regard to sustainability should examine what the institution is doing qualitatively and translate that into a quantitative data set.

2.4.1 Defining Benchmarking Processes

A good evaluation of a benchmark will look at "key themes include[ing] measurement, comparison, identification of best practices, implementation, and improvement" (Anand & Kodali, 2008, p.258). A key use for a benchmark is that it provides results that are used for either internal or external comparison. Data from a benchmark is useless if similar metrics from either itself at a different point in time or external institutions cannot be obtained. "A benchmarking process must identify organizational competencies, gauge their value or impact according to some consistent metric (cardinal, real, monetary, etc.) and also establish how these competencies contribute to the sustainability of the exemplar organization" (Moriarty, 2011, p. 598). In other words, a benchmark should pick out strong areas of the institution being benchmarked, and somehow rate these strong areas on a scale that can also be used at other institutions as well as to itself in the future.

2.4.2 Considerations for Evaluation

It can be difficult to make a universal benchmark, or one that can be used at many different places without adaptation. There are factors that can affect where a university will rank on the chosen metric scale that do not necessarily relate to what is being benchmarked. These factors include implementation bias, funding, community values, and stakeholder comprehension (Bers, 2006). A benchmarking tool should stress comprehensibility so that it can be understood by a broad range of stakeholders, allowing everyone involved to have access to the results (Shriberg, 2002). Additionally, depending on the context of the tool, the methodology should be appropriately complex based on the administrator. A benchmark should ideally be easy to administer without bias if the administrator is not someone who has experience with benchmark implementation. Additionally, funding and scope should also be taken into consideration. A benchmark with a smaller budget for implementation and analysis will most likely not be as comprehensive or have a smaller scope compared to a larger, more thorough benchmark.

Therefore, evaluation of a benchmark should include how it handles external factors, such as those listed above.

A good benchmarking tool should consider as many factors as can possibly be measured effectively. This is comparable to the different methods used to measure progress and success discussed earlier. A good benchmark would be a tool similar to the GPI scale that takes all aspects into consideration, or even the HDI and HPI that only look at two of the three areas of sustainability. A poor benchmark would be one like the GDP measurement that only cares about one aspect and ignores other aspects which may be negatively impacted. Having multiple points of data collection yields a stronger tool, because a tool with many different sources of data can better triangulate and validate its results. It should be universally applicable and comprehensive, in that it encompasses as much information on the topic being benchmarked as possible without being overly lengthy. It should be able to identify important issues and provide mechanisms to prioritize sustainability-related issues (Shriberg, 2002). Factors such as ease of implementation as well as the surrounding community should also be taken into consideration (Moriarty, 2011). It should not ask institution specific questions or have a bias towards one institution, and should also fit the environment of implementation. In this project, the community is a university. Therefore, the questions should be geared towards topics such as curriculum and institutional research. The Higher-Ed Sustainability Evaluation should integrate motivations, processes, and results into a comparable and understandable format that is more than just a portrayal of status (Shriberg, 2002).

When evaluating the Higher-Ed Sustainability Evaluation, it is helpful to break up the tool and look at its individual sections. Important questions to ask include how the tool measures data, and how comparison between institutions is being done (Kempner, 1993). Other questions that should be asked include what metric is being used, and how the Higher-Ed Sustainability Evaluation looks at external factors. Breaking the tool up into individual parts and looking at them separately accomplishes a few things; it makes it easier to organize and manage the evaluation process, and allows for a more thorough critique at the end of the evaluation as it potentially yields a more organized understanding of the tool.

3 Methods

The goal of this project was to perform an assessment of the Higher-Ed Sustainability Evaluation that was created in the fall of 2017, by a previous research team. To accomplish this goal, we had to:

- Perform an initial analysis of the tool's utility
- Investigate the faculty's opinion of the tool
- Carry out a pilot implementation of the Higher-Ed Sustainability Evaluation at the University of Worcester
- Evaluate the results of the implementation
- Compare the tool and its results to the existing benchmarking tool, STAUNCH

This project took place between March 10th, 2018 and April 27th, 2018. The first step of the project was to understand the goals our sponsor had for both the project and the assessment tool, so that we could assure their prominence in the final tool, followed by an initial analysis to evaluate its content and usability. As a part of this process, Dr. Heather Barrett was asked to provide contact information for relevant faculty members (professors and administrators) that would be beneficial to interview. At the conclusion of these interviews the implementation of the revised tool was conducted at the University of Worcester. The results of this implementation were then taken to faculty and administrators for follow up interviews. Each of these major steps were directly followed with an update/revision of the tool based on the newly acquired information, when necessary. With the short amount of time left, a brief comparison was made to the previously implemented STAUNCH tool results for the University of Worcester in 2013.

3.1 Pre-Implementation

3.1.1 Faculty Interviews

Once we finished the initial analysis and critiques it was important to obtain outside opinions of the tool from faculty members recommended by Dr. Barrett and Katy Boom. These opinions were gathered through the use of semi-structured interviews (Berg, 2012). The data gathered from the interview process served to triangulate our initial analysis and gave us professional insight on the tool and its content.

We began the interview process by determining which faculty are relevant to interview. The selection process primarily involved asking Dr. Heather Barrett, the Academic Lead for Sustainability, for faculty contacts that are involved with sustainability research and/or curriculum.

We believed that a semi-structured interview was the best method for this situation. In general, an interview is more beneficial than a survey or a focus group for this type of information gathering as it allows for more personal communication. Surveys do not allow for a rapport to be built and this is crucial to probe out their honest thoughts and opinions, along with the flexibility of molding the questions to the interviewee and taking the interview in the direction it goes (Berg & Lune, 2012). Semi-structured interviews allowed for this type of leniency while still having the original framework to start off each interview the same. Additionally, because the interviews were a time sensitive portion of the project it was beneficial to have the time flexibility that is allowed with single person interviews, whereas focus groups could have taken a long time to organize, and surveys could have taken a long time to get results.

The interviews were budgeted to take 30-45 minutes to complete, varying based on how much time and information the faculty member had and was willing to offer. We did not expect them to last too long, as the main focus was to get the interviewees opinion on the tool's questions, which we sent to them prior to the interview. We conducted the interviews primarily in teams of four, one person asking the questions and leading the interview while the others took notes. It was valuable to have more than one person performing the interview because the extra minds in the room were able to offer unique opinions and viewpoints to aid the discussion. It also allowed for our notes from the interview to be more accurate, as a single notetaker can easily lose track of the discussion if they are not typing fast enough.

3.1.2 Analysis

We performed an analysis of the Higher-Ed Sustainability Evaluation and the implementation guide created by the previous group. This analysis occurred both pre-implementation and during implementation, as not all problems could be foreseen. While the analysis before implementing the tool provided helpful feedback on issues with the Higher-Ed Sustainability Evaluation and the implementation guide that would logically cause problems, the

analysis during implementation results in more concrete changes due to unforeseen difficulties and incorrect direction on the guide.

The pre-implementation analysis included reading through each question on the Higher-Ed Sustainability Evaluation and the implementation guide provided by the previous team. We were looking for issues with wording of questions causing ambiguity in answers and whether the question accurately represented the full aspects of sustainability in the University of Worcester's curriculum and research. The analysis that occurred during the implementation also included looking for these problems that were not foreseen during the pre-implementation analysis. Furthermore, this analysis widely revolved around the implementation guide provided. The tool had never been implemented before this. Therefore, the guide provided by the previous group was not based off of an implementation, which caused the guidance on several of the questions to be inaccurate as the information was not located where the guide suggested.

3.2 Implementation

We conducted the implementation of the Higher-Ed Sustainability Evaluation based on the implementation guide provided by the previous project group, who developed the tool. Most of the explanations for answering questions include utilizing the University's website or speaking with the Director of Sustainability. The implementation guide included each question on the benchmarking tool for sustainable curriculum and research, and explained how to find the information needed to answer each question on the tool. Some of the questions that included using the University's website used the method of content analysis. This method often uses keywords, which is extremely useful for this project when considering the large database that is the University's website (Ryan & Weisner, 1998). All other questions mainly used the knowledge of faculty at the University. This was a method of interviewing, in particular a structured method because they had specific questions and did not stray from them (Berg & Lune, 2012). However, full interviews were not conducted. The interviews were only used to obtain the knowledge required for answering the questionnaire. The faculty selected to answer these questions were already identified by the previous group and were noted in their guide. These questions were either sent through email or answered in person, whichever was most

convenient for the faculty. The informed consent, shown in **Appendix 3**, was also used in these interviews.

As mentioned above, the implementation guide provided was not always accurate as the tool had never been implemented before. Therefore, when the location of the implementation guide was wrong, several actions were taken. If the guide offered a faculty member that would be able to answer the question, that faculty member often gave a suggestion of another faculty member that would be able to answer the question. Under that circumstance, the suggested faculty member was reached out to. If the guide offered a website location that would be able to answer the question, but it did not, we went through a couple of different steps. We would either search the website for the information, often on the sustainability section of the University of Worcester website, or search for faculty that had job titles that related to the question. Both of these methods proved helpful as several questions were answered by different locations of the website than what was suggested and several others were answered by faculty that were not mentioned in the original implementation guide.

Some of the questions would have been difficult and time-consuming to answer manually, so we spent some time trying to find more efficient ways to answer these questions. One of the methods we found to speed up the process was using a Regex search extension on our chosen browser to easily search for all of the keywords at the same time. Another significant part of this was creating two pieces of software that would automate, or partially automate, the process of analyzing the modules and research.

3.3 Post Implementation

3.3.1 Interviews

After the implementation of the tool, we performed follow up interviews with some of the faculty that we had previously interviewed. The format was similar to the first round of interviews, in that they were semi-structured. The faculty that we contacted for the follow up interviews were the ones that we had successfully interviewed before implementation, and that had agreed to be contacted again for the follow up interviews. The questions primarily focused on if the interviewee feels that the results of the tool accurately represent the sustainability

efforts of the university. The results of these interviews were used to validate the tool and the accuracy of its results. It also provided a source for improving the tool based on faculty opinion and our experience implementing it in a real environment.

3.3.2 Comparison to STAUNCH

The university has implemented STAUNCH, another sustainability benchmarking tool, twice in the past, once in 2010 and again in 2013. The university wanted a comparison between the Higher-Ed Sustainability Evaluation and STAUNCH, to see the similarities and whether the results could be looked at together. The best way to compare the two tools is to compare both their methodology and the results that the tools produce. Therefore, past STAUNCH reports and guides were used to compare against the methodology and results of the Higher-Ed Sustainability Evaluation. These reports and guides were read through carefully and compared directly to the methodology and results of the Higher-Ed Sustainability Evaluation.

4 Results

The results of our project include not only the implementation results of the Higher-Ed Sustainability Evaluation, but also the outcomes of the faculty interviews pre- and post-implementation, the changes made to the tools, the changes made to the implementation guide, and a comparison to the STAUNCH implementation previously done at the University of Worcester.

4.1 Pre-Implementation Interviews

We contacted 47 members of faculty with an interview request via email on Friday, March 16th, 2018. The members of faculty selected were from a wide variety of levels across multiple institutes. This list includes the academic representatives of the Responsible Futures Group, a group on campus involved with sustainability related efforts. Learning and teaching leads were also contacted, as well as various heads of institute and institute research heads. These members were selected based on recommendations from our sponsor. As expected, the overall response rate from the latter two groups were minimal in comparison to the number of responses received from those who are academically involved with sustainability. In total, we were able to schedule 6 face-to-face interviews, as well as 1 faculty member who answered our interview questions remotely in a survey-esque format. These interviews took place during the week of Monday, March 19th, 2018. Each interview ranged in length between 15 and 40 minutes, the majority lasting on the longer side. Notes were taken during each interview with the permission of the interviewee.

It was not necessary to perform a full-scale coding analysis due to the low quantity and length of the interviews conducted. Instead, the notes taken at each interview were reviewed and checked for common themes and opinions between faculty members. In general, faculty had a positive opinion of the idea behind benchmarking sustainability efforts at the University of Worcester. Most of the faculty thought that the tool had many positive aspects, with one faculty member holding the opinion that the tool would not be an effective benchmark. While the faculty that had a positive opinion of the tool thought it could be beneficial for its areas of focus, they also mentioned that an all encompassing benchmark of sustainability would not be feasible. A common opinion between the faculty members was that the methodology behind finding the

information on the benchmarking tool would be very difficult to achieve. For example, four faculty members expressed their doubts about our ability to find the amount of grant funding for sustainability related research.

In the opinion of four faculty, the primary factors inhibiting the integration of sustainability into curriculum was lack of time and resources. A common theme between our interviewees was that they wanted to integrate sustainability into their modules, but they lacked the time and the money to do so. None of the faculty members we interviewed were aware of any incentive programs for curriculum in sustainability, despite the existence of the "Learning for Responsible Futures Award", which is an incentive program that gives a cash prize for those who integrate sustainability into curriculum and research. This reveals a potential issue with question C9, which is that even though a university might have an incentive program (and thus be able to answer yes to C9 and get full points), if the existence of an incentive program is not widely known about by faculty members it will not be utilized and thus, effectively be like one does not exist. As a final thought, some of the interviewees felt that not all the questions held the same importance to their respective tools. With this in mind, they thought that some of the questions should be worth more or less points to reflect how important they are. An example of this is question C8 on the curriculum tool. This question relates to the university performing an assessment of sustainability literacy and knowledge of its students. The interviewees felt that this was the most important question, as students understanding what they are learning about sustainability and going into the world with that knowledge of sustainability should be the University's true goal.

4.2 Implementation

The implementation process provided the results of the Higher-Ed Sustainability Evaluation as well as valuable feedback on the quality of the tool and the implementation guide. The following outlines the results from both the curriculum tool and the research tool as well as our recommendations on how the tools and implementation guide can be improved based our experience.

4.2.1 Curriculum Tool

The University of Worcester scored strongly on the curriculum tool, only losing points on three of the questions. For reference, each question is worth up to five points. Questions C1, C2, C3, C4, and C10 are graded on a gradient and can be worth any integer from zero to five and the remaining questions are yes or no answers being worth five or zero points, respectively. For the 10 question 50 point tool, the total score was 41 out of a possible 50 points. The University lost points on questions C2, C3, and C8. The following paragraphs outline a piece of software (the SustainabiliTool) developed to decrease required time to search through module and research descriptions for keywords, the number of points the university received for each question on the curriculum tool and why it was scored in that way, as well as giving the median scores from the STARS tool for relevant questions as the STARS tool was used to develop the Higher-Ed Sustainability Evaluation.

The SustainabiliTool was originally created to answer question C2, but was extended to help answer question R2 as well. This piece of software uses the University of Worcester's module catalog webpage to get the information about each module the university offers. The SustainabiliTool was created in the form of a Firefox extension. When installed, it creates a pop-up when the user navigates to the module database page, asking if the user would like it to run. If allowed, it then gets the information about each module from the university's web page and searches for the relevant keywords. Any module with a keyword in either the title or the description will be displayed on the webpage, along with information about the search. The information that is displayed is the number of modules that have been analyzed up to that point, the number of modules that had sustainability related keywords, and the percentage derived from the first two values. Once the code is finished, the loading text is replaced with text to inform the user, and a popup message is created with the same information that is printed on the page.

These questions were answered using the methods described in the Methods section. Question C1 is: 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. To increase the accuracy of this question, as well as other questions that utilized keyword searches, a validity analysis was completed. Using the sustainability related keywords established by the UN 2030 Agenda to identify sustainability related courses and modules gives

rise to a potential problem with the validity of the results, as there could exist both false positives (courses or modules that contain a keyword but are not related to sustainability) and false negatives (courses or modules that do not contain a keyword but are related to sustainability). In order to account for the possibility of false positives and false negatives, we performed a validity analysis on the courses and modules. For this question 20% of the course descriptions that were flagged as sustainability related during the keyword search and 20% of them that were not flagged as sustainability related were read and marked as sustainability related or not. We then got the percentage of false negatives and false positives. 58.55% (154) of the courses were flagged as sustainability related during the keyword search, leaving 111 courses that were not flagged as being related to sustainability. However, when performing the validity check of the courses flagged as sustainable, 35% of them were false positives. When performing the validity analysis of the courses that were not flagged as sustainability related, 17% of them were false negatives. Once removing the false positives and adding the false negatives, 44.69% of the courses were deemed to be related to sustainability. Therefore, the university received a five for this question while only 20% was needed for a five (University of Worcester, 2018). The median score from the STARS tool is 13.47% (AASHE, 2018).

Question C2 states: Number of modules that include sustainability related topics or themes, relative to the total number of modules offered at the institution, as a percentage. Similar to question C1, a validity analysis of the module descriptions was performed as this question also included a keyword search. 10.8% (137) of the modules were flagged as sustainability related through the keyword search. The validity analysis of 20% of flagged modules showed that 21.43% were false positives. As there were 1112 modules at the university not flagged as sustainability related, 5% of the modules not marked as sustainability related were checked in the validity analysis, which showed that 10.71% are false negatives. This resulted in an increase in sustainability related modules to 16.57% which provides a score of four on this question (University of Worcester, n.d.). The median score on the STARS tool is 9.92% (AASHE, 2018).

Question C3 asks: 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. To answer this, a data analyst in the Data Management Unit was contacted to receive registration records for all modules and the modules that were deemed sustainability related. According to

registration records, 3027 of the 9255 students enrolled at the University of Worcester are enrolled in a sustainability related module, which is 32.7%. Of the 3027 students enrolled in a sustainability related module, 835 are enrolled in more than one sustainability related module. That awards the university a two on this question. This percentage only covers the modules students registered for in the 2017-18 school year however, as this was the only information we gained access to. Therefore, it does not account for whether students have taken sustainability modules in past academic years. The median score on the STARS tool is 42.15% (AASHE, 2018).

Question C4 is looking for: 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. To determine this, the module section of each departments' webpage was examined for the courses that were deemed sustainability related. The university received a five on this question, as all seven of the university's departments include sustainability somewhere within their curriculum (University of Worcester, 2015). The median score on the STARS tool is 37.61% (AASHE, 2018).

Question C5 asks: Does the institution contain one or more student organizations with a purpose directly related to sustainability? The University of Worcester has several student organizations that have purposes somewhat related to sustainability, but the answer to this question is best represented with the Bright Futures Society, which specifically focuses on student employability and connected students and employers (Worcester Students' Union, 2017). Therefore, the university scored a five on this question.

Question C6 is looking for: Does the institution maintain a regularly updated sustainability website? The university has an entire section of its website devoted to sustainability as well as a separate website that is also related to sustainability (Susthingsout, 2018). For the answer to be yes, the website must be updated at least once a month. Each of these websites contain dates they were last updated on the bottom of each page, so those dates were observed to ensure a page on the website had been updated in the past month. Therefore, the university received a five on this question.

Question C7 questions: Does the institution's student union offer at least one university wide sustainability-focused educational program or event at least once a year? The Student Union offers several of these events throughout the year. One is the Food Swap Shop, which provides a place for students to recycle unwanted food items. Another is Go Green Week, which is a week where there are sustainability related events each day that encourages both student and public participation (Worcester Students' Union, 2018). Therefore, the university also received a five on this question.

Question C8 is looking for: Does the institution conduct an assessment of the sustainability literacy and knowledge of its students? According to the university's director of sustainability, Katy Boom, no such assessment is done at the university, earning the university a zero on this question.

Question C9 asks: 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? This does exist at the university through the Learning for Responsible Futures Awards, so the five points were awarded. This scheme was launched in 2012 and seeks to reflect commitments to incorporate sustainability across programs and departments. To date, twenty awards, all worth around £3,000, have been made through this program. These awards have been given to support both research projects and integrating sustainability related topics into modules (University of Worcester, 2017).

Question C10 asks: Is the institution utilizing its campus by having physical locations which specialize in the following areas of sustainability? Fourteen categories of sustainability were identified and the university had either physical locations or policies for all fourteen of these categories. These categories and what the university devotes to each can be seen in **Appendix 4**. Therefore, the university received a five on this question as well, giving it a total score of 41 out of 50.

4.2.2 Research Tool

The University of Worcester scored strongly on the research tool, only losing points on 2 of the questions. For reference, each question is worth up to five points. Questions R1, R2, R3, and R4 are graded on a gradient and can be worth any integer from zero to five and the

remaining questions are yes or no answers being worth five or zero points, respectively. For the 10 question, 50 point tool, the total score was 44 out of a possible 50 points. The University lost points on questions R3 and R8. The following paragraphs outline the number of points the university received for each question on the Research tool and why it was scored in that way, as well as giving the median scores from the STARS tool for relevant questions as the STARS tool was used to develop the Higher-Ed Sustainability Evaluation. Furthermore, a program (the SustainabiliTool) was written to decrease the required time to search and find research articles needed throughout the research tool. This tool automated the key word searches so we did not have to personally go through every individual research article or abstract.

Question R1 asks for: Number of projects funded from grants and contracts specifying sustainability-related research, relative to the total number of projects funded from grants and contracts at the institution, as a percentage. The University of Worcester had a total of 16 projects funded by grants and contracts. Of these 16 projects, 14 of them were deemed sustainability-related by the university's Research and Knowledge Exchange Facilitator. This means the university received a five on this question, as that is an astonishing 87.5% of projects funded from grants and contracts being related to sustainability. While this question would ideally use a keyword search of the titles and abstracts of these funded projects, that was not able to be done. These projects are more sensitive than others, as they relate to direct funding to the university. The project abstracts were not provided to us. Therefore, we had a discussion with the university's Research and Knowledge Exchange Facilitator about what would be considered a sustainability related research project and that individual then deemed whether projects were sustainability related or not.

Question R2 is looking for: 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. This was done using the SustainabiliTool to search for keywords in research articles published by faculty from the University of Worcester. The research this tool was used on were found on the WRAP (Worcester Research and Publications) database (Worcester Research and Publication, 2018). Using the SustainabiliTool on this database allowed us to find all the published research since 2013 (the last year the STAUNCH tool was implemented) related to sustainability. This resulted in 22% of the articles being related to sustainability, which falls

under the >10% category yielding the top score of five for the question. This true percentage was determined after a validity assessment was conducted to find false positives and false negatives. Of the 199 articles flagged as sustainability related research, 20% were evaluated and 17.5% were false positives. For the 703 research articles not flagged as sustainability related, 5% were evaluated and 8.33% of these were false negatives.

Question R3 questions: 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. This question was answered using the same component of the SustainabiliTool as R2. In addition to the function described above, it also kept track of the authors who wrote sustainability related articles. Once it is finished running, it can report the percentage of authors that wrote a sustainability related article, relevant to the total number of authors. The result from this process was about 29.6% of authors having worked on sustainability related articles. This gave the university a score of four for this question, as the gradient was 25-32%.

Question R4 searches for: 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. This question was answered by going to each institutes staff list and cross referencing this with the list of authors who had published a research article, found in question R2. The result was that every institute had at least one staff member who had published a sustainability related research article, which implies that they conduct sustainability related research.

Question R5 asks: Does there exist one or more resource centres on campus providing sustainability-related research or services? This question is a yes or no, and was found by asking the director of sustainability, Katy Boom, if this was true or not. The answer was yes, her work with the Worcester Bosch Group is an example, and the university got the full 5 points for this question.

Question R6 looks for: Does the institution have an ongoing program to encourage students in multiple disciplines or academic programs to conduct research in sustainability? The University of Worcester does provide these programs through several avenues. First, the

university offers a Masters by Research program. While this program does not specifically encourage sustainability related research, many of the Masters that can be completed through research incorporates sustainability, which encourages sustainability related research by students from all disciplines (University of Worcester, 2016). Second, the university has a Research Development department which hosts events for student and faculty researchers to help develop their research. While many of these events do not relate to sustainability, several do and they encourage researchers from all disciplines to take part in research (Researcher Development, n.d.). Therefore, the University received a five on this question.

Question R7 wants: 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). The director of sustainability, Katy Boom, provided us with details about the Learning for Responsible Futures Awards, which meets these requirements so the five points were awarded. This award was launched in 2012 and seeks to reflect commitments to incorporate sustainability across programs and departments. To date, twenty awards, all worth around £3,000, have been made through this program. These awards have been given to support both research projects and integrating sustainability related topics into modules (University of Worcester, 2017).

Question R8 asks: 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? We found the answer to this question by asking Karen Dobson, a Research and Knowledge Exchange Facilitator at the University of Worcester, about research policies. There are no research policies that directly give positive recognition to interdisciplinary research, so the university did not score points for this question.

Question R9 questions: 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. This was answered by going to The Hive's website, a cooperative library designed to serve both the University of Worcester, and the community of Worcester. The Hive gives access to all these materials, and thus the University scored a full 5 points.

Questions R10 is looking for: 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? The answer for this question was also provided by Karen Dobson. The university does provide funding to cover the cost of open-access publishing.

4.3 Post-Implementation Review

The post implementation review consisted of a series of follow up faculty interviews. In addition, a comparison to the previously implemented STAUNCH tool is performed. The purpose of this post implementation analysis is to validate the results of the tool and ensure that the tool is accurately representing sustainability at the University of Worcester.

4.3.1 Follow Up Interviews

For the follow up interviews, we contacted the same members of faculty that agreed to meet for our first round of interviews, the majority of whom said they would be willing to talk to us again during the pre-implementation interviews. In the end, due to time constraints, only three of these faculty members were able to be interviewed a second time. These interviews ranged between 15 and 45 minutes in length. The questions that we asked were short, with the primary focus being whether or not the tools accurately reflected sustainability at the University. Of the three people that we interviewed, all of them stated that they felt the tools were relatively accurate. One faculty member stated that it might be useful to have a section of the tool focused on sustainability within student life on campus. This would include access to opportunities such as bike and car shares, student gardens, and other sustainability themed amenities available to students.

4.4 Comparison to STAUNCH

The University of Worcester has implemented a sustainability benchmarking tool in the past called Sustainability Tool for Auditing University Curricula in Higher-Education (STAUNCH). The STAUNCH tool is more exhaustive than the Higher-Ed Sustainability Evaluation, but is much more focused. The STAUNCH tool focuses specifically on curriculum, and even more specifically individual modules and what institute those modules fall under. The

2010 implementation of STAUNCH found that 24% of modules relate to sustainable development. The university showed improvement by the 2013 implementation of STAUNCH when it found that 34% of the modules were related to sustainable development. The implementation of the Higher-Ed Sustainability Evaluation found that 16.57% of the modules related to sustainability. If this is compared straight to the STAUNCH implementations and taken at face value, it would mean that the University of Worcester's inclusion of sustainability in its curriculum has decreased greatly. However, this straight comparison cannot truly be made accurately for several reasons. First, the STAUNCH tool does not use the same methodology in which to determine whether a module is related to sustainability or not. The Higher-Ed Sustainability Evaluation utilized a simple keyword search while the STAUNCH tool uses specialized software to analyze module descriptions. This difference in methodologies would give rise to different results. There are also varying definitions and understandings of sustainability, which could be another reason for different results in defining whether a module is related to sustainability. While STAUNCH and the Higher-Ed Sustainability Evaluation are both sustainability benchmarking tools, they are vastly different with different methodology. Therefore, comparing results from the two tools will not be an accurate representation of progress the University of Worcester has made toward incorporating sustainability into its curriculum. However, the Higher-Ed Sustainability Evaluation can continue to be implemented in the future and the results can then be compared to track the university's progress.

5 Conclusion and Recommendations

Our conclusions consist of an overall summary of the tool results, and how this reflects on the university compared with the opinion of various faculty members. In addition, recommendations for modifying the methodology in the implementation guide, as well as some changes to the tool, are provided to make future implementation at the University of Worcester easier, more accurate, and repeatable. Additionally, some related opinions and comments related to the project overall and to sustainability in general are also expressed.

5.1 Tool Results

The overall results of the curriculum tool were positive, yielding a score of 41/50 for the University. In general, the overall faculty opinion given in the post implementation interviews stated that this is a relatively accurate representation of sustainability curriculum at the university. Most faculty agreed that overall integration of sustainability related themes in modules is good, but there is room for improvement, especially regarding student retention of sustainable ideas. A common opinion was that assessing sustainability literacy among students is important and should potentially be weighted higher than the other categories. Many staff that were interviewed expressed the want to integrate more sustainable ideas into their classes, but were limited by both time and resources. This shows that the overall opinion of increasing sustainability in curriculum is high, which is something that is not necessarily reflected and shown in the tool.

The results of the research tool were similar, with an overall score of 44/50. We were able to talk with a number of faculty members who are heavily involved with research, and they seemed to agree that a relatively high score with room for improvement was an accurate representation of sustainability research at the school. Particularly, there were some comments about our keyword choice. Their opinion was that the chosen sustainability keywords were good for a generalized search of sustainability themes in research articles; however, research at the University of Worcester is somewhat specialized, in that a lot of research done is about topics related to health such as dementia and domestic violence. One can argue that these topics have the potential to be sustainability related, but it was unlikely that our chosen keywords would pick

up on these articles. As a result, many potential sustainability related articles might not have been recognized by the tool during implementation.

The obvious solution is to put more thought into the keywords used to scan for sustainability related themes. This is easier said than done, but some recommendations that we came up with are removing “work” and “employment” from the keyword list. In our analysis, we found that the items flagged by these two keywords were almost entirely false positives, due to their broad nature. During implementation, we realized early on that “work” was an issue and removed it, as it yielded a large percentage of results, and most of them were not sustainability related. The keyword “Employment” was more of a prevalent issue in the course analysis, as many courses would feature this keyword due to future employment being a strong consideration for a student picking a course.

Additionally, more variants of the keywords could be added. For example, a search for keywords that are hyphenated (e.g. well-being) would miss non-hyphenated occurrences of the same word. Also, if the entity that the tool is being used to evaluate does a lot of research in a specialized area then the keyword list should be revised to include related, specialized terminology. This process of adding keywords will be unique for every university at which the tool is used. Thus, there would not be a universal way to find keywords a priori. However, a broad methodology is provided in an updated implementation guide, found in **Appendix 2**.

5.2 Implementation Guide

During implementation, we found that the implementation methodology developed previously was incomplete. It often had inconsistencies with the location of the information we needed to implement the tool. A lot of our methodology for finding information differed quite a bit compared to the original guide. As such, throughout the course of this project, the guide was overhauled and changed to be more accurate and easier to repeat in the future, in the likely event that the university will use the tool again. This updated guide can be found in **Appendix 2**.

The original guide says that question C3 can be answered by the “Director of Sustainability Department”, but this was not where we found the information. For this question we needed to get access from the registrar or other faculty to see how many students have taken

the sustainability related modules determined in C2. For C5 the guide says to go to the "Student Union office" when the information was more easily found by asking the Director of Sustainability. When answering C6 the guide gave very little help. It simply said to go to https://www.worcester.ac.uk (the universities website). A better option -would be a direct link to the sustainability page, "https://www.worcester.ac.uk/discover/sustainability.html", along with their other sustainability website "http://susthingsout.com". In C7 there are two locations given to find the answer, but we also found that the answer was on the student union's website at https://www.worcsu.com/yourunion/susustainability. Question C9 says to ask professors, however all the professors we interviewed knew of no incentive programs. We then asked the Director of Sustainability and she told us of one incentive program that they run. Question C10 states: Is the institution utilizing its campus by having physical locations which specialize in the following areas of sustainability? We changed the wording from "physical locations" to "physical locations or policies" as several of the categories have specific policies regarding them, but having physical locations dedicated to them would not make sense. Finally, question R1 states: Amount of funding from grants and contracts specifying sustainability-related research, relative to the total amount of funding from grants and contracts at the institution, as a percentage. We changed the wording of this to the following: number of projects funded from grants and contracts specifying sustainability-related research, relative to the total number of projects funded from grants and contracts at the institution, as a percentage. We believe that this better represents the effort from the university to complete research related to sustainability and have it funded. Some research projects receive much more funding simply due to the nature of the project costing more than others. This could cause the data to be skewed as one project may sway the answer more than another, which is undesirable.

The research tool was significantly more difficult to implement than the curriculum tool. This was primarily because questions R1, R3, R6, R7, R8, and R10 required information that was difficult for us to acquire. R1 was difficult because the information is confidential, and the others were difficult simply because the information was not easily accessible. The confidentiality issue may not be significant if, in the future, the tool is implemented by someone who would have access to such information. However, the other issues may still be a problem because the information will still be difficult to find. For example, question R6 and R7 ask about incentives that the school has for encouraging students and professors to do research on

sustainability topics. These incentives could officially exist without being well know. Therefore, even if we do not find evidence of the incentives, we cannot be sure that they do not exists. Additionally, even if they do not officially exist, professors may provide their own incentives to their students or other professors. This could lead to issues about whether or not their actions count as actions taken by the institutions. The updated implementation guide for completing the research tool is given in Appendix 2.

In summary, the major changes that were made to the implementation guide include a more in-depth descriptions of information locations, relevant faculty contacts who were able to provide us with hard to access data, and the inclusion of the SustainabiliTool (and the other similar programs that were written. See Appendix 5) to help sort through the information. This should allow for easier implementation in the future.

5.3 Comments and Final Recommendations

Overall, the team believes that the project was a success. The curriculum and research benchmarking tools were both implemented, and based on the feedback from faculty that we received, the scores appear to accurately reflect the University of Worcester's attainment of sustainability in their respective categories. It is apparent that, while the University of Worcester is already doing well in regard to sustainability integration, there is a strong interest among faculty members to increase these efforts even further. This interest is why having a way to easily benchmark progress is important; being able to gauge progress in this manner makes assessing continuous improvement easier.

Our first recommendation is that for question R3 the grading range for four points be changed from 25-31% up to 25-32% and for five points be increased from >31% to >32%. This recommendation is simply because all the other ranges are eight percentage points while the score of four was only seven, so it provides consistency to the gradient scores. Additionally, changing question C9 from "existing departments" to "existing modules" because the tool is for measuring the curriculum and modules are more pertinent.

During our pre-implementation interviews, we found that many of the participating faculty were under the opinion that, while benchmarking sustainability is a great way to measure

progress, it is also important to ensure that the students leaving the school retain the sustainable ideas that they are exposed to during their time at the university. There are a number of different ways that this can be done, but most require a large amount of time. An example would be to administer a sustainability literacy test at a set interval of time, and comparing the scores of graduating students to their scores in the past. This could serve multiple purposes: it would give an idea as to the amount of sustainability knowledge that students have when entering the school, which is an indicator as to whether or not potential student applicants view the university as "green" or not. It will also gauge how much students learn about sustainability throughout their education, and whether or not they have a good grasp of sustainable ideas that they can apply to their jobs and community after they graduate.

Being able to benchmark how well the university is focusing on and implementing sustainability is important, but it is more important to measure how much is being retained by the students. What they learn and implement in their careers is what will further future sustainability advancement on a global scale. While it is important to measure the university's actions to ensure a continually increasing focus on sustainability, it is more important to ensure students' retention of the knowledge. For this reason, future groups working on this project should not only focus on answering the Higher-Ed Sustainability Evaluation that has already been made, but also compose a new portion that evaluates student knowledge of sustainability during their time as students, which will allow the university to see if they are producing sustainability literate graduates.

6 References

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7 Appendices

7.1 Appendix 1: Tools Analyzed

This is the list of benchmarking tools that the previous IQP team used to develop their custom tool.

Tool: The Sustainability Tracking Assessment and Rating System (STARS)
Creator: The Association for the Advancement of Sustainability in Higher Education (AASHE)
Found at: https://stars.aashe.org/

Tool: The College Sustainability Report Card (CSRC)
Creator: The Sustainable Endowments Institute
Found at: http://www.greenreportcard.org/

Tool: The Sustainability Tool for Auditing University Curricula in Higher-Education (STAUNCH)
Creator: Rodrigo Lozano at the Cardiff University

Tool: The Sustainability Assessment Questionnaire (SAQ)
Creator: University Leaders for a Sustainable Future (ULSF)
Found at: http://ulsf.org/sustainability-assessment-questionnaire/

Tool: The Program Sustainability Assessment Tool (PSAT)
Creator: Center for Public Health Systems Science (CPHSS)
Found at: https://sustaintool.org/

Tool: The Kingston Report
Creator: V. Hands and R. Anderson at Kingston University

Tool: The Graphical Assessment for Sustainability in Universities (GASU)
Creator: Rodrigo Lozano
Found at: https://www.sciencedirect.com/science/article/pii/S0959652606000357

Tool: The Unit-based Sustainability Assessment Tool (USAT)
Creator: Swedish/Africa International Training Programme
Found at: http://www.eauc.org.uk/theplatform/usat_unit-based_sustainability_assessment_tool

Tool: GreenMetric
Creator: University of Indonesia
Found at: http://greenmetric.ui.ac.id/

7.2 Appendix 2: Updated Tool Implementation Guide

This guide is taken from the report written by Berman-Jolton et. al. (2017), but has been modified significantly over the course of our project.

7.2.1 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, the previous group examined the STARS 2.0 & 2.1 database including over 500 higher education institutions. Based on that information, they looked at the universities that scored on the low and high end in each category. Then they gave each number, 1-5, a percentage based on the median scores.

7.2.1.1 Curriculum Tool

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. A regex search can be used to scan each course description for keywords.
Median Score: 13.47%

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. The first part of the SustainabiliTool can be used on this webpage to analyze the modules.
Median Score: 9.92%

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: Contact the registrar's office with a list of sustainability-related modules, generated from question C2.

Relevant Contact: Registrar Data Analyst, https://www.worcester.ac.uk/registryservices/937.htm
Median Score: 42.15%

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%

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 OR the University of Worcester societies list on the student union website https://www.worcsu.com/sports_activities/societies/societiesa-z/
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

6. Does the institution maintain a regularly updated sustainability website?
Location: https://www.worcester.ac.uk/ OR http://susthingsout.com/
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.

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.

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.

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: Director of Sustainability

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.

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: https://www.worcester.ac.uk/discover/what-we-do-sustainability.html

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.

7.2.1.2 Research Tool

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
Relevant Contact: The Research and Knowledge Exchange Facilitator
Grading: The previous group looked at data for the median amount of funds dedicated to research from every publicly available university in England. From this the previous group determined that of all research conducted an amount of 10% of the funds dedicated to sustainability is more than an adequate amount.

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. The second part of the SustainabiliTool can find articles with the keywords in their abstract or title.
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, the previous group determined that the mean of sustainability themed publications was 5% so the previous group established a range of scores based on that percentage as the median.

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.*
When running the second part of the SustainabiliTool, it will report the total number of authors found, and the number of authors that wrote a sustainability related article. This is the best way to approximate an answer to this question.
Median Score: 19.08%

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.*

When running the second part of the SustainabiliTool, it will create a list of all authors that have written a sustainability related article. This list can then be cross-referenced with the institute staff list.

Median Score: 37.14%

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

OR

The Director of Sustainability

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

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

OR

https://www.worcester.ac.uk/discover/community-involvement.html

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.

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.

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?

Location: Research School located in the Jenny Lind building.

Relevant contact: The Research and Knowledge Exchange Facilitator

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.

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?

Location: The Hive- City Campus or the Hive website

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.

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?

Location: Research School located in Jenny Lind Building

Relevant contact: The Research and Knowledge Exchange Facilitator

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

1. The institution provides incentives for open publishing

7.3 Keyword List

Goal 1- Poverty Poverty	**Goal 10- Inequality** Reduce Inequality Inequality
Goal 2- Food Hunger Food Security Nutrition Sustainable Agriculture	**Goal 11- Habitation** Inclusive Human Settlements Inclusive Cities Cities Human Settlements
Goal 3- Health Healthy Lives Well-Being All ages--elderly	**Goal 12- Consumption** Sustainable Consumption Consumption Productive Patterns
Goal 4- Education Equitable Education Inclusive Education Opportunities for all	**Goal 13- Climate** Climate Change
Goal 5- Women Gender Equality Empower women Women Girls	**Goal 14- Marine-ecosystems** Conserve Oceans Sustainable Oceans Oceans Marine Seas
Goals 6- Water Water Sanitation	**Goal 15- Ecosystems** Terrestrial Ecosystems Ecosystems Manage Forests Desertification Land Degradation Land Biodiversity
Goal 7- Energy Affordable Energy Reliable Energy Sustainable Energy Energy	
Goal 8- Economy Sustainable Economic Growth Sustainable Growth Economic Growth Productive Employment Employment Decent Work	**Goal 16- Institutions** Peaceful Societies Inclusive Societies Access to Justice Justice Inclusive Institutions Accountable Institutions
Goal 9- Infrastructure Resilient Infrastructure Infrastructure Sustainable Industrialization Industrialization Foster Innovation Innovation	**Goal 17- Sustainability** Global Partnership for Sustainable Development Sustainability Sustainable

7.4 The Original Tools

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:

| UNIVERSITY OF WORCESTER | HENWICK GROVE | UK | WORCESTER | WR2 6AJ | 01905 855000 | HTTPS://WWW.WORCESTER.AC.UK |

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:

7.5 Appendix 3: Faculty Interview Questions

All our invitation to the University of Worcester faculty regarding interviews will begin with the following statement:

Hello <Relevant Title and Name>,

We are a group of students from Worcester Polytechnic Institute located in Worcester, Massachusetts, USA. We are working on a research project with Dr. Heather Barrett that involves assessing a benchmarking tool for sustainability efforts at the University of Worcester. We will be covering sustainability as it applies to curriculum, and as it applies to research. We would like to request approximately 30 minutes of your time for an interview about your involvement and research with sustainability, as well as your opinion of the tool. Your opinion and the information that you provide will be used to either validate the tool as it exists, or to modify it.

Records of your participation in this study will be held confidential. However, the study investigators, the sponsor or it's designee and, under certain circumstances, the Worcester Polytechnic Institute Institutional Review Board (WPI IRB) will be able to inspect and have access to confidential data that identify you by name. Any publication or presentation of the data will not identify you, unless you specify otherwise. We would like to both record and take notes during the interview, with your permission. This interview is completely voluntary, and you are free to decline, stop the interview, or skip questions at any point.

We have attached both benchmarking tools to this email; one for curriculum, and one for research. Each one consists of 10 questions related to sustainability. We would be grateful if you could quickly look them over prior to the interview. We would be happy to answer any questions that you have, either about the interview process or otherwise.

It would be greatly appreciated if we could have a response by the end of the day Monday, March 19th. We will be conducting the interviews throughout the week of March 19th from 9am-5pm each day. If you have the time, please respond with when you are available for an interview so we can make sure we do not double schedule. If you are unavailable for an interview, but would still be willing to provide feedback, please respond to this email and we will forward the interview questions onto you.

For more information about this research or about the rights of research participants contact:

Professor Susan Jarvis, ECE Department, WPI, 100 Institute Road, Worcester, MA (Tel.7846-961881, Email: sjarvis@wpi.edu). You may also contact the chair of the WPI Institutional Review Board (Prof. Kent Rissmiller, Tel. 1-508-831-5019, Email: kjr@wpi.edu) or WPI's University Compliance Officer (Jon Bartelson, Tel. 1-508-831-5725, Email: jonb@wpi.edu).

Thanks,
Jacob Fennick, Tyler Kornacki, Jason Morgan, Isaac Woods

The following questions will be asked to University of Worcester faculty that agree to participate in an interview.

7.5.1 Questions (Pre-Implementation):

1. In what areas of sustainability do you work?
    a. OR: Do you have any interaction with sustainability in your work?
2. Do you think it is important to integrate sustainability in to university curriculum?
3. Do you think the university could improve their engagement of sustainability in its curriculum and/or research? If so, how? If not, what is inhibiting it?
    a. OR: Do you think the university could integrate sustainability into your area of focus better? If so, how? If not, what is inhibiting it?
4. How progressive is the University of Worcester in regard to Sustainability education? Compared to other universities?
5. After looking over the tool, what is your initial response?
6. Do you believe certain categories of sustainability should be weighted higher than others?
7. In which areas do you feel the benchmarking tool is lacking?
8. If you could add a question to this tool what would it be?
9. Do you believe benchmarking sustainability can be done effectively? Why or why not?

The above invitational correspondence will be slightly edited to be more relevant for an interview occurring after the tool is implemented. This includes changing dates and slightly modifying the wording in the event that we had already interviewed the faculty member. Everything else, such as the section on identity and volunteering, will remain the same.

7.5.2 Questions (Post Implementation):

1. What area of sustainability do you specifically work with? (*Only if interviewee did not take part in previous round)*
2. In your opinion, is the score that the University of Worcester received from this benchmarking tool an accurate representation of university sustainability efforts as a whole? Why or why not?
3. In your opinion, does the tool accurately represent university sustainability curriculum?
4. In your opinion, does the tool accurately represent university sustainability research?
5. Would this tool be better suited for external, institutional comparison (multiple universities same time) or internal comparison (same university multiple times)?
6. What would you have done differently?

7.6 Appendix 4: C10 Explanation

Sustainability Category:	Fulfillment by the University of Worcester:
Air & Climate	The Hive: self-ventilation reduces CO_2 emissions Smoke-free Campus (University of Worcester, 2017)
Buildings	The Hive: Designed specifically with sustainability in mind (University of Worcester, 2017)
Energy	150 kilowatts of solar panels (University of Worcester, 2017)
Food & Dining	Food Swap Shop (Worcester Students' Union, 2018) Bronze Soil Association Food for Life accreditation (University of Worcester, 2017)
Grounds	University Gardens (University of Worcester, 2017)
Purchasing	University Procurement Strategy: Identifies 11 ways to ensure environmentally friendly procurement (University of Worcester, 2017)
Transportation	Woo Bike: Bike share Car share (University of Worcester, 2017)
Waste	Sustainable Waste Management Strategy: Plan to move towards zero waste (University of Worcester, 2017)
Water	Water Strategy: Outlines drivers to reduce water consumption, targets for reduction, current consumption, and water reduction projects (University of Worcester, 2017)
Coordination & Planning	Director of Sustainability, Katy Boom
Diversity of Affordability	Scholarships: Provided for different areas such as sports and international students Loan Programs (University of Worcester, 2018)
Investment and Finance	Ethical Investment Policy: Outlines investment strategies including not investing in companies with negative ethical records (University of Worcester, 2017)
Public Engagement	The Hive- Public library
Wellbeing & Work	The Hive, Peirson Building: Quiet work spaces Fit-4-Life: Program encouraging physical and mental health for students (University of Worcester, 2017)

7.7 Appendix 5: The SustainabiliTool©

Two pieces of software were created to aid in answering C2, R2, and R3. The first piece of software is a Module Analyzer for C2, and is a written as a Firefox extension in JavaScript that runs when the University of Worcester's Module database is opened. The second piece of software is a Research Analyzer written for R2 and R3, and is written as python script. This script can be given a JSON file from the University of Worcester's WRAP database, and will parse it to find the articles that are sustainability related (based on title and abstract). It will also find the authors for the sustainability articles, in order to get the percentage of authors writing sustainability articles compared to the total number of authors writing research articles.

7.7.1 Software 1: The Module Analyzer

The code can be found here (https://github.com/BenchmarkIQP18/ModuleAnalyzer)

The Firefox extension can be installed as a temporary add-on in the usual methods. The simplest method is to go to the `about:debugging#addons` page and click `Load Temporary Add-on`. A file selection dialog will appear, and the `manifest.json` file should be selected. Once this has been done, an alert will appear on the module directory page, and if yes is selected the code will run.

7.7.1.1 The code

There are multiple files that compose this software, but the code that is run is below.

```
/** This script will analyze the University of Worcesters Module Directory, found at:
                https://ext-webapp-01.worc.ac.uk/cgi-bin/module/module_directory_17tt.pl
                If the path changes significantly then the script might not work.
*/

//// Global variables
// Get the full url of the page for ajax posts later
var URL = `${document.location.protocol}//${document.location.hostname}${document.location.pathname}`;
/* Used to keep track of how many unresolved Ajax requests we have.
         Should allow us to run a thing after all modules are retrieved */
var GlobalStats = {
        moduleCount: 0,
        susModules: 0,
        waitingFor: 0,
        susModulesList: [],
        otherModuleList: []
};

// var saveFile = "Module Title, Module Description, Keyword Count,"
var keywordList = ["\\bAccess to Justice","Accountable Institutions","Affordable Energy","All ages--
elderly","Biodiviersity","Cities","Climate Change","Conserve Oceans","Consumption","Decent
Work","Desertification","Economic Growth","Ecosystems","Employment","Empower women","Energy","Equitable
Education","Food Security","Foster Innovation","Gender Equality","Girls","Global Partnership for
```

```
Sustainable Development","Healthy Lives","Human Settlements","Hunger","Inclusive Cities","Inclusive
Education","Inclusive Human Settlements","Inclusive Institutions","Inclusive
Societies","Industrialization","Inequality","Infrastructure","Innovation","Justice","Land
Degradation","Land","Manage Forests","Marine","Nutrition","Oceans","Opportunities for all","Peaceful
Societies","Poverty","Productive Employment","Productive Patterns","Reduce Inequality","Reliable
Energy","Resilient Infrastructure","Sanitation","Seas","Sustainability","Sustainable
Agriculture","Sustainable Consumption","Sustainable Economic Growth","Sustainable Energy","Sustainable
Growth","Sustainable Industrialization","Sustainable Oceans","Sustainable","Terrestrial
Ecosystems","Water","Well-Being","Women\\b"]
var keywordRegex = new RegExp(keywordList.join('\\b|\\b'), 'giu');

var loadingAnim;

/***** Code *****/

// Ask to run
if(window.confirm(`
I have detected that this is the module page for the University of Worcester.
Would you like me to analyze that for you?
`)) {
        runModuleAnalyzer()
}

// Actual stuff to run
function runModuleAnalyzer() {
        console.log("Analyzing Modules");

        // Some fun loading animation stuff
        // var lod = ['|','/','--','\\','|','/','--','\\'];
        var lod = ['','.','. .','. . .'];
        var lodN = 0;
        jQuery("#results_table").html(`<p id='loading_text'>Finding sustainability related modules
${lod[lodN]}</p>
<div id='stats'>
<p>Total modules analyzed: ${GlobalStats.moduleCount}</p>
<p>Sustainability related modules: ${GlobalStats.susModules}</p>
<p>Percentage: ${GlobalStats.susModules/GlobalStats.moduleCount*100}%</p>
<p>Waiting on ${GlobalStats.waitingFor} modules</p>
</div>
`);
        loadingAnim = window.setInterval(function() {
                lodN+=1;
                jQuery("#loading_text").text(`Finding sustainability related modules
${lod[lodN%lod.length]}`);
        }, 300);

        // Get the department and level options from the form
        departments = document.getElementById('dept_select').options;
        levels = document.getElementById('level_select').options;

        // For each through both the departments and levels
        // Option 1 is "-Select-", so we need to skip it
        for(i = 1; i < departments.length; i++) { // Make sure you are getting all depts/levels
                for(j = 1; j < levels.length - 1; j++) {
                        // We have decided to ignore graduate modules, so end at '-1'

                        // Send an Ajax request for the list of modules in a given department for a given
level
                        // Params for the request
                        postData = {
                                choices: 'yes',
                                dept: departments[i].value,
                                level: levels[j].value,
                                psl_code: '',
                                credits: '0',
                                pre_req_check: 'N'
                        };

                        // Send the request (as a post)
```

```
                        console.log("Sending Ajax for: "+departments[i].value +" "+levels[j].value)
                        $.ajax({
                                type: "POST",
                                url: URL, // The ajax does not work if you dont give it a full url, not
sure why
                                data: postData,
                                dataTypes: "html",
                                complete: function(data, status){
                                        console.log(`Retrieved a module list`);
                                        readModuleList(data.responseText);
                                },
                                error: function(xhr, status, error) {
                                        console.error(error);
                                }
                        });
                }
        }
}

/* Helper to read the list of modules (response to initial requests) */
function readModuleList(responseText) {
        // The result is an html block, so we need to parse it into something useful
        var parser = new DOMParser();
        var ResDoc = parser.parseFromString(responseText, "text/html");
        var links = ResDoc.getElementsByClassName("dialog");

        /* There are two links for every class, the one with the name and the calendar one
                 The innerText for the first link is the module title, the innerText for the second is
empty
                 If they change the layout of the response this might break */
        var modules = Array.from(links).map(el => el.innerText).filter(el => el != "");

        // We now have a list of modules names, so we need to request the information about each one
        modules.forEach(getModuleInfo);
}

/* Helper to get a modules info based on its name (sends request) */
function getModuleInfo(moduleName) {
        // Similar ajax to before, but the query is different
        postData = {
                mod_code: moduleName,
                module: "yes"
        };
        // Keep track of unresolved requests
        GlobalStats.waitingFor += 1;
        // Send the request
        $.ajax({
                type: "POST",
                url: window.thisURL,
                data: postData,
                dataTypes: "html",
                complete: function(data, status){
                        if(status == "success") {
                                readModuleInfo(data.responseText);
                        }
                        else {
                                console.error(`Could not get information for module !{moduleName}`);
                        }
                },
                error: function(xhr, status, error) {
                        console.log(error);
                }
        });
}

/* Helper to read the results of a module request */
function readModuleInfo(responseText) {
        var parser = new DOMParser();
        var ResDoc = parser.parseFromString(responseText, "text/html");
```

```
        /* Get the module name and description.
                 They are in the only h3 and p elements, so thats how I get it.
                 If they change the layout of the response this might break */
        fullName = ResDoc.getElementsByTagName("h3")[0].innerText;
        mDescription = ResDoc.getElementsByTagName("p")[0].innerText;
        var [mCode, mName] = fullName.split(" - ", 2);

        // Keep track of how many modules we have analyzed
        GlobalStats.moduleCount += 1;

        // Check for keywords
        if(keywordRegex.test(mDescription) | keywordRegex.test(mName)) {
                // Keep track of the analyzed modules that match
                GlobalStats.susModules += 1;
                GlobalStats.susModulesList.push([mCode, mName, mDescription]);
                // Highlight words in description and name
                hDes = mDescription.replace(keywordRegex, `<span class="highlight">$&</span>`);
                hName = mName.replace(keywordRegex, `<span class="highlight">$&</span>`);

        jQuery("#results_table").append(`<tr><td>${mCode}</td><td>${hName}</td><td>${hDes}</td></tr>`);
        }
        else {
                GlobalStats.otherModuleList.push([mCode, mName, mDescription]);
        }

        // Check to see if this is the last response
        GlobalStats.waitingFor -= 1;
        if(GlobalStats.waitingFor == 0) {
                // Stop the animation
                window.clearInterval(loadingAnim);
                $("#loading_text").text("Finished Analyzing");
                // Alert the user that it is finished
                alert(`
The Module Analyzer has finished running

Results:
Total modules analyzed: ${GlobalStats.moduleCount}
Sustainability related modules: ${GlobalStats.susModules}
Percentage: ${Math.round(GlobalStats.susModules/GlobalStats.moduleCount*100*100)/100}
`)
                /*
                // Print lists of sus modules and non-sus modules. Used in validation
                // (could not find a better way to export the information)
                susdata = GlobalStats.susModulesList.map(
                        el => el.join('#').replace(/[\n\r\t]/gm,' '))
                        .join("\n");
                console.log("Sus Modules")
                console.log(susdata);
                otherdata = GlobalStats.otherModuleList.map(
                        el => el.join('#').replace(/[\n\r\t]/gm,' '))
                        .join("\n")
                console.log("Other Modules");
                console.log(otherdata)
                //*/
        }
        // Write the stats to the page. Allows it to be clear that it is working
        jQuery("#stats").html(`
<p>Total modules analyzed: ${GlobalStats.moduleCount}</p>
<p>Sustainability related modules: ${GlobalStats.susModules}</p>
<p>Percentage: ${Math.round(GlobalStats.susModules/GlobalStats.moduleCount*100*100)/100}</p>
<p>Waiting on ${GlobalStats.waitingFor} modules</p>
`);
}
```

7.7.2 Software 2: The Research Analyzer

The code can be found here (https://github.com/BenchmarkIQP18/ResearchAnalyzer)

The second piece of code is a python script. The code can be run through the command line. It expects a JSON file that can be created by exporting the results of a search on the University of Worcester's WRAP database. If given a filename as a command line parameter, it will attempt to analyze that file. If it is not given the file, it will look for a file named `export_worcesterprints2013.json` in the same directory as the script. The script creates two files, `researchAnalysed.tsv` and `susAuthors.tsv`. It will also print some information to the command line. It skips any item that it cannot get a title or abstract for, and any authors that it cannot get a last name for.

7.7.2.1 The code

```
# This is a script that will analyze a json produced by the University of Worcester's WRAP
database
import sys
import json
import os
import re

# Setup keyword regex
keywordList = ["\\bAccess to Justice","Accountable Institutions","Affordable Energy","All
ages--elderly","Biodiviersity","Cities","Climate Change","Conserve
Oceans","Consumption","Decent Work","Desertification","Economic
Growth","Ecosystems","Employment","Empower women","Energy","Equitable Education","Food
Security","Foster Innovation","Gender Equality","Girls","Global Partnership for Sustainable
Development","Healthy Lives","Human Settlements","Hunger","Inclusive Cities","Inclusive
Education","Inclusive Human Settlements","Inclusive Institutions","Inclusive
Societies","Industrialization","Inequality","Infrastructure","Innovation","Justice","Land
Degradation","Land","Manage Forests","Marine","Nutrition","Oceans","Opportunities for
all","Peaceful Societies","Poverty","Productive Employment","Productive Patterns","Reduce
Inequality","Reliable Energy","Resilient
Infrastructure","Sanitation","Seas","Sustainability","Sustainable Agriculture","Sustainable
Consumption","Sustainable Economic Growth","Sustainable Energy","Sustainable
Growth","Sustainable Industrialization","Sustainable Oceans","Sustainable","Terrestrial
Ecosystems","Water","Well-Being","Women\\b"]
keywordRegex = re.compile('\\b|\\b'.join(keywordList), flags=re.I|re.U)

# Json File from database
file_name = "export_worceprints2013.json"
if(len(sys.argv) > 1):
    file_name = sys.argv[1]

# Get the json from the file
rjson = json.load(open(file_name, 'r', encoding="utf-8"))
print("Loaded Json")

# TSV file for research output
rtsv = open("researchAnalyzed.tsv", 'w', encoding="utf-8")
rtsv.write('Title\tAbstract\tKeywords\n')
```

```
ortsv = open("otherResearchAnalyzed.tsv", 'w', encoding="utf-8")
ortsv.write('Title\tAbstract\n')

# Accumulators
articles = 0
susArticles = 0
total = 0
skipped = 0
susAuthors = []
allAuthors = []

# For all the results in the json
for robj in rjson:
    try:
        total+=1
        rTitle = robj['title'].replace('\n',' ').replace('\r',' ').replace('\t', ' ')
        rAbs = robj['abstract'].replace('\n',' ').replace('\r',' ').replace('\t', ' ')

        # Count only after possible failure to find title/abstract
        articles+=1

        # Get all the authors into a list
        creators = []
        for auth in robj["creators"]:
            aLast = auth["name"]["family"]
            aFirst = auth["name"]["given"]
            if(aLast and aFirst):
                creators.append(aLast +", "+ aFirst)
            elif(aLast):
                creators.append(aLast)
        allAuthors += creators

        # If its got a keyword in the title or abstract
        if(keywordRegex.search(rTitle) or keywordRegex.search(rAbs)):
            susArticles+=1
            # Get the list of keyword hits, and sort/remove duplicates
            matchesL = keywordRegex.findall(rTitle) + keywordRegex.findall(rAbs)
            matchesL = sorted(list(set([el.lower() for el in matchesL])))
            rtsv.write("{}\t{}\t{}\n".format(
                rTitle, rAbs, ','.join(matchesL)))
            susAuthors += creators
        else:
            ortsv.write("{}\t{}\n".format(rTitle, rAbs))

    except KeyError:
        skipped+=1
        continue

rtsv.close()
ortsv.close()

susAuthors = sorted(list(set(susAuthors)))
allAuthors = sorted(list(set(allAuthors)))

# TSV file for authors
atsv = open("susAuthors.tsv", 'w', encoding="utf-8")

# Write authors
atsv.write('\n'.join(susAuthors))
atsv.close()
```

```
# Print Results
print("Done")
print("Found {} items".format(total))
print("Skipped {}".format(skipped))
print("Analyzed {} research articles".format(articles))
print("Found {} sustainability research articles".format(susArticles))
print("Found {} authors, {} writing sustainability related articles"
      .format(len(allAuthors), len(susAuthors)))
```