Critiquing a Sustainability Research Benchmarking 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
on May 04, 2017

Submitted By:
Sylvester Halama
James Macfarlane
Virginia Nunez Mir

Submitted to:

Advisor:
Ruth L. Smith, Worcester Polytechnic Institute

Sponsors:
Katy Boom, University of Worcester
Victoria Hands & Richard Anderson, Kingston University

RLS-AA9Z

Abstract

To increase cross-disciplinary research, researchers at Kingston University in London developed a methodology to identify key sustainable development researchers. Our goal was to test and enhance this methodology by applying it to University of Worcester. We expanded the design with an alternative staff search technique with a wider scope, tested profile analysis, and interviewed staff for research interest links. Our enhanced methodology fosters the initial purposes of Kingston's methodology by creating a platform to support a network of sustainability researchers.

Acknowledgements

We would like to thank the following for their help and support throughout the duration of our project:

Members of the WPI Community

Professor Ruth L. Smith for her advice and support throughout our time in Worcester, UK

Professor Robert Krueger for his work developing the Worcester, UK project center

Professor James A. Chiarelli for advising us during the preparatory course

Members of the Worcester, UK project teams for their peer support throughout the term

University of Worcester

Katy Boom for helping to create our project and providing insight throughout the term

Gerry Beattie for filming several presentations throughout the term

The staff members who agreed to be interviewed for our project

Kingston University

Victoria Hands for helping to create our project

Richard Anderson for providing valuable insight about his original work throughout the term

Acronyms and Key Terms

Acronyms:

AULSF - Association of University Leaders for a Sustainable Future

GASU - Graphical Assessment of Sustainability in Universities

GRI - Global Reporting Initiative

SDR - Sustainable development research

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

Key Terms:

Benchmarking - Evaluating and understanding the current position of an organization

Find a Researcher - A search program available at Kingston University that only includes 465 staff members considered research active

Keywords - In terms of this project, a list of 77 words/phrases, related to sustainability, that were used to identify research staff

Kingston University - An institution located near London that developed the methodology we tested and enhanced

Snowballing - In terms of this project, beginning with a small amount of staff members and expanding by asking each staff member to identify further staff members

Spreadsheet - In terms of this project, a file created that contains each staff member, a link to their profile, and which sustainability keywords they have on their profile

University of Worcester - An institution in Worcester, England where our enhanced methodology was applied

Executive Summary

The idea of sustainable development has been widely discussed and is now finding its way into higher education institutions. Researchers at Kingston University, located in London, developed a benchmarking methodology with the purpose of understanding the state and depth of sustainable development research at their university. The goal of our project was to test and enhance Kingston's methodology so that it can be applied to the University of Worcester, a less research-intensive institution located in Worcester, England. The completion of our project involved testing the current methodology at the University of Worcester and forming recommendations throughout the process, based on the observations we made.

The Kingston methodology assessed sustainability content by extracting keywords related to sustainability from the Kingston University Sustainability Policy and the United Nation's document titled, "Transforming our world: the 2030 Agenda for Sustainable Development." The authors used a search tool called Find a Researcher to identify research active staff related to sustainability, using each of the keywords as their subject area. The Kingston authors then grouped the Kingston University research staff based on their link to sustainable development research, either as high link, potential link, or a weak link. Based on these results, the researchers developed a rough estimate of which staff and which departments contribute most to sustainable development research.

As part of our project, we tested the effectiveness of the Kingston methodology on University of Worcester using a slightly altered method. We focused our analysis on three concerns that arise from methodologies on sustainability research: understanding the subtleties of the sustainability language, identifying the values and objectives of the community, and sorting

through the complexity of data compilation methods and data analysis methods.

We address the subtleties of language by analyzing the effectiveness of the keywords developed by Kingston methodology. To that end, we developed a special Google search to find staff at University of Worcester that had keywords in either their profile or the publications listed in their profile. We then created a spreadsheet that lists all staff that had any keywords associated with them. To address data analysis methods we combined quantitative and qualitative methods on our spreadsheet. Quantitatively, the staff is portrayed by the number of keywords associated with their profiles, and qualitatively, they are portrayed by which specific keywords appeared on their profiles.

The next step of our project was to create a map of researchers at University of Worcester. To cover concerns of data compilation and data analysis methods, we combined the analysis of online research profiles with interviewing key staff identified from the spreadsheet. We used a process called "snowballing" where a sample of researchers is first identified, and then these researchers identify more researchers that are related to sustainable development research. Successful results from this process led to more interesting and relevant researchers than our initial spreadsheet. To understand the values and objectives of the researcher community, we included questions in our interview targeted at understanding the challenges of sustainability research and the network the researchers belong to.

Findings

Upon initial completion of the keyword search, we had identified 573 staff members at the University of Worcester. Generally, the researchers that had the most keywords tended to be the most involved in sustainable development research. We made a recurring observation with the broader keywords, in that they were not always used in a sustainable-related context within

profiles. This finding suggests that some keywords could be modified to reduce context-related issues, especially the broader keywords such as "work."

We compared our agreement rate, or the percentage of staff members that all team members ranked the same when ranking using interviews versus using online profiles. For staff members ranked through interviews, we had an agreement rate of 100%. For staff members ranked without interviews, the lack of information led to a reduced agreement rate of about 47%.

Upon looking at initial results of the ranking, 43 out of the 75 initial researchers ranked were agreed upon by all three of us, which is approximately a 53% agreement rate. The next 28 out of 75 researchers were ranked very closely to each other, which means that about 94% of the rankings were either immediately agreed upon or had a minor disagreement. The remaining 6% of researchers had major disagreements and resulted in the longest discussions. This implies that ranking subjectivity between different users is not a major concern.

Further insight into the university's internal community was obtained from the interviews. Researchers tended to know more about their research itself, while university executives had a much better understanding of the various university policies concerning research and publications. Additionally, executives had a much better understanding of all the institutes at the university.

A finding of the staff profiles was that they were fairly up to date. The interviews suggest that while some profiles might be missing the latest details, most were updated enough to give an accurate representation of each staff member's work. When asked about their primary method of contacting other researchers for collaborations, with most of them opting for personal connections and other networks. Very few reported being part of networks outside their own areas.

The principle of snowballing was most effective during the initial round of interviews. After the first 10 interviewees were selected from the spreadsheet, these researchers were able to point us towards other researchers relevant in sustainable development, expanding our original list to 30 people. However, as interviews proceeded with researchers who had been snowballed, the subsequent snowballing mostly identified researchers who either had previously been identified or initially identified from the spreadsheet. Additionally, these researchers tended to only identify the more prominent individuals.

Recommendations

Keywords that returned more than 100 results seemed to be used in other senses of the word rather than a sustainability sense of the word. We, therefore, suggest that the keywords be modified in order to improve their focus towards sustainability and reduce the occurrence of false positives. We recommend utilizing the keywords simply for the purpose of initial identification and utilizing interviews for more detailed information.

A recommendation for snowballing involves rephrasing the interview question, "Is there anybody we should talk to, perhaps who is in another institute and isn't well-known?" While it is difficult to assess how effective the snowballing principle is, at a minimum, it serves as a cross-check against the keyword search.

We recommend that interviews be used to supplement the online profile search and be used to assist the user in ranking the researchers. We recommend that stage two be performed by first analyzing all of the online profiles compiled during stage one. To reduce subjectivity, more than two users should complete this step. Interviews can then follow with the staff members on which users disagreed. An important consideration in planning the interviews is to avoid major holidays, as we found that timing our interview process during Easter greatly reduced the

number of positive responses.

Our findings on the challenges in identifying sustainability research revealed that the lack of interdisciplinary research could be addressed if the university provided ways to naturally integrate interdisciplinary research into staff's normal workloads. Some recommendations include providing visual representations of the network, as well as providing incentives for researchers that perform interdisciplinary work.

As there is not one overarching solution to the concerns methodologies on sustainability research, future research should continue to improve methods of identifying what sustainability truly is. By studying the various definitions of sustainability, we can begin to understand more complex ideas behind sustainability language.

Authorship

Abstract: Sylvester Halama, James Macfarlane, and Virginia Nunez Mir
    edited by Sylvester Halama, James Macfarlane, and Virginia Nunez Mir

Acronyms and Key Terms: James Macfarlane
    edited by Virginia Nunez Mir

Executive Summary: Sylvester Halama, James Macfarlane, and Virginia Nunez Mir
    edited by Sylvester Halama, James Macfarlane, and Virginia Nunez Mir

Introduction: Sylvester Halama, James Macfarlane, and Virginia Nunez Mir
    edited by Sylvester Halama, James Macfarlane, and Virginia Nunez Mir

Literature Review:
    Sustainability Research in Higher Education Institutions: James Macfarlane and Virginia Nunez Mir
    edited by Sylvester Halama, James Macfarlane, and Virginia Nunez Mir

    Research on Research: Sylvester Halama and Virginia Nunez Mir
    edited by Sylvester Halama, James Macfarlane, and Virginia Nunez Mir

    Pioneering Sustainability Research Benchmarking: Sylvester Halama and James Macfarlane
    edited by Sylvester Halama and James Macfarlane

Methodology: Sylvester Halama, James Macfarlane, and Virginia Nunez Mir
    edited by Sylvester Halama, James Macfarlane, and Virginia Nunez Mir

Analysis and Findings: Sylvester Halama, James Macfarlane, and Virginia Nunez Mir
    edited by Sylvester Halama, James Macfarlane, and Virginia Nunez Mir

Conclusions and Recommendations: Sylvester Halama, James Macfarlane, and Virginia Nunez Mir
    edited by Sylvester Halama, James Macfarlane, and Virginia Nunez Mir

Table of Contents

List of Figures

List of Tables

Introduction

The Earth of 2017 is a world becoming more aware of the need for increased sustainable practices. Sustainable development research, be it economic, environmental, or social, is therefore a critical focus point for higher education institutions. An initial definition of sustainability can be considered "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland & Khalid, 1987). Throughout the last few decades, it has gone from a relative afterthought to a focus of governments and higher education institutions. Sustainability has begun to change the way we address the use of resources, as evidenced by the recent development of globally acknowledged sustainable declarations (Wright, 2002).

As sustainable practices develop, many institutions around the world are expanding their interests in sustainable development research. With this expansion, universities have identified a need to assess their roles in sustainable development research in their community. However, literature on benchmarking sustainable development research is scarce. Within the context of this project, benchmarking does not refer to an evaluation of the university with the purpose to create a score that can be used to compare universities. Instead, benchmarking refers to the identification of staff with sustainability interests with the purpose of starting a process that will bring attention to interesting sustainability researcher and promote inter-disciplinary collaboration. Researchers at Kingston University, located in London, have developed a benchmarking methodology with the purpose of understanding the extent of sustainable development research at their university.

The goal of our project was to first test, then develop an enhanced benchmarking methodology that could be applied to the University of Worcester, located in Worcester, England. The university is interested in exploring their sustainability research, despite being considered less research-intensive than Kingston University. To that end, the project involved testing the current methodology by implementing it at University of Worcester and observing how well the methodology approached the complex forms of sustainability. Since Kingston's methodology is currently the only benchmarking tool to focus exclusively on sustainability research, we are interested in exploring and investigating possible improvements that can be made. We hope that our critiques and recommendations will be of benefit to Kingston University and the University of Worcester, and increase knowledge in the area of sustainable development research.

Literature Review

In today's world, a focus on sustainable development research has been identified by universities and governments worldwide (Wright, 2002). Responding to this focus, universities began to intensify sustainability research during the late 20th century, when environmental damage started to become more widely recognized. As research continued, a common point of interest was determining how to measure, or benchmark, sustainability (Kyrö, 2003).

Sustainability Research in Higher Education Institutions

The importance of universities pursuing this role became more prominent following the creation of the Talloires Declaration. This document, created in 1990, was directly purposed toward university heads. It asked that universities work together to increase sustainability efforts in order to curb an eminent challenge (Wright, 2002). To that end, the declaration included a 10-point action plan focused on sustainability. Of these points, three are related to research, as the declaration described research as the method to "strengthen its communities for local and global citizenship" (Association, 1990).

Following the lead of the Talloires Declaration and others, a group at the University of British Columbia has analyzed key sustainability practices at universities and created seven goals that universities should strive for, in order to become more sustainable. These goals have a more internal focus, depicting the need for universities to study themselves introspectively to determine their status in sustainability research. A meaningful aspect of this study was the comment on how strong collaboration should be stressed in universities (Moore, 2005). The current competitive environment of universities does not foster the best environment for research

conducive to sustainability. While competition can encourage people to strive within their field, sustainability is an interdisciplinary field. Separating disciplines results in fierce competition over funds while an interdisciplinary approach allows the faculty to discuss what the most effective use of funds would be (Moore, 2005).

Several other declarations, such as the Swansea Declaration, which represented over 400 universities, have outlined the importance of universities to promote research in sustainable development. However, the methods of tracking the progress of sustainable research remain largely unexplored.

Research on Research

The scarcity of literature on benchmarking sustainability research may be due to how difficult the task is. This difficulty can be attributed to the varied and intricate nature of the subject. Unless otherwise stated, benchmarking in this paper refers to the research on sustainability research that identifies staff with sustainability interests. This project identifies three difficulties with research on sustainability research. The first is that a benchmarking methodology that attempts to create a snapshot of research on a topic must be able to take account the subtleties of the language used by researchers. The second is that the benchmarking methodology must identify the values and objectives of the community, as well as the stakeholders related to the project (Scerri & James, 2010). The third and final concern we are covering is related to the complexity of data compilation methods and data analysis methods, such as online sources versus the use of interviews, and qualitative analysis and quantitative analysis.

Defining Sustainability

One way to address the first concern, the subtleties of language, is by exploring the definitions of sustainability. Sustainability is a complex idea that, due to its extensive range, requires careful analysis to form a definition. The complex nature of sustainability is reflected in the way different people, with different backgrounds, approach the topic in their research. However, our project relies on our making decisions on staff's connection to sustainability. As such, it is important that we determine a definition of sustainability that is flexible enough that it can reconcile the differences in these approaches, but practical enough that it can serve as a strong backbone to our analysis. Through the following definitions, we explore the different ways to discuss sustainability.

Perhaps the most well-known and widely discussed definition is the report *Our Common Future*. Dr. Gro Harlem Brundtland, Prime Minister of Norway at the time, presented *Our Common Future* to the United Nations World Commission on Environment and Development in 1987. The report, now commonly known as the Brundtland Report, was created as one of the first commitments realizing that global climate change and resource depletion is in our future. The Brundtland Report created the well-known definition of sustainability that is still in use today, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland & Khalid, 1987). The Report addressed many needs before the General Assembly of the United Nations, including to propose long-term strategies for sustainable development, to recommend ways of cooperation among developing countries, to find ways for the international community to deal with environmental concerns, and to define long-term environmental issues. A unique factor of the Brundtland report was that it

claimed environmental quality and social equity are fundamental goals for impoverished nations as well as wealthy ones. It also states that economic and technological activities can only be improved as far as the biosphere is able to handle its effects (Krueger, 2017).

The Brundtland report was the first to introduce the idea of the three main pillars of sustainability: social, economics, and environment. While the environment pillar is the one that receives the most attention due to well-known issues such as climate change and pollution, both the social and economics pillars are just as important, in both our specific project and elsewhere.

Each of the three main pillars builds the scaffold of sustainability through distinctive forms of support. Of these three, the environment pillar is the most widely known. In a basic sense, environmental sustainability consists of living within the availability of resources (Hansmann, 2012). This can include such examples as land, food, material, and energy resources. These examples are often widely viewed as the extent of sustainability efforts. However, environmental sustainability by itself does not cover all aspects of society (Hansmann, 2012). The social and economic pillars should also be equally considered when planning sustainable development.

The next pillar, social sustainability, can be considered to be the ability of a society to maintain social well-being (Hansmann, 2012). This can include organizations of varying levels maintaining well-built relationships with one another. A counterexample to social sustainability is that of unrest between countries. Social sustainability includes long-term well-being, and a war does not meet this goal (Hansmann, 2012). As a result, maintaining peace is an excellent means of meeting social sustainability.

The final pillar of sustainability, economic sustainability involves businesses using their

resources efficiently and responsibly so as to consistently produce a profit (Hansmann, 2012).

Building upon a simple business principle, a company cannot continue to operate if it is unable

to make money. By finding ways to become more efficient, a business can reach economic

sustainability and function well in the long term (Hansmann, 2012). An example of economic

sustainability is the way in which companies adapt to the needs of consumers. As consumer

needs rapidly change, it is important that businesses adapt as well. In some cases, businesses are

even beginning to forecast the changing consumer needs as they are happening (Hansmann,

2012). This ability to forecast is quickly becoming an important facet of economic sustainability.

The interaction of the three pillars of sustainability creates a Venn diagram as seen in

Figure 1, where each combination of two pillars creates a different result that falls short of the

ultimate goal. The combination of social and environmental sustainability can be considered

"bearable" (Hansmann, 2012). Meanwhile, the combination of social and economic

sustainability is referred to as "equitable" (Hansmann, 2012). Finally, the combination of

economic and environmental sustainability is labeled as "viable" (Hansmann, 2012). Each of

these combinations, while important in their own rights, fall short of the ultimate goal of

sustainability. It is only through the combination of all 3 pillars that a society can be considered

"sustainable" (Hansmann, 2012). The ability to cover each of these pillars can be outlined with a

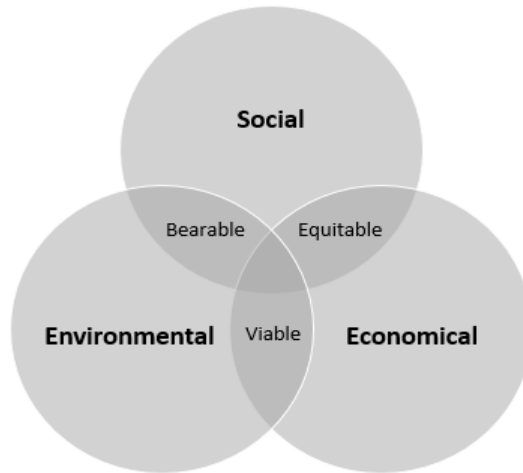set of goals developed by the United Nations.

Figure 1: Venn Diagram of the Three Sustainability Pillars (V. Nunez based on Hansmann, 2012)

With Brundtland's definition in mind, we now look at the current globally accepted sustainability plan, the 2030 Agenda for Sustainable Development created by the United Nations. This agenda plays a direct role in the definition of sustainability used in Kingston's methodology that will be further described later. The agenda was developed to substitute the Millennium Development Goals for 2015, and is expected to be the basis that policymakers use for their decisions. The 2030 Agenda lists seventeen goals to make progress in sustainability in terms of the triple bottom line, or environmental, social, and economic sustainability. The goals address specific aspects of sustainability using various approaches to address the triple bottom line. The five categories the goals are placed in are people, planet, prosperity, peace, and partnership.

The people category focuses on ensuring a healthy environment for all humans, such as ending poverty and hunger. The importance of maintaining a healthy environment carries over to the planet category. Planet describes supporting the needs of the present and future generations by preventing the degradation of the environment. Next is prosperity, ensuring that humans can live fulfilling lives in harmony with economic, social, and technological progress. Peace is tied in with prosperity, and is defined as creating societies free of fear and violence. To address the

8

earlier categories, the last category of partnership ensures the goals are solved with a feeling of solidarity and participation from countries to make this an easier process (United Nations, 2015).

We need to look at other definitions of sustainability to get a deeper understanding and begin to understand more complex ideas behind sustainability language. By widening the range of our definition, we hoped to better capture the value to sustainability research of more works.

We explored the definition of sustainability proposed by Thomas N. Gladwin, James J. Kennelly and Tara-Shelomith Krause in The Academy of Management Review (1995). Gladwin, Kennelly, and Krause performed a review of all the different sustainability definitions published to that date. From this review, they developed five "concepts of sustainable development" (Gladwin, Kennelly, & Krause, 1995) based on the common themes across all definitions. These five concepts, as seen in **Figure 2**, are inclusiveness, connectivity, equity, prudence, and security.

According to the concept of inclusiveness, sustainability must be a wide field that is both short-term and long-term, local and global, and uses a whole-systems approach (Gladwin, Kennelly, & Krause, 1995, p. 878). Through this wide encompassing system, environmental changes must be seen from the point of view of human elements. This relationship between the environment and the human aspect of sustainability is further emphasized in the second concept. This concept, connectivity, refers to the importance of addressing environmental, social, and economic world issues, as linked (Gladwin, Kennelly, & Krause, 1995, p. 879). Sustainability must solve these world concerns together, and not as independent entities. The third concept, equity, highlights the need for resources to be distributed fairly, across generations, and across species (Gladwin, Kennelly, & Krause, 1995, p. 879). Prudence, the fourth concept, demands

caution in human actions. Caution is defined in terms of environmental, and socio-economic

resiliency. Prudence calls for human actions that consider the unpredictability of systems and

therefore prepare for unexpected consequences (Gladwin, Kennelly, & Krause, 1995, p. 879).

These actions should be reversible, must include preventive measures, and stay within safe

limits. The final concept, security, concentrates on maintaining the health and safety of

environmental and social systems (Gladwin, Kennelly, & Krause, 1995, p. 879). Together, these

five concepts form an idea of sustainability that gives equal importance to the three pillars of

sustainability, while emphasizing the connections between them.
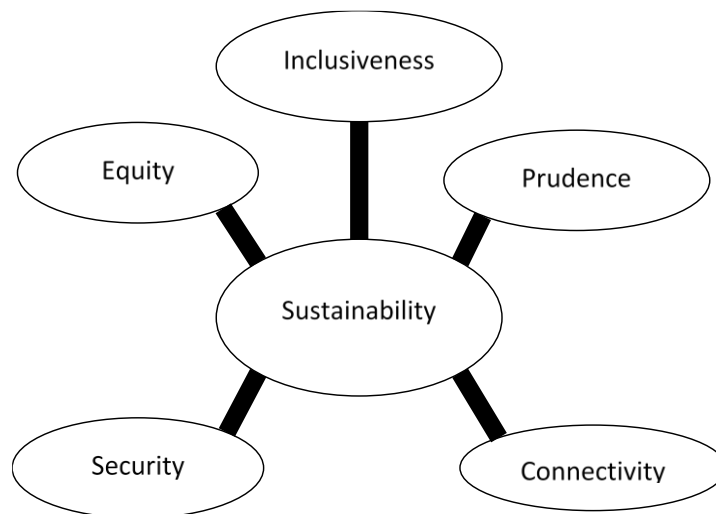
Figure 2: The Five-concept Definition of Sustainability (V. Nunez based on Gladwin, Kennelly, & Krause, 1995, p. 879)

We consider a final definition that explains sustainability as a multi-level hierarchy

consisting of four different levels of sustainability. **Figure 3** shows these levels as a pyramid,

with level one at the bottom and level four at the top. D. Marshall and Michael W. Toffel have

introduced a sustainability hierarchy that explains not what is being sustained and how, but the

effects that lead to categorizations of those actions. This enables the term sustainability to be

defined on a series of levels instead of one strict definition.

Level one is the base level of the hierarchy, stating, "Actions that, if continued at the current or forecasted rate, endanger the survival of humans" (Marshall & Toffel, 2005). Definitions of sustainability generally begin here, as this is the broadest definition.

Level two begins to look at actions that are not as easily distinguishable as sustainable or not, stating, "Actions that significantly reduce life expectancy or other basic health indicators" (Marshall & Toffel, 2005). In this level, any actions that reduce the health of humans in any way are considered unsustainable.

Level three states, "Actions that may cause species extinction or that violate human rights" (Marshall & Toffel, 2005). This is the top category that the authors believe should be included in the definition of sustainability. This category can be somewhat complicated because of the complex relationships between animals in the food web and other species in an ecosystem.

Level four should not be included in the definition of sustainability according to the authors. The category is defined as "Actions that reduce quality of life or are inconsistent with other values, beliefs, or aesthetic preferences" (Marshall & Toffel, 2005). Level four can be controversial because people of different backgrounds may have different views of what is considered sustainable. Level four refers to aesthetic sustainability practices like preservation of open space and ecosystems for recreational uses (Marshall & Toffel, 2005). The authors argue that this level should not be included in the definition of sustainability because of two reasons. First, views on this category can be conflicting depending on regional views on the subject. Second, aesthetic purposes broaden sustainability to the point that the term is diluted and does not carry any significance to itself anymore. For this project, it is important that we not forget this level, but potentially include it during our analysis. While the authors argue this may dilute

the term sustainability, we believe it may exclude more valuable topics related to sustainability that should be included in sustainability discussions in university research.
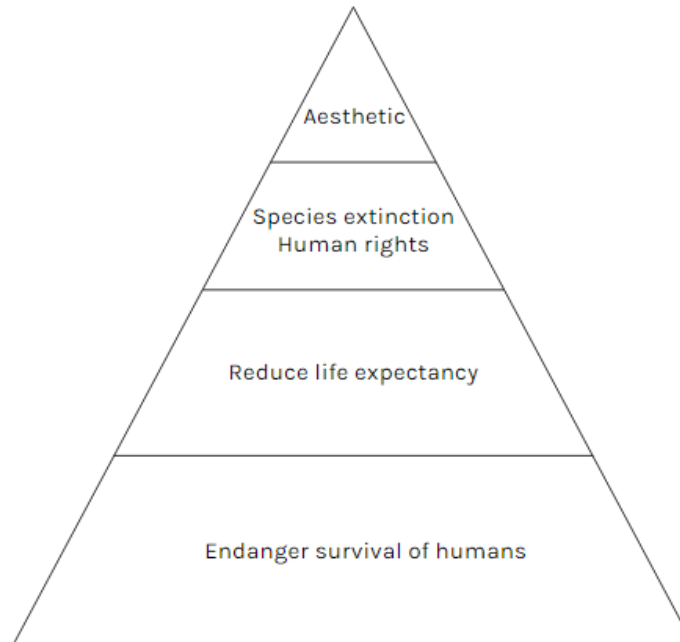
Figure 3: Marshall & Toffel's Four-level Definition of Sustainability (S. Halama based on Marshall & Toffel, 2005)

All of these definitions of sustainability share similar core characteristics. The first is that they all address the relationship between the three pillars. The second is that they all promote the importance of intergenerational equity. The differences lie in the manner that these characteristics are expressed.

The Brundtland definition and the multi-level definition, both place special emphasis on intergenerational equity. In contrast, the five-concept definition gives equal importance to the relationship between the three pillars and intergenerational equity. The Brundtland definition has the benefit of being concise while also covering a large scope. This large scope, however, can also be a limitation when a more precise definition is needed to back a claim on the connection to sustainability, or lack of connection, of a staff member.

In the case of a multi-level approach to defining sustainability, the authors decided to divide sustainable development into a set of levels that the reader can use to choose their level of sustainability. This, in turn, narrows the definition of sustainability into a more practical and specific term that can vary depending on the exact situation. However, this definition focuses only on the impact of actions, and can, therefore, be too narrow for situations where a wider scope is needed to bring together interconnected concepts. Furthermore, a definition that exclusively focuses on actions might not be relevant for an analysis of research whose purpose is to increase understanding.

The value of the five-concept definition's unifying approach aligns well with this project's interest in increasing interdisciplinary research in sustainability. However, this definition is very restrictive if all five concepts must be covered to be considered research in sustainability. For example, works that support only one of the three pillars of sustainability might still be interesting for our project, but would be excluded according to this definition.

From this, we can see that the limitations of one of these definitions are the strengths of another. A methodology needs to be sufficiently dynamic to capture the key aspects of these definitions. Careful consideration must be taken with methods that attempt to simplify these definitions, such as the use of a keyword system.

Understanding the Community

The second concern of research on sustainability research is that the benchmarking methodology must identify the values and objectives of the community and stakeholders of the project. To approach this question, we considered how the university's decisions and characteristics are affected by factors internally in the university and externally in the

community.

We start with the effects of the university's external factors. For instance, the resources of a university will have a direct effect on its sustainability efforts. A university will look to external funding sources if the government cannot publicly fund higher education for the public (Stephens et al., 2008). However, these external funding sources might restrict the focus of the university's research, diverging from the university's goals. For example, private investments will usually not be focused on the public good. This was seen in the case of malaria, a widely known epidemic disease that required serious research. However, treatment for malaria, as a public good with a low possibility of repayment, was not studied intensely. Instead, private investments were generally focused towards profitable ventures. Malaria was not studied extensively because there was no apparent financial return (Stephens et al., 2008).

Internally, the structure of faculty promotion in a higher education system can also prohibit the university from focusing on sustainability. The university's structure may be set up to promote faculty who only show success in scientific papers or journals. Current academic systems dissuade interdisciplinary collaborations and promote narrow academic focuses, with results being published in academic journals (Stephens et al., 2008). Universities must also promote staff who show an enhanced social engagement toward sustainability (Stephens et al., 2008), thus encouraging unexpected collaborations between staff and researchers.

To help identify sustainable indicators within a community, authors Andy Scerri and Paul James elaborate on a two-level approach to both learn about and discuss knowledge of the status of the community in their sustainability practices. In level one, research is done to begin to understand the status of the community as a whole. It is important to know who key participants

are and what their roles are. In the end, an initial understanding of the community should be created. This level must also include learning about various indicators, definitions, and themes of sustainability. The authors note that during this process, the researcher must learn how the community fits in the economic domain, the ecological domain, the political domain, and the cultural domain (Scerri & James, 2010).

Level two increases participation from simple research to actively participating in learning of the state of sustainability in the community. Level two is to be built upon the knowledge previously discussed in level one. During this process, the authors note that it is important to reflect on the issues that may be important within the community by moving from a basic social profile to identifying major tensions and setbacks. The tools to complete level two include panel groups, questionnaires, interviews, and community events (Scerri & James, 2010).

As previously mentioned, level one of Scerri and James' method begins, in effect, by asking about the location of our project. Therefore it is important to examine the universities that serve as the setting of our project so that we can begin to recognize the way the university approaches sustainable development.

Background of Our Setting

Views on sustainability can vary widely based on both culture and location. Additionally, cities and universities can often encourage the views of the general public on many topics. For example, Worcester and the University of Worcester are both looking to encourage sustainable views within their greater community (K. Boom, personal communication, February 16, 2017). Therefore, we felt it was important to investigate the background of the location where we worked.

The city of Worcester, England has a tumultuous history that saw the city be abandoned and re-established on several occasions, before finally developing into the city that exists today. Worcester was initially settled on a plain of level ground located adjacent to the River Severn and raised considerably above its typical tide level (Page & Willis-Bund, 1924). Worcester would become the primary, and only, settlement along a lengthy stretch of the Severn. Despite the industrialization of the city, Worcester is looking to retain its rural Midlands appeal. Additionally, the city is interested in becoming self-sufficient; that is, they hope to eventually meet all of their own needs without relying on any other location.

The earliest roots of Worcester can be traced as far back as the first century. Much of Worcester's early history involves differing occupancies, as it was initially a Roman settlement before changing to a Saxon settlement (Page & Willis-Bund, 1924). Worcester experienced many setbacks over the centuries such as raids, fire, and plague. Additionally, the government was eventually overthrown and replaced in 1835 (Page & Willis-Bund, 1924). After this milestone, Worcester was able to finally settle and develop as a city.

With the city finally starting to settle, Worcester's population started steadily rising in a trend that continues to this day. Additionally, transportation services to the city began to develop. By the end of the nineteenth century, both canals and railroads had been extended to Worcester (Lambert, 2014). These improvements caused the population to increase faster, and Worcester began to attract tourists and students as well. A common interest amongst both the city and the university is the topic of sustainability. Both organizations are looking to further explore the topic, in the hopes of making Worcester a self-sufficient city that doesn't rely on any other location.

Compared to the city, the University of Worcester has a much younger history. Located on a hill across the River Severn from the city, it was founded in 1946 as an emergency teacher training school after the Second World War (University of Worcester, 2017). It continued in this capacity until the 1970's, when degrees first began to be validated under a separate institution name. Officially, the university was granted the ability to award degrees in 1997 (Lambert, 2014). The university began significant expansion after this milestone, and in 2005 the university was granted full university status (Lambert, 2014).

Now well established in education, the university continues to expand in research. In 2010, the university was granted the power to award research degrees (University of Worcester, 2017). Additionally, the university began to expand beyond its original campus, referred to as St John's. The University opened the City Campus in 2010, which became home to the Business School (University of Worcester, 2017). Additionally, in 2012 construction was completed on The Hive. This landmark building is a collaboration between the university and Worcestershire County Council, and includes city offices as well as study space. To this day, the university continues to expand its campus while also expanding its teaching and research interests, and currently hosts about 10,000 students and 1,200 staff members.

University of Worcester has also collaborated with the University of Michigan in attempting to benchmark their sustainability performance. Dr. John Callewaert, the Emerging Opportunities Program Director at University of Michigan's Graham Sustainability Institute, visited the university and provided ideas for new directions of sustainability topics (University of Worcester, 2016). The two universities are working together to participate in The WikiRate Project, an EU-funded platform to promote transparency on sustainability practices. In this

project, both universities will be mapped according to the United Nations Sustainable Development Goals discussed earlier.

In recent years, the University of Worcester has earned a reputation as one of the most sustainable universities in the United Kingdom (University of Worcester, 2017). This is in part due to the university's focus on infusing sustainability-related topics into their curriculum. In 2010 and again in 2013, the University of Worcester assessed its curriculum for sustainability content. Both times, Worcester used the Sustainability Tool for Auditing for University Curricula in Higher-Education, or STAUNCH (International Society of Sustainability Professionals, 2015). Developed by Rodrigo Lozano at Cardiff University in Wales, the tool assesses course descriptions for sustainability content (International Society of Sustainability Professionals, 2015). A score is only assigned if sustainability content is observed; by default no score is assigned. As part of the audit, the program created graphs and charts to help the user analyze the results.

In both instances of the program being used, Worcester identified one user to run the audit program. The purpose of this was to eliminate the possibility for interpretation issues between multiple users, and keep audit results as consistent as possible (International Society of Sustainability Professionals, 2015). In 2017, Worcester is looking to assess its research staff for sustainability content, and create a network of sustainable development research staff. Since STAUNCH was developed purely for assessing course curriculums, it cannot be used for this function. As such, Worcester is looking to use a methodology developed by researchers at Kingston University.

Kingston University

Kingston University was originally founded in 1899, as Kingston Technical Institute. It is located along the River Thames in Kingston upon Thames, southwest of Central London. Formally recognized as a technical college in 1926, Kingston began slowly yet steadily expanding over the twentieth century (Kingston University, 2017). In the 1950's, the college opened its first dormitories as well as its first library (Kingston University, 2017). Being vested in technical interests, Kingston purchased a computer in 1966 (Kingston University, 2017). This noteworthy fact attracted more students to Kingston than ever before.

During the 1970's, several different colleges merged together to form Kingston Polytechnic. These colleges included Kingston Technical Institute, Kingston College of Art, and Gipsy Hill College (Kingston University, 2017). These mergers gave Kingston a larger platform than it had previously, and allowed for further expansion. The university achieved full university status in 1992, and was thus renamed Kingston University (Kingston University, 2017). Currently, the university plays host to about 20,000 students and 2,000 staff members. Continuing expansion into the twenty-first century, the university now includes a Sustainability Hub. This department is similar to the sustainability department seen at University of Worcester; both are continually finding ways to implement sustainability in all aspects of their university. However, their approaches can be different simply due to the differences between the universities.

As research interests increase in sustainability and sustainable development, Kingston University has pioneered the concept of benchmarking purely sustainable development research. This new concept becomes part of a larger effort to network sustainable development researchers and encourage interdisciplinary research (R. Anderson, personal communication, March 21,

2017). Kingston's initial development has attracted the attention of many universities around the United Kingdom, and further development of their benchmarking methodology is likely to come.

Data Methods

The last difficulty of performing research on sustainability research that we studied in our project is the consideration of different data compilation methods and data analysis methods. For the purposes of this project, we focus on the analysis of data input from other researchers. In particular, we first focus on the differences between relying on online sources versus the use of interviews, and then focus on qualitative and quantitative.

The use of online sources presents many benefits. An evident benefit is that sources can be obtained more "quickly, globally, and cheaply" (Davidov & Depner, 2011). In the time that it takes to set up meeting times and carry out one interview, many more sources can be compiled from online data. Additionally, through online sources, information on researchers temporarily unavailable locally is still accessible. The use publicly available online sources can also serve as a way to avoid ethical complications regarding personal data (Englander, 2012), and avoid problems in finding researchers willing to be interviewed (Bargh & McKenna, 2004).

A common concern with online sources is that they might not represent a reliable picture of the researcher's ideas. On one hand of the argument, some studies show that there is little difference between the information posted online and information obtained in person. One such study reported that the way values are portrayed remains invariant regardless of the method of data collection (Davidov & Depner, 2011). Another study found that for participants with a "high education level", such as researchers, information gathered from the web is practically identical to that obtained in person (Bandilla, Bosnjak, & Altdorfer, 2003). On the other side of the

argument, however, some studies show that there are limitations with online sources that arise from the decreased interactivity. One of the studies mentioned before shows that errors in the online data might arise from lack of motivation to preserve accuracy, and ambiguous descriptions (Davidov & Depner, 2011). Another study comments that a potential limitation of understanding online data is the lack of nonverbal cues that complement face-to-face communication (Bargh & McKenna, 2004). Furthermore, unlike interviews, when analyzing online data it is not possible to immediately ask for clarification from the research (Bargh & McKenna, 2004).

Interviews have a complexity of their own. One question relates to the level of structure of the interview. Completely unstructured interviews are on one extreme, and fully outlined interviews are on the other. Unstructured interviews have the benefit of allowing the interviewee to express their values and sparking discussion without much influence from the interviewer (Englander, 2012). On the other hand, interviews with a set list of questions to follow allow for standardization of the method (Englander, 2012).

The second concern on data is whether a qualitative or quantitative approach is more appropriate. On one hand of the argument, quantitative results leads to a reliable and easily replicable test. The objective quality of quantitative results also allows for comparison between universities, which is a useful vehicle to discover ways to improve. On the other hand, quantitative results do not account for the intricate interactions between the different topics that involve sustainable development. Finally, research in psychiatry shows that people understand concepts better when developing ideas in the abstract plane of qualitative description, and grounding them to the concrete level of quantitative information (Razafsha et al., 2012).

The use of online data, unstructured interviews, structured interviews, qualitative

methods and quantitative methods do not have to be mutually exclusive. Through a process called triangulation, some scholars recommend researchers to use different methods together to increase the trustworthiness of their data analysis (Jick, 2006, pg. 43; Crafting, 1991). Other scholars, however, warn that the use of mixed methods for data collection and analysis must be carefully constructed so that the methods act as a "unified process with the same underlying theory of science" (DiCicco-Bloom & Crabtree, 2006).

Pioneering Sustainability Research Benchmarking

Different organizations/institutions have begun experimenting with answering these research on research concerns through the development of sustainability benchmarks. In the context of these tools, benchmarking would generally consist of a series of questions and answers would indicate the level of sustainability against a set of predefined standards (Kyrö, 2003). Based on the results, each organization/institution can implement new practices in order to improve performance, both in sustainability and elsewhere (Kyrö, 2003). Our team evaluated several of these sustainable development benchmarking tools as a way to understand the existing attempts at exploring the difficulties of sustainability research.

In 2009, a group of scholars at University of Texas in Austin, Arizona State University, Georgia Institute of Technology, and Carnegie Mellon University combined to produce a benchmarking questionnaire for U.S. universities in sustainability education and research. The goal of the collaboration was two-fold: to measure to what degree sustainability topics are covered in engineering courses, and to what degree sustainability topics are being funded for research (Allen et al., 2009). To that end, two questionnaires were developed by the group of

scholars to measure these two points.

The first questionnaire was sent to engineering department heads at universities across the U.S. The questionnaire consisted of several quantitative-based questions, which measured how many courses were offered that covered sustainability and how many research projects covered sustainability (Allen et al., 2009). The second questionnaire, which covered the research aspect of the study, was sent to the faculty members identified by their department heads, as well as individuals who have produced noteworthy publications related to sustainability. The questionnaire consisted of qualitative-based, open-ended questions that allowed the selected individuals to elaborate on their specific work (Allen et al., 2009).

The benchmarker created by University of Texas in Austin, Arizona State University, Georgia Institute of Technology, and Carnegie Mellon University addressed some of the research on research concerns. The concern of different data methods is addressed through their combination of qualitative and quantitative approaches. The question of subtleties in language is addressed by including questions in their questionnaire that are only aimed at understanding their subjects' interests. The final concern of community relationships is mentioned in their conclusion that that a set of "community standards" need to be developed in order to ensure that universities are heading in the right direction with sustainability and sustainable engineering.

In 2006, Rodrigo Lozano of Cardiff University published a tool for Graphical Assessment of Sustainability in Universities, or GASU. As with most other benchmarking tools, GASU was intended to cover sustainability in all aspects of a university (Lozano, 2006). An interesting aspect of the publication is that it includes a table of previous benchmarking tools. In this table, the advantages and disadvantages of each benchmarking tool are displayed (Lozano,

2006). Lozano hoped to address as many of the disadvantages covered as possible with GASU, and create a more comprehensive benchmarking tool.

Similar to STAUNCH, the GASU tool consists of a worksheet that allows a user to enter grades for varying sustainability criteria (Lozano, 2006). These criteria are modified from a previous tool, the GRI, and are intended to cover as many different areas of sustainability as possible. When Kingston University began developing their sustainable development research methodology, they drew from the criteria that Lozano developed and identified in GASU. Despite attempting to address the disadvantages of many previous benchmarkers, GASU's worksheet method does not cover any of our research on research difficulties.

Another tool, the "Sustainability Assessment Questionnaire", was developed between 1999 and 2001 by the Association of University Leaders for a Sustainable Future (AULSF, 2009). This tool was also geared towards colleges and universities. The questions cover a broad scope of topics including curriculum, faculty and staff development, operation, outreach and service, student opportunities, and research. The AULSF designed the questionnaire in an effort to make it as wide-ranging as possible and appeal to many different universities.

The questionnaire described sustainability within the context of a university as qualifying in, among others, the following characteristics:

- Including sustainability issues in the required studies of all academic disciplines, and promotes the development of critical thinking;
- Research by faculty and students address sustainability;
- Using "knowledge of sustainability" as a factor when considering promotions, appointment of employees, and tenure, while also providing existing faculty with

the means to expand their knowledge on sustainability and rewarding sustainable

practices by faculty;

- Organizing student-led groups that promote sustainability;

- Explicitly stating sustainability as a part of their mission and purpose (AULSF, 2009).

All of these characteristics affect the sustainable development research either directly, by promoting or rewarding research in this area, or indirectly, by increasing knowledge and support for these issues. This could allow a benchmarking effort to assess not only research, but other areas that could have an impact on research. It is worth noting that when considering the question of data methods, the AULSF preferred to avoid a questionnaire that led to a score, due to an internal belief that a quantitative result would not be reliable without longer analyses and might discourage use from some potential users (AULSF, 2009).

In each of these sustainable development benchmarking tools, research is included as a topic. However, it is hardly the focus of these benchmarking tools and is often underdeveloped. For example, the questionnaire by the University of Texas in Austin, Arizona State University, Georgia Institute of Technology, and Carnegie Mellon University uses its analysis of sustainability research as a tool to understand sustainability engineering. Similarly, the GASU and AULSF benchmarkers utilize level of sustainability research as an indicator within the greater scheme of their analysis. While each of these benchmarkers offer starting points, sustainable development research, as its own specific category, requires more exploration and differentiation from the overall topic of sustainability.

Kingston University's Methodology

Existing benchmarking tools for higher institutions generally attempt to analyze the university's current state with regard to sustainability as a whole; sustainable development research is often one of the categories analyzed in these benchmarkers. The methodology developed at Kingston University is the first that focuses exclusively on sustainable development research (Hands & Anderson, 2017). This unique characteristic makes this methodology interesting for testing and enhancing. This methodology we are critiquing can be found in the research journal *Sustainable Development Research at Universities in the United Kingdom*. It is an article, written by Victoria Hands and Richard Anderson from Kingston University, titled "Benchmarking Sustainability Research: A Methodology for Reviewing Sustainable Development Research in Universities."

Kingston's methodology incorporated the topics of language, community, and sources of data. These topics are important towards Kingston's long-term goal of making their methodology as widely applicable as possible (R. Anderson, personal communication, March 21, 2017). However, the consideration of community is less developed in the original methodology when compared to the other two considerations. Further development of all three considerations will allow other universities to better benefit from the benchmarking methodology.

The benchmarking methodology was not written with the intent of providing final conclusions. As part of this purpose, it is important to consider how the methodology uses the term "benchmarking." Most benchmarking tools previously explored compared each scenario against a set of standards, and assigned a score that could be compared against other locations. This is not the intent of Kingston's methodology, as it is designed to remain within each university (Hands & Anderson, 2017). Ultimately, it is intended to serve as the start of a process,

by identifying and bringing sustainability researchers together and then encouraging interdisciplinary collaboration (R. Anderson, personal communication, March 21, 2017).

The methodology consisted of two stages. Stage one consisted of a compilation of staff profiles potentially linked to sustainability research. All information for this stage, such as published articles, professor profiles, etc. was obtained from a publicly available online search tool; this was located on the university's webpage (Hands & Anderson, 2017). Drawing upon the language consideration, the profiles are found by searching for research interests that matched a list of keywords. These keywords were obtained from the Kingston University Sustainability Policy and the United Nation's document titled, "Transforming our world: the 2030 Agenda for Sustainable Development" (United Nations, 2015). This is a convenient detail for reproducibility. However, level of access to information may vary between universities, as acknowledged in the article, and should therefore be considered (Hands & Anderson, 2017).

Stage two consists of analyzing the research profiles compiled in stage one, and draws upon the consideration of sources of data. A combination of content analysis (Krippendorff, 2013) and thematic analysis (Patton, 2002) is used to determine the extent to which the profiles focus on either of three "viability factors": sustainability content, research impact, and knowledge transfer viability.

Interviews of the staff being profiled were not included in these initial two stages of the benchmarking methodology, in order to save time and avoid ethical complications. Had it been included within the methodology, this would have been the primary incorporation of the community consideration. However, the authors suggested that interviews could be conducted as a later phase, to complement the data from the two stages after the benchmarking has been

completed (R. Anderson, personal communication, March 21, 2017). Regardless, the methodology requires customization at each location it is used. This customization includes factors such as location and thoroughness of staff profiles, the number of staff at the university, and the availability of search platforms (R. Anderson, personal communication, March 21, 2017). When customizing the process, it remains important to consider factors for analysis.

When reviewing each staff member profile, the Kingston methodology tries to achieve the necessary compromise between qualitative and quantitative analysis, two seemingly incompatible methods. Its approach is reminiscent of design science research. This method illustrates how to answer questions that are qualitative in nature, such as those related to the human condition, through a technological approach (Cassidy & Hamilton, 2016). The method follows by analyzing the mutually exclusive components of research by separate, and then determining the links and causation of these components (Cassidy & Hamilton, 2016). The Kingston methodology's version of this method is to separate research into the three viability factors that it then uses to assess a staff's profile. A more complete picture can then be determined by comparing the available components, or viability factors, to all possible components or even the full staff profile (Cassidy & Hamilton, 2016).

One limitation of the direction of Kingston's methodology is that the quantitative aspect of the technological approach is not a focus of their methodology, and therefore design science research is not truly achieved. Two other limitations, acknowledged in the article, are the availability and accuracy of the online staff profiles and the subjectivity of basing scores on the interpretation of user. In terms of the first limitation, the use of a single online database is not only convenient, but also provides consistency. However, not all universities have an online

database of their researchers. Even at universities where an online database exists, not all researchers necessarily keep and/or maintain a profile. Improvements addressing these factors would serve to address the community consideration and make Kingston's methodology more universal.

Concerning the second limitation, relying on user interpretation is unavoidable with a topic as complex as sustainability, but it introduces subjectivity into the product of the methodology. Given that interviews were to be completed at a later phase, the initial rankings were based entirely off the information available in researcher profiles (R. Anderson, personal communication, March 21, 2017). This decreases the presence of the data method consideration, as multiple data sources would allow for cross-checking.

Additionally, the keyword system's ability to adapt to the dynamic nature of defining sustainability is a point of limitation. The set nature of these keywords means that sustainability will also have a set definition for the purposes of any application. This restricts the potential of the language consideration; addressing the keywords to be more dynamic could be a potential improvement. Addressing these limitations, in conjunction with our own observations, is at the center of our methodology.

Methodology

The goal of our project was to test and enhance Kingston's benchmarking methodology so that it can be applied to the University of Worcester. This means that in addition to utilizing Kingston's methodology, we also had to assess their methodology itself. Our methodology was conducted by performing a desk-based study and conducting interviews with select members of staff, in order to assess Kingston's original methodology.

Mission Statement and Objectives

Dr. Victoria Hands and Dr. Richard Anderson created a benchmarking methodology, with the ultimate goal of developing a network of staff at Kingston University related to sustainable development research. We collaborated with University of Worcester and Kingston University in order to gain understanding of their current work and further it. This included weekly conversations with one of the authors of the Kingston methodology, Dr. Richard Anderson. Based on these conversations, in addition to our own research, we were able to understand Kingston's original work. First, Kingston's methodology used a keyword search that identified key researchers at Kingston University. Then, their methodology continued by ranking each researcher into one of three categories and leaving open the possibility for future interviews. By studying Kingston's methodology and its components, we can create an enhanced methodology that may be more effective in less research-intensive universities. To achieve our goal, we designed a set of objectives that attempt to approach the difficulties of research on research.

The project was accomplished by pursuing the following objectives:

- Test effectiveness of keyword-based searching and user interpretation based ranking

- Compare the use of online profiles versus interviews as sources of data

- Understand the community of sustainability researchers at University of Worcester

Test effectiveness of keyword-based searching and user interpretation based ranking

The first objective of this project was to identify research staff potentially linked to sustainability by experimenting with a keyword search similar to Kingston University's methodology. This would, in turn, allow us to analyze the effectiveness of the keywords developed by Kingston. As explained in the literature review, a keyword-based search may be an oversimplification of the term sustainability. However, to determine the effectiveness of the keyword list at identifying researchers, we must test this keyword method. The list of researchers would allow us to proceed to the second stage, where we would rank and categorize the faculty with respect to their link to sustainable development research at University of Worcester. To begin this first stage, we created a Google search that exclusively looked within University of Worcester's staff pages using one specific keyword at a time. The search was in the format "site:worcester.ac.uk/discover '[*keyword*]'." It was important that we used quotations around our keyword, otherwise Google would search staff profiles using words similar to our keyword. After this term was searched, we received a listing of every instance of the keyword being used within the "/discover" section of the University of Worcester website. The keywords used were from Kingston's methodology, and included terms such as cities, water, or sustainable agriculture.

A benefit of using this method is that it is easily replicable with any university with staff pages. A limitation of this method is that the search is less focused and can lead to many false positives. Keywords found not only in the staff profile, but also the navigation areas of the website, would appear in the search results. Another type of false positive was staff members

that matched a keyword, but are not necessarily involved in any research duties. This was not a factor for Kingston University due to their use of a researcher-specific search engine. For our project, staff profiles of this type were initially filtered out in order to test the search method. However, a possible benefit of these "false positives" is that it creates the opportunity for the university to notice non-research-active staff of interest. Therefore, the choice in scope of the type of staff that will be included in the list remains in the user's hand.

For a university with a dedicated staff search, such as Kingston University, using our method would be less productive as it yields a lower percentage of relevant results. However, for universities without a dedicated staff search, such as University of Worcester, our Google search method provides a viable alternative, despite the limitations. The next stage of our benchmarking methodology works with either method, so the university can decide which of the two to use based on their characteristics. Using this listing, we had to sort out results that included the keyword but were not staff profiles. We inspected all search results in order to find the cases where a keyword was used, but not regarding a researcher.

The next stage was to now identify and track which researchers were associated with which keyword. A spreadsheet listing every keyword used was created with vertical columns representing each keyword. Whenever a listing with a researcher was found, the researcher would be added to the list in a row and a mark placed at the intersection of the researcher and the keyword. If the researcher appeared for different keywords, the same row would be used but the mark would be placed in both corresponding columns. At the end of this step, we would have the keywords that were associated with each researcher.

In order to incorporate a quantitative aspect in a mostly qualitative method, a keyword count for each researcher was included next to the researcher. This would give us statistics on

which researcher had the most keywords associated. We anticipated that the count would help

identify the top researchers associated with sustainable development.

When completed, our spreadsheet had the form seen in **Table 1**:

Table 1: Example of Staff Members in Spreadsheet (S. Halama)

Last	First	Role	Institute	Count	Website	Cities	Work
						1 hit	2 hits
Doe	John	Researcher	Science	1	google.com		x
Smith	Mary	Executive	Business	2	google.com	x	x

With the spreadsheet created, the next step was to rank the staff members that were

identified. During this process, the user of the methodology analyzes the profiles compiled

during stage one. This analysis, or stage two, yields a list of staff members in four different

categories: High Profile of SDR, Potential to Develop High Profile of SDR, Links to SDR, and

No Links. Only staff listed in the first three categories are of interest for the results. **Table 2**

shows an example of researchers, one profiled in each of the three category. Completing this

analysis with accuracy and consistency, is a concern acknowledged in the paper of the Kingston

methodology. The authors consider the subjectivity that arises from relying on user interpretation

for the analysis of profiles a limitation of their methodology (Hands & Anderson, 2017). For

example, two different users may rank researchers differently based on their beliefs and

background in sustainable development research. By analyzing the staff collected in our

spreadsheet, we aimed to gain an understanding of the level of connection to sustainable

development research of these key players in the network.

Table 2: Sample Profile Rankings (S. Halama based on Hands & Anderson, 2017)

	High Profile SDR	Potential For High SDR	Links to SDR
Researcher A	**X**		
Researcher B		**X**	
Researcher C			**X**

Furthermore, we address the concern of subjectivity by using our knowledge of the profiles, and our definitions of sustainability. The issue of subjectivity was explored by discussing the thought process each of us used for ranking researchers. We analyzed all staff who matched at least five keywords. The cutoff at five keywords was selected because it marks the top two thirds of the range of matched keywords for our specific list. However, a limitation is that staff members with few keywords yet have high sustainability links could be excluded. The staff members in this list were categorized into the four categories. We then carefully discussed the thought process staff members that were ranked differently by at least one member of our team.

Compare the use of online profiles versus interviews as sources of data

Two sources of data were used to identify researchers at University of Worcester: the staff profiles found online and the interviews. These sources were used to gather data of different types. Following the concerns of using different data sources, we consider the use of

triangulation, where both methods of collecting data are used together to complement each other. In order to validate the joint use of these sources through triangulation, we must examine whether these two methods work well in a unified way. We based our analysis on testing both methods separately and comparing the information found in the staff profiles and interviews.

In order to find researchers at Kingston University, the authors used a tool at Kingston called Find a Researcher (Hands & Anderson, 2017). This tool is available for users to find research staff at Kingston sorted by research interest. Using online sources facilitates searching for keywords, as it shortens the time and effort required to follow the methodology. The use of a single online database also ensures that future runs of the methodology will be congruent and reproducible. While this method works well for universities with a researcher database, it can fall short at other universities.

A potential improvement with this method is that online accessibility to faculty profiles can vary from university to university. Not all universities have online repositories of their research active staff. Therefore, a methodology that heavily depends on the use of online resources might not be widely applicable. Another potential improvement of this method is the accuracy of the staff profile directory. Even for universities that do have online databases, all profiles might not be available online and many professors might not keep their profiles updated. The accuracy of the search for profiles, therefore, depends on the amount of information that each researcher provides about him or herself.

University of Worcester is amongst those universities that do not have a dedicated search tool for their staff. However, their website lists staff profiles with research and teaching interests. To compile the profiles, we used the Google Search previously described. This was followed by stage two, where we analyzed the staff profiles in order to find researchers related to sustainable

development. For the analysis, we carefully examined each profile in terms of the three viability factors to determine if the profile should be considered in the list of profiles with a high profile of sustainable development research.

Our interview process was our second source of information. **Figure 4** displays the outline of interview questions asked. During our interview process, we asked questions specifically related to their current research, how they would rate themselves in terms of sustainable development, what groups and networks they are a part of, have they represented the university in the wider public forum, and the status of their online profile. These questions were designed to provide similar information to what is provided on the online staff profiles. After concluding both of these methods, the results were compared with each other.
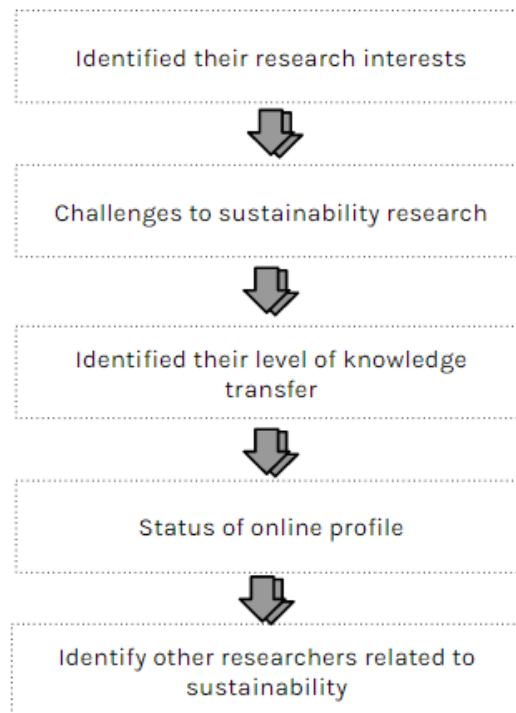

Figure 4: Our Interview Process (V. Nunez)

Understand the community of sustainability researchers at University of Worcester

While the interviews were used to validate sources of data as previously discussed, they were also used to gain an understanding on the internal community of researchers at University of Worcester, and the external community these researchers interact with. As such, several of the interview questions were geared towards this purpose. The goal was to create a network of the researchers involved in sustainable development in order to encourage cross-disciplinary research.

The first question posed towards this purpose asked each staff member what they felt the greatest challenge facing sustainability research is. While open-ended, the question was designed in order to encourage diverse responses. The hope was to observe any trends in responses, especially between staff members of different departments. As these trends developed, it could be observed whether university researchers had uniform views or not. This in turn could lead to a better understanding of values and objectives of the community of sustainability researchers at University of Worcester.

The next several questions were designed to cover the concept of knowledge transfer. This included questions involving where each researcher posted their research, the networks and groups they belong to, and if they have represented the university on sustainability-related issues.

The last question we asked had the purpose of snowballing more researchers, an idea suggested in the Kingston methodology. **Figure 5** provides a visual representation of this principle. We introduced snowballing in order to understand the community of researchers, and reach relevant staff members not included on this list because of a lack of keywords. Snowballing relies on the idea that each person will contribute to our network by providing their own known connections. In an attempt to use this principle, we began by contacting ten

researchers. After our discussion with them, we then asked if they could lead us to other researchers in a similar field or researchers that could be related to sustainable development. When followed through for multiple iterations, our list of researchers "snowballs" into a more complete and reliable map.
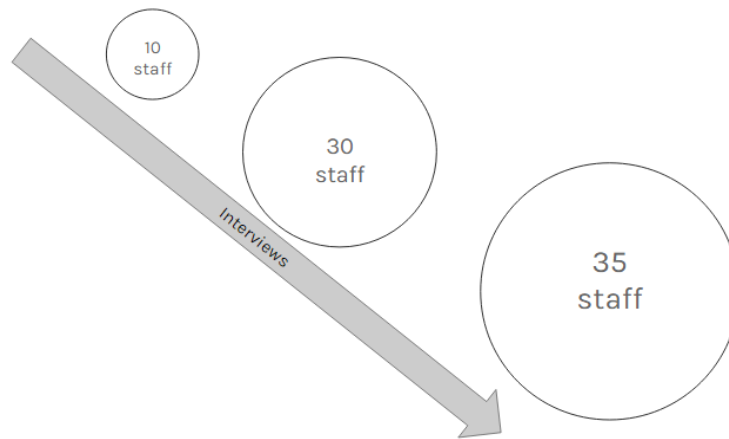

Figure 5: The Snowballing Principle (V. Nunez)

Analysis and Findings

Our methodology involved the analysis and modification of Kingston's original methodology. This gave rise to many results and findings that were observed throughout the process. Our results point towards a methodology with a widely applicable keyword-based search, and an analysis of staff members through their profiles and through interviews.

Analysis of Keywords

Upon completion of the keyword search, we had identified 573 staff members at the University of Worcester. These staff members represented a wide variety of departments, and their duties differed greatly. Additionally, many staff members were found by more than one keyword; one researcher was identified by as many as 14 keywords.

Figure 6 displays the relationship between number of keywords and level of sustainable development research. While not an absolute correlation, generally the researchers that had the most keywords tended to be the most involved in sustainable development research based on our posterior rankings. This is a hint at the keywords ability to identify researchers despite the difficulties of language. While these results seem favorable for the use of a keyword-based search, our sample size was not large enough to make a conclusive statement. Out of the 573 staff members initially identified, 368 had more than 1 keyword on their profile. Of those 368 staff members, only 75 had 5 or more keywords on their profile. The existence of multiple keywords on a profile could often serve as a cross-check, in case one of the keywords was not used in a sustainability-related context.
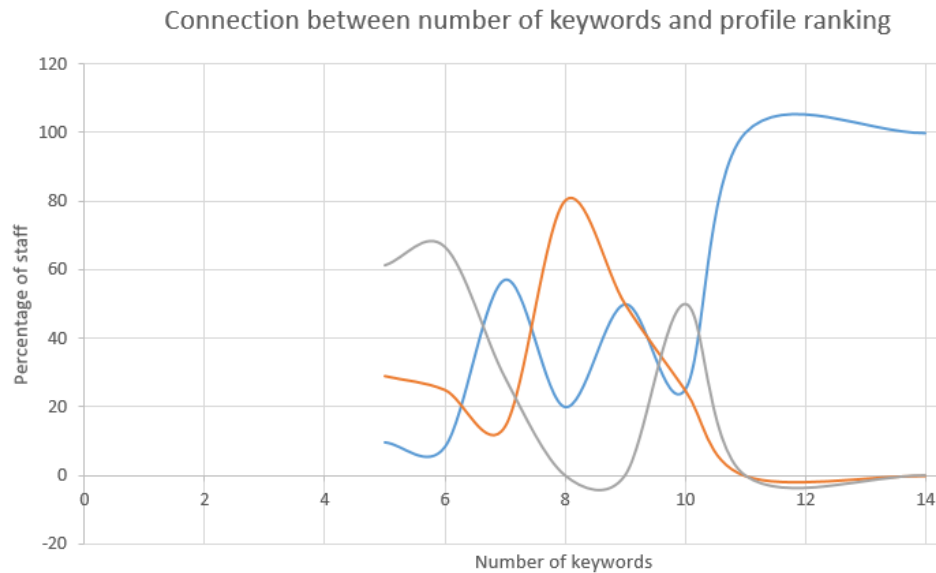
Figure 6: Connection between number of keywords and profile ranking (V. Nunez)

The sustainability keywords used provided varying results. While several keywords returned 0 staff profiles, others returned as many as 210 staff profiles. A correlation observed was that the most specific keywords, generally multi-word keywords, returned fewer results. An example is the keyword "Resilient Infrastructure", which identified 0 staff members. Conversely the broadest keywords, generally a single word, returned the most results. An example is the keyword "Social", which identified 210 staff members. This could reflect how the keyword list, based only on one definition of sustainability and Kingston's University's mission statement, may be inefficient at identifying researchers in a real setting. Further evidence to the inefficiency of the keyword search lies in the number of important researchers that the method missed. This is explored in the findings under the Snowballing Principle section.

This limitation of the keyword search regarding language was further demonstrated through a recurring observation with the broader keywords. Keywords that returned more than

100 results were not always used in a sustainable-related context within profiles. The biggest example of this was the keyword "Work", which identified 128 staff members. A common phrase seen during profile analysis was "Their work entails…", or something similar. Similar observations were made with keywords such as "Social" and "Community."

While the keyword "work" returned many profiles as described above, it also returned an interesting, unexpected phrase related to sustainability. This phrase, "work-based learning", was seen across several profiles as an interest with teaching. This suggests that a potential benefit of a wide-ranging keyword search is to discover different ways a word can be used to approach sustainability topics.

Comparison of Interviews and Online Profiles

To address concerns of data methods, we wanted to assess whether interviews and online profiles could be used together to rank staff members. To validate the ability of the two methods to work together towards the same goal we tested the methods separately. A comparison of these methods yielded insight into how to better combine them.

We compared our agreement rate, or the percentage of staff members that all team members ranked the same, of the two methods. Staff members ranked through interviews were always ranked unanimously. This agreement rate of 100% could suggest that the information provided during interviews was more useful in determining rankings. A quality of the interviews that was particularly useful for ranking was the ability to ask for clarification. One of the major places of disagreement when ranking was due to the quality and depth of information given from the staff profiles. This was not a problem for interviews, which gave us the ability to directly frame the conversation in the context of sustainability. This allowed the researcher to explicitly

describe the connection to sustainability of their research, which decreased the need for us to make assumptions. The lack of these qualities from interviews led to a reduced agreement rate of about 47% for staff members ranked exclusively by their online profiles. A specific example of this phenomenon was observed during the ranking of a staff member that only two members of our team had interviewed. The two team members that attended the interview ranked the staff as a High Profile. In contrast, the team member that did not participate in the interview, and was ranking the staff member purely based on the online profile, chose the Links to SDR category. Upon reading the note transcription from the interview, the last team member promptly agreed to rank the staff member as a High Profile.

In terms of quantity, in the time taken to coordinate and attend 15 interviews, we were able to rank 75 profiles. Even if we only consider the profiles that were ranked unanimously, the online profiles still covered 28 more staff members than the interviews.

Scheduling

Staff members with interesting profiles were selected from our spreadsheet. An initial ten staff members were selected, with the goal of more being identified later through the snowballing principle. Each time a new staff member was identified, an email was sent requesting an interview.

In total, we interviewed 15 staff members out of a total 30 that were emailed, giving us a 50% response rate. A contributing factor to this low response rate was the timing of the Easter holiday, as many staff members were away from the university. While some staff members did not respond to the initial email, others responded citing Easter as the reason they couldn't meet with us. A few then referred us to staff members who might be available, contributing to the

snowballing principle.

Stage Two Ranking Disagreements

In order to determine a less biased method of ranking researchers, we ranked each researcher individually to crowd source the thought process. This allowed disagreements to come to light so that the subjectivity of ranking could be discussed and potentially improved. Some basic ideas of our thought process were written into a document for future use.

Upon looking at initial results of the ranking, 43 out of the 75 initial researchers ranked were agreed upon by all three of us, which is approximately a 53% agreement rate. The next 28 out of 75 researchers were ranked closely to each other; that is, each researcher was given two of the same ranking and then another ranking in a category adjacent to the first two. This accounts for 37% of the rankings. This means that about 94% of the rankings were either immediately agreed upon or had a minor disagreement. The remaining 6% of researchers had major disagreements and resulted in the longest discussions. This implies that while subjectivity arising from different users plays a role in the ranking, the role does not have a huge impact. This impact is minimized even further when more than one user ranks the same staff members, and then sorts through the disagreements.

The main sources of disagreement were from the fact that we didn't have enough knowledge on the researcher to give them an accurate ranking. We also didn't know the impacts of their research, which is an important consideration.

An additional finding was that the Potential to Develop a High Profile category was given more weight than initially expected. Instead of it being a "medium" category, it was changed to a category more in the idea that the researcher should have a high profile but there is something

preventing them from getting there. These include if their interests were linked to sustainability but too focused within a particular field. Another factor was if they did not appear to have any research within the last three years, making it less clear if the researcher is active anymore. Another factor is if we could not find examples of a high knowledge transfer because there were little publications or networking stated in their profile.

The High Profile category was generally obvious because they could be found to have clear links to the sustainable development goals and lists of their work. However, it was sometimes difficult to decide between the Links to SDR and Potential to Develop a High Profile categories. Often this was because the researcher had a few publications that could be found sustainable, but it was a challenge to decide where the line was drawn in terms of having enough to be Potential or not enough and put into Links category.

Snowballing Principle

Our research included the idea of snowballing, where new researchers were identified by referral from other, previously known researchers. This method was used to find researchers not included in the spreadsheet for, amongst other reasons, not having any of the keywords in their profile.

The principle of snowballing was most effective during the initial round of interviews. After the first 10 interviewees were selected from the spreadsheet, these researchers were able to point us towards other researchers relevant in sustainable development. Many of these researchers were in fact identified on our spreadsheet. With the additional researchers identified, the list of researchers we contacted for interviews expanded to 30 people.

After this initial round of interviews and snowballing, the principle became less effective.

As interviews proceeded with researchers who had been snowballed, the subsequent snowballing mostly identified researchers who had either already been snowballed, or had been initially identified from the spreadsheet. Additionally, these researchers tended to identify the more prominent individuals; that is, those who had already been interviewed and had clear links to sustainable development research.

At this point, the snowballing principle appeared to have run its course. The original purpose, to identify less prominent yet important researchers, did work as intended during the first round of interviews. After this first round, the principle mostly identified already prominent researchers. The most prominent researchers were identified by many of the other researchers we interviewed. Ultimately, the snowballing principle did direct us to staff members in different positions, with differing views on sustainable development research.

Reflecting on the university's researcher community, each researcher was generally only well-connected within their own specific institute. While several institutes exist at the University of Worcester, there do not appear to be strong connections between the different institutes. A few researchers snowballed other researchers in other institutes, but most researchers only had contacts within their own institute.

Differences between Researchers and Executives

Further insight into the university's internal community was obtained from the interviews. We found that there were differences in information from researchers to executives. Researchers tended to know more about their research itself, and less about the policies and logistics surrounding their research efforts. Compared to research staff, university executives had different information to pass along. This information also helped to provide insight on what the

different researchers had shared. University executives had a much better understanding of the various university policies concerning research and publications. Additionally, executives had a much better understanding of all the institutes at the university. These differences in information between researchers and executives served to paint a more complex picture of sustainability research efforts at the University of Worcester. Understanding these differences was key to understanding ways to develop a strong network that can foster sustainable development research at the university.

Challenges in Sustainability Research

While exploring staff's connection to sustainability, we inquired about their opinion on the challenges of sustainability research. This was key to understanding the values and objectives of the researchers that were to be part of our network. The first trend to become evident was, in fact, the *lack* of a trend in the challenges picked by the staff as most important. Almost all staff members had unique answers to what the greatest challenge facing sustainability research is.

These challenges included:

- lack of interdisciplinary work;

- lack of time;

- lack of funding;

- lack of emphasis on social aspects;

- difficulties in measurability and benchmarking;

- excessive focus on tangible results;

- difficulties in defining sustainability;

- lack of education as a leader in sustainability;

- over-privatization of sustainability research.

Some trends can be seen, however, when comparing all of the challenges mentioned by the staff members, as opposed to just their top challenge. Of these challenges, the lack of interdisciplinary work, lack of funding, and lack of time were the most recurring. Several staff members went as far as to mention these challenges as being inter-connected. For example, there is no emphasis in funding interdisciplinary work, which gives researchers less incentive to use their limited time to work outside their comfort areas. Other staff members mentioned that the time problem affects interdisciplinary research because the university does not provide ways to naturally integrate interdisciplinary research into their normal workloads.

Staff Profiles

Contrary to our expectations, most staff members claimed that their profiles were updated regularly. Comparing the information obtained from the interviews with the information found on the profiles suggests that while some profiles might be missing the latest details, most were updated enough to give an accurate representation of each staff member's work. Additionally, our interviews explored staff members' preference on online research profiles. ResearchGate and LinkedIn were popular options among staff to publish their work online, but it was not ubiquitous. Furthermore, less research-focused staff members were much less likely to have online profiles outside of the one required by the university. When asked about their primary method of contacting other researchers for collaborations, few staff members chose any of the online profiles, with most of them opting for personal connections and other networks. To complement this finding, we asked staff members about the networks they currently belonged to, within and outside the university. Aside from the members of University of Worcester's

Sustainability Committee, very few reported being part of networks outside their own areas. Together, these two findings add to the explanation of why interdisciplinary research rarely happens naturally. Since staff members look at their own networks and circles for connections, and these networks remain within their area, connections with members outside of their area are infrequent.

Conclusions and Recommendations

As noted in previous sections, Kingston's methodology and our methodology used different approaches but lead to the same goal. Testing and enhancing Kingston's methodology led to the results discussed above, and we can now use that analysis to form recommendations to make the benchmark more effective.

Keywords

Our enhanced methodology, developed for the University of Worcester, utilized the same keywords as Kingston's original methodology. An analysis of these keywords reveals that some are more effective than others in finding researchers related to sustainable development. While testing the methodology created by Kingston, the effectiveness of keywords was determined by analyzing the context in which they were used. Words that returned more than 100 results had multiple instances of the word being used in manner not related to sustainability. For example, the word work was used in the form "His work entails..." Thus, defining a set of keywords that accurately encompasses the complexities of sustainability remains an open question. Furthermore, the keyword search missed at least 15 important staff members, found later through snowballing. Therefore we recommend utilizing the keywords simply for the purpose of initial identification, and utilizing interviews for more detailed information.

We also believe that using more search modifiers could lead us to more researchers and less faculty in other positions or news articles. For example, in future cases, the term "-'news listings'" may refine our search results by eliminating news articles and eliminate time needed to sort through search results. Although this may reduce the number of results, the universities can still choose to include news listings if they believe it will be beneficial.

Snowballing

The snowballing principle proved useful in identifying additional staff members. As previously discussed, developing a set list of sustainability keywords is not an easy undertaking. While testing Kingston's methodology, the process of snowballing was used to overcome the difficulties of creating the keyword list. Once 30 researchers had been reached, the snowballing principle had mostly identified people already included on this list. Additionally, most researchers identified the more prominent researchers through snowballing.

A recommendation for snowballing involves rephrasing the interview question. During most of our interviews, we phrased the snowballing question as: "Is there anybody that comes to mind who we should talk to?" This approach often led to researchers within the same institute, whom we had already spoken to. Therefore, a potential rephrasing of the snowballing question is: "Is there anybody we should talk to, perhaps who is in another institute and isn't as prominent?" This could direct researchers towards identifying a lesser known colleague who is less likely to have previously been identified. While not a perfect solution, we recommend snowballing as a potential supplement to using the list of keywords. It is difficult to speculate on how effective the snowballing principle is, and its effectiveness likely varies between universities. However, at a minimum it is a helpful cross-check against the effectiveness of keyword searching. Further research is needed that explores other methods of complementing the keyword search.

Interviews complementing Stage Two

The interview process suggested by Kingston proved to be a useful tool in the development of our map of researchers at University of Worcester. Online profiles were found to

have less detail than an interview provided, and therefore caused more disagreements in the ranking of the researchers. In contrast, the rankings based on interviews were unanimously agreed upon each time. Therefore, we recommend that interviews be used to supplement the online profile search and be used to assist the user in ranking the researchers. We recommend that stage two is performed by first analyzing all of the online profiles compiled during stage one. To reduce subjectivity, more than two users should complete this step. Interviews can then follow with the staff members on which users disagreed. An important consideration in planning the interviews is to avoid major holidays, as we found that timing our interview process during Easter greatly reduced the number of positive responses.

Networking

Our findings on the challenges in sustainability research, as described by staff in the University of Worcester, revealed that the lack of interdisciplinary research has the potential to be improved if the university provided ways to naturally integrate interdisciplinary research into staff's normal workloads. Additionally, our findings on staff's existing networks show a strong connection between staff's area of interest and the networks to which they belong. Since staff members predominantly look at their own networks and circles for research connections, interdisciplinary research could be increased by promoting networks that span across departments. In the future, methods of networking and collaboration between researchers needs to be further developed and potentially improved. We recommend that by using the data from this research, a type of network can be created in order to address interdisciplinary work.

Currently, the researchers are listed in an excel sheet (Appendix E). However, the use of a visual representation of the network can aid universities in promoting this network. One

possible type of representation is a network diagram. The circles, or nodes, in the diagram would

represent the researchers that made it into the list. Nodes at the center would represent the High

Profiles, and as the network branched outwards the nodes would represent the Potential to

Develop a High Profile, and finally on the outer edge, the Links to SDR profiles. These nodes

could be color coded according to their ranking. If a researcher wants to locate other researchers

with similar interests, they can start at the center to find the most connected researchers.

Furthermore, the nodes should be grouped by institute or department, allowing for quick

differentiation, and making it easier to find researchers outside your area. Lastly, if two

researchers know each other, their nodes would be connected by a line, or link. This would allow

researchers to use existing connections to discover potential contacts.

Another similar graph could be non-ribbon chord diagram. This diagram would have all

the same characteristics described previously. The concentric circles would allow for easier

reading of the nodes, but would make the links less useable.

Due to the large number of researchers that might be needed to fit into the diagram, we

suggest creating an interactive graph that only shows the researcher name and research interest

on the node, and hovering gives you more information. The diagram could also offer suggestions

on collaborations based on researchers with similar interests that do not have a link between

them. This could promote unknown connections to happen. Other recommended interactive

features are the ability to filter by research interest, and the ability to only include research-active

staff on the diagram. These features can be easily implemented in JavaScript and posted online,

or distributed by email, for easy access to sustainability researchers interested in collaboration.

A concern raised by an interviewed staff member is that even if a network is created,

there is no guarantee that it will be utilized. Therefore in addition to creating a network, it may

be worthwhile to explore incentives for its use. The university could take advantage of the differences between researchers and executives to promote the network. For example, they can use the executive's knowledge across institutes to develop policies that bring the departments together. A future project could potentially focus on developing this network and investigating options for its implementation. As both Kingston's methodology and our methodology were intended to start larger processes, there remains room for future development of this idea.

Conclusion

Benchmarking sustainability research is a complex topic that requires addressing a number of difficulties. Additionally, definitions of sustainability continue to vary depending on context and location. Much work has been done in attempting to improve benchmarking sustainable research, and this work may bring us one step closer. We found that several difficulties with sustainability language, data sources, and interactions with the community all play key roles in the analysis. As there is not one overarching solution, future research should continue to improve methods of identifying what sustainability truly is, in the hopes of increasing sustainable development research at universities.

References

Allen, D., Allenby, B., Crittenden, J., Davidson, C. I., Hendrickson, C., Matthews, H. S., & Murphy, C. F. (2009, July 6). Sustainability in Engineering Education and Research at U.S. Universities. Environmental Science & Technology, 43(15).

Association of University Leaders for a Sustainable Future (AULSF). (2009). Sustainability assessment questionnaire 2009. Retrieved January 18, 2017, from http://www.ulsf.org/programs_saq.html.

Bandilla, W., Bosnjak, M., & Altdorfer, P. (2003). Survey administration effects? *Social Science Computer Review, 21*(2), 235-243. doi:10.1177/0894439303021002009

Bargh, J. A., & McKenna, K. Y. A. (2004). The internet and social life. *Annual Review of Psychology, 55*(1), 573-590. doi:10.1146/annurev.psych.55.090902.141922

Brundtland, G. H., & Khalid, M. (1987). Our common future. *New York*.

Cassidy, L. & Hamilton, J. (2016) "A design science research approach to website benchmarking", Benchmarking: An International Journal, Vol. 23 Iss 5 pp. 1054 – 1075

Davidov, E., & Depner, F. (2011). Testing for measurement equivalence of human values across online and paper-and-pencil surveys. *Quality & Quantity: International Journal of Methodology, 45*(2), 375-390. Retrieved from http://econpapers.repec.org/article/sprqualqt/v_3a45_3ay_3a2011_3ai_3a2_3ap_3a375-390.htm

DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical Education, 40*(4), 314-321. doi:10.1111/j.1365-2929.2006.02418.x

Englander, M. (2012). The interview: Data collection in descriptive phenomenological human scientific research. *Journal of Phenomenological Psychology, 43*(1), 13-35. doi:10.1163/156916212X632943

Gladwin, T. N., Kennelly, J. J., & Krause, T. (1995). Shifting paradigms for sustainable development: Implications for management theory and research. The Academy of Management Review, 20(4), 874-907. doi:10.2307/258959

Hands, V., & Anderson, R. (2017). Benchmarking sustainability research: A methodology for reviewing sustainable development research in universities. Sustainable Development Research at Universities in the United Kingdom, 27-47. doi:10.1007/978-3-319-47883-8_3

Hansmann, R. (2012). Principal sustainability components: empirical analysis of synergies

between the three pillars of sustainability. *International Journal of Sustainable Development & World Ecology, 19*(5), 451-459. Retrieved April 21, 2017.

International Society of Sustainability Professionals. (2015). Retrieved March 28, 2017, from https://www.sustainabilityprofessionals.org/resources/staunch%C2%A9-sustainability-tool-auditing-university-curricula-higher-education

Jick, T. D. (2006). Mixing qualitative and quantitative methods. *Combining Empiricist Methods,* 43-52. Retrieved from http://www.econis.eu/PPNSET?PPN=592367428

Kingston University. (2017). Retrieved March 28, 2017, from http://www.kingston.ac.uk/aboutkingstonuniversity/factsandfigures/ourhistory/

Krefting, L. (1991). Rigor in qualitative research: The assessment of trustworthiness. *The American Journal of Occupational Therapy : Official Publication of the American Occupational Therapy Association, 45*(3), 214-222. doi:10.5014/ajot.45.3.214

Krippendorff, K. (2013). Content analysis: An introduction to its methodology (3rd ed.). California: SAGE Publications Inc

Krueger, R. 2017. Sustainable Development. The International Encyclopedia of Geography. 1–14.

Kyrö, P. (2003). Revising the concept and forms of benchmarking. *Benchmarking: An International Journal, 10*(3), 210-225. Retrieved April 21, 2017.

Lambert, T. (2014). A Brief History of Worcester, England. Retrieved January 20, 2017, from http://www.localhistories.org/worcester.html

Lozano, R. (2006). A tool for a Graphical Assessment of Sustainability in Universities (GASU). *Journal of Cleaner Production, 14*, 963-972. Retrieved March 28, 2017, from https://www.researchgate.net/publication/222603753_A_Tool_for_a_Graphical_Assessment_of_Sustainability_in_Universities_GASU.

Marshall, J. D., & Toffel, M. W. (2005). Framing the elusive concept of sustainability: a sustainability hierarchy.

Moore, J. (2005). Seven recommendations for creating sustainability education at the university level: A guide for change agents. *International Journal of Sustainability in Higher Education*, *6*(4), 326-339.

Page, W., & Willis-Bund, J. W. (1924). The city of Worcester: Introduction and borough. *British History Online, 4*, 376-390. Retrieved January 20, 2017, from http://www.british-history.ac.uk/vch/worcs/vol4/pp376-390#fnn42

Patton, M. Q. (2002). Qualitative research & evaluation methods (3rd ed.). London: Sage Publications.

Razafsha, M., Behforuzi, H., Azari, H., Zhang, Z., Wang, K. K., Kobeissy, F. H., & Gold, M. S. (2012). Qualitative versus quantitative methods in psychiatric research. Methods in Molecular Biology (Clifton, N.J.), 829, 49. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/22231806

Scerri, A., & James, P. (2010). Communities of citizens and 'indicators' of sustainability. Community Development Journal, 45(2), 219-236. doi:10.1093/cdj/bsp013

Stephens, J. C., Hernandez, M. E., Román, M., Graham, A. C., & Scholz, R. W. (2008). Higher education as a change agent for sustainability in different cultures and contexts. *International Journal of Sustainability in Higher Education*, *9*(3), 317-338**.**

United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. New York: United Nations, Department of Economic and Social Affairs.

University of Worcester. (2017). Retrieved March 28, 2017, from http://www.worcester.ac.uk/discover/university-history.html

Wright, T.S.A., (2002) "Definitions and frameworks for environmental sustainability in higher education" ,International Journal of Sustainability in Higher Education, Vol. 3 Iss: 3, 203–220.

Appendix A

Email to University of Worcester staff members requesting an interview:

Dear [*Staff member's title and name*],

We are a group from Worcester Polytechnic Institute (WPI) located in Worcester, Massachusetts in the United States. We are currently residing at the University of Worcester to perform a project on sustainability research benchmarking, in conjunction with Ms. Katy Boom and Kingston University. We have been pursuing questions on how to identify sustainable development research, by exploring a methodology developed by Kingston University.

We were hoping to be able to have a 15-20 minute discussion with you on your current research and interests in relation to sustainability. We would appreciate your help in mapping sustainable development research at University of Worcester. We have received ethical approval for our research from WPI's Institutional Review Board.

We have a flexible schedule and are able to meet most times and over Skype if needed.

Thank you for your time,
Sylvester Halama
James Macfarlane
Virginia Nunez Mir

Appendix B

Interview questions for University of Worcester staff members:

1. Do you have a 4 year research strategy?
2. How would you describe your own research?
3. Do you consider your research to be related to sustainability, and if so, how?
   a. From these categories, where do you see yourself best?
      i. High Profile of SDR
      ii. Potential to Develop High Profile of SDR
      iii. Links to SDR
      iv. No links to SDR
4. What do you consider to be the most interesting / or greatest challenges facing Sustainability research?
5. What research areas are you currently focusing on?
6. What groups and networks are you a member of internally in the university and externally, and what professional affiliations do you have, and other networks?
7. Do you and / have you represented the university on sustainability issues in the wider public forum - such to the local and national community, commercial and government sectors?
8. Are you required by your university to maintain/update an online profile?
   a. When was your research profile last updated, and how?
9. Do you post your research/profile anywhere else? If yes: Where?

In order to cover the problem of some people not having profiles, we want to use the "snowball principle" to identify interesting researchers in sustainable development, without profiles, that we may have missed:

10. Are there people in mind we should get in touch with in terms of sustainable development research?

Appendix C

Criteria for ranking staff member profiles:

High Profile-
- No doubts, links are immediately obvious
- Clear SDR topics, and clear connection in recent publications
- High knowledge transfer

Potential to Develop High Profile-
- Explicitly states interest that is linked
- Sits in potential rather than high because too focused in one particular topic
- Qualifies as high but may or may not be research active (have they published in the last three years?)
- Qualifies as high, but not much networking (knowledge transfer)

Links-
- Interests linked to sustainability show through research, but aren't explicitly stated
- Topics are related to sustainability but not directly

Appendix D

Full list of sustainability keywords, developed by Kingston University authors:

Access to justice
Accountable institutions
Affordable energy
All ages
Biodiversity
Cities
Climate change
Community
Conserve oceans
Consumption
Decent work
Desertification
Economic
Economic growth
Ecosystems
Elderly
Employment
Empower women
Energy
Environment
Environmental
Equitable education
Equity
Ethical
Ethics
Food security
Foster innovation
Future
Gender equality
Girls
Global
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
Land degradation
Long-term impact
Manage forests
Marine
Nutrition
Oceans
Opportunities for all
Peaceful societies
Poverty
Production patterns
Productive Employment
Reduce inequality
Reliable energy
Resilient infrastructure
Resources
Sanitation
Social
Sustainability
Sustainable agriculture
Sustainable consumption
Sustainable development
Sustainable economic growth
Sustainable energy
Sustainable growth
Sustainable industrialization
Sustainable oceans
Terrestrial ecosystems
Water
Well-being
Women
Work

Appendix E

Spreadsheet that identifies University of Worcester staff members related to sustainability:

The following page shows the final network of sustainability researchers identified by this project. For a full list of researchers in excel format, please contact:

Sylvester Halama: shalama@wpi.edu

James Macfarlane: jmacfarlane@wpi.edu

Virginia Nunez Mir: vcnunez@wpi.edu

Katy Boom, University of Worcester (UK): k.boom@worc.ac.uk

Richard Anderson, Kingston University (UK): Richard.Anderson@kingston.ac.uk