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Chapter 38

Effective Structures for Sustainability Programs in Higher Education

Lauren C. Edmonds and John P. Swaddle

Abstract

This paper presents qualitative and quantitative approaches to campus sustainability research, through which we identify factors most strongly associated with the success of sustainability programs at select institutions of higher education. Our comparative case study of eight colleges and universities identifies variables we then correlate to outcomes measured by a modification of the Sustainable Endowments Institute's Green Report Card score. Data analysis comprised of a principle components analysis to identify correlated groupings of variables and a subsequent regression analysis using the principle components. The variables most strongly correlated with outcomes were: relative funding, reliability of funding, bottom-up initiation, physical space, and program size. These variables had positive correlations, leading to the conclusion that campuses aiming for successful sustainability programs should make significant investments in their programs while fostering grassroots campus support.

Our work contributes a quantitative analysis of the factors leading to success of sustainability programs and provides a model for both implementation and also verification with a larger sample of institutions. We focused on identifying variables and a measurement of success to create a model; this model now needs to be applied to a larger sample size to test its reliability. This research was motivated by the need to produce practical recommendations for sustainability programs in higher education. The clear identification of variables makes it simple to translate this research into practice. Already, The College of William and Mary has received a series of recommendations from the application of this research and has begun implementing a selection of those.

Introduction

In the 1990s, institutions of higher education experienced a shift and began to acknowledge their role as participants in environmental issues, rather than as observers. Before this time, universities frequently studied the environmental impacts of others, but they rarely turned this analysis onto themselves (Creighton and Cortese 1992; Eagan 1992). It was in 1992 that David Eagan noted "campus environmentalism is starting to alter perceptions about what higher education is for, what is worth learning, and what graduates ought to understand and do about environmental concerns" (Eagan 1992). The way universities operated, the way they were constructed, the way they managed their own environmental responsibilities, among a myriad of other actions, imparted lessons to students about their relationship with the environment (Orr 1991; Rohwedder 2004; Cohen 2007).

Colleges and universities have an enormous immediate environmental impact simply from their institutional size and population. Reducing this high environmental impact is often the primary concern of campus sustainability programs. Beyond this immediate impact, institutions of higher education influence the way their graduates live the rest of their lives. As one

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campus sustainability leader told us about Clemson University's sustainability goals, "It's probably more important to change the culture of the students in the long run, of all the students who graduate, than it is for Clemson University to be carbon neutral because our students go out and change the world" (Sill 2011). The influence of colleges and universities extends far beyond their campuses through the values they teach their graduates. Sustainability is a perfect example of how students can learn outside of the classroom. Perhaps the idea has been best articulated by David Orr: "Students are taught in various and subtle ways beyond the content of courses" (Orr 1991). The concept echoes through much of the published sustainability research (Pittman 2004; Rohwedder 2004; Bacow and Moomaw 2007; Thompson and Creighton 2007). The way in which the institution conducts its business and teaches its students instills them with the lessons to become the leaders of tomorrow.

For these reasons, the environmental sustainability of colleges and universities has become a major focus of higher education research and operations. Campus sustainability has been gaining traction as the prevailing trend in higher education. If it is to become more than a trend, however, colleges and universities need to successfully institutionalize their sustainability efforts.

Our research focuses on the structure of campus sustainability programs and how the different structures are associated with the different sustainability outcomes. The ultimate goal is to identify the institutional structures most strongly associated with positive campus sustainability outcomes. We use the term "program" inclusively, as to encompass sustainability initiatives of every shape and size. Some schools have chosen to establish an office to coordinate and lead their sustainability efforts. Other schools dedicate one staff position to the sustainability projects on campus. On some campuses, sustainability is still an afterthought, a responsibility added on to existing positions. These programs vary widely in structure and also in outcomes.

This paper focuses on the research design of a comparative case study and the results of that study. We begin by explaining the case selection and data collection. We discuss the variable identification and measurement and the outcome measurement in depth. Finally, we present the results of the quantitative analyses and discuss the implications of the patterns in the data.

Methodology

Our research employs an innovative quantitative method to the study of sustainability programs at institutions of higher education. In the data analysis, we identified twenty variables across sustainability programs and created a system for scoring these variables on either numerical or ordinal scales. We also developed a system for scoring outcomes of sustainability programs, adapted from the Sustainable Endowments Institute's Green Report Card. With numerical values for the variables and outcomes, we were able to conduct a statistical analysis of the data and develop an empirical model. Correlations with statistical significance were possible, leading to tangible recommendations. The predominant research on sustainability programs has been qualitative, relying on descriptive case studies, and our research contributes an example of a quantitative study. Our work advances the discussion on sustainability in higher education by demonstrating the potential for quantitative methods and empirical models.

Research Approach

We adopted a comparative case study approach to collect information about campus sustainability programs (Tight 2003; Walker et al. 2004). Case studies are frequently used to thoroughly study a campus' institutions for any issue area; "Externally, the evaluator may compare institutions in an effort to identify practices that work and those that do not. This work is particularly valuable for those attempting reform in their own institutions" (Walker et al. 2004). The comparative analysis of the studies is integral to the research in order to provide perspective on the information collected for the separate institutions.

Case Selection

For this research we chose eleven campuses for study, though only eight were ultimately analyzed. The cases were chosen with the specific goal of providing useful policy recommendations to The College of William and Mary, a public institution located in southeastern Virginia. Appropriate comparisons are integral to identifying structures and policies that occur in one institution, but that could be effectively emulated elsewhere (Tight 2003). To offer cases relevant to The College, we began with the entire list of peer institutions identified by the College Provost's Office and the list of public colleges and universities in Virginia. Thirty-seven schools appeared on this original list. We then narrowed this list by several criteria to ensure that any successful structures identified would be transferable to The College.

Only schools in rural or suburban areas were considered. Variation in settings had the potential to affect a campus' options for sustainability efforts in ways outside the focus of this study so we restricted the focus to settings similar to William and Mary's location in Williamsburg, Virginia, a city with a population of under 12,000 residents.

The student population and endowment are important factors in the operation of the institution. The student population is indicative of the college or university's overall size. Larger institutions typically have greater resources available because of their scale. An institution's endowment is representative of its financial situation.

The final element in case selection was ensuring variation in structures and outcomes. Evaluating schools with only one form of program would fail to highlight the differences possible in the structure of sustainability institutions. If all of the schools chosen had successful programs, it would be impossible to correlate any structure with poorly ranked outcomes.

Through this process, ten colleges and universities, in addition to William and Mary, were selected for the comparative analysis.

1. Brandeis University
2. Clemson University
3. Rutgers University
4. University of California – Irvine
5. University of California – Santa Barbara
6. University of Georgia
7. University of New Hampshire
8. Wake Forest University
9. The College of William and Mary
10. Virginia Military Institute
11. Virginia Polytechnic Institute and University.

As research progressed, the University of California campuses in Irvine and Santa Barbara were excluded from the study because they did not receive scores for the Sustainable Endowments Institute Green Report Card, which was ultimately used to measure the success of programs. The University of Georgia was unavailable for the data collection interview and was also excluded from the analysis.

Data collection: personal interviews and further research

Because campus sustainability research is relatively new, little raw data is available for comparative analyses. Information released publicly is either synthesized in independent reviews of institutional practices or selectively released by the institutions themselves. In early 2011, there was no sector-wide system for reporting sustainability data at the level necessary for a comparative analysis. Most campuses have yet to incorporate sustainability measures into the data they collect through their institutional research offices (Litten and Terkla 2007). These circumstances make personal interviews the most practical method to gather specific sustainability data from colleges and universities. Personal interviews are also considered a highly appropriate method of gathering data related to campus sustainability for comparisons among institutions of higher education (Tight 2003).

The sustainability program for each college and university selected was first contacted via email. The email was sent to the primary contact associated with sustainability on the institution's website. In some cases, the interview solicitation was sent to a program-specific address, others provided personal staff or faculty addresses as sustainability contacts. After we made contact with a representative, arrangements were made for a telephone interview.

The telephone interview, conducted by LCE, consisted of fifteen questions regarding sustainability at the institution. The conversation was conducted using a web-based conference call system which enabled us to record interviews for transcription afterward.

The University of New Hampshire was the only institution to deny our request for an interview. However, the University of New Hampshire released a book detailing its program in 2009: *The Sustainable Learning Community*. Instead of conducting a personal interview, we answered the same questions using their book and website for the information. Throughout this report, we use the term interview but include this research as well.

After personal interviews were conducted to collect specific information on institutions' sustainability practices, further information was obtained from their official publications and websites and from data publicly released by the Sustainable Endowments Institute.

Data analysis

After conducting the interviews, we identified twenty variables related to campuses' sustainability programs. Some variables had numeric values, such as the school's endowment; others were assigned ordinal values on defined scales. We measured outcomes using a modification of the Sustainable Endowments Institute's (SEI) Green Report Card score.

Variable identification and measurement

The basic variables for comparing the institutions were its *endowment*, its distinction as either a *public or private* school, and its *enrollment*. We used the endowment data provided by the National Association of College and University Business Officers (NACUBO) – Commonfund Study of Endowments for 2010, with the exception of Virginia Military Institute, which came from the Sustainable Endowments Institute. The Sustainable Endowments Institute's listing of a school as either public or private was also used. The enrollment data was taken from the *Princeton Review* information on colleges and universities.

Unless otherwise noted, all subsequent variables were scored on scales of zero to three using information gathered through the interviews and further research.

The source of a program's initiation is an indicator of its campus-wide support. Some campuses had a primarily grassroots support to begin a sustainability program. Other programs were instigated by members of the upper administration. Recognizing there can be a

call for sustainability from all levels of the campus, we used two distinct variables identified as *bottom-up initiation* and *top-down initiation*.

We assigned scores for institutions' current *staff involvement*, *faculty involvement*, and *student involvement* in the sustainability program.

Beyond an institution's endowment, other financial variables were considered, such as funding across the colleges and universities. The variable of *relative funding* compares the funding amount provided to sustainability efforts on the campus relative to the other institutions. The *funding reliability*, measures the consistency of funding available. The existence of a *student fee* may provide a program with additional funding, and its presence was scored as a binary character.

Providing essential information to answer our research questions, the structure of a college or university's sustainability program was measured in three variables: *physical space*, *scope*, and *program size*. A dedicated physical space for sustainability on campus has a dual impact through the efficiency of sustainability efforts and the cultural norms suggested (Fugazzotto 2009). The scope of a program has the potential to have an extensive impact on its success level. On the ordinal scale, zero indicated the school did not have a sustainability program, one showed that a school had a facilities-based program, two that it has an academic scope, and three that the scope was within the senior administration. Program size is a relative measure of the positions (full-time equivalents) enveloped in sustainability programs across campuses.

Age of the program was another variable considered to influence its success.

Campus policies regarding sustainability were identified by an institution's public commitments or organization memberships. These variables were scored as a zero if the policy or action did not exist on the campus or a one if it did. The existence of a *climate action plan* or *sustainability action plan* were scored in this binary manner. These plans are institution-specific and encompass campus policies on sustainability. The campus' status as an *AASHE member*, *STARS participant*, or *PCC signatory* was a variable of an institution's commitment to sustainability and involvement in the larger movement. These programs also all offer resources to campuses intended to improve their sustainability programs.

Outcome measurement

To measure outcomes, we chose to use the information produced by the Sustainable Endowments Institute (SEI). The Institute is a non-profit organization that releases an annual Green Report Card in which they score colleges and universities on a variety of sustainability measures. Each institution receives an overall score represented with a letter grade, but SEI also releases scores for the components of schools' sustainability programs. SEI's emphasis on transparency in their data and scorings (unless the information is withheld by the college or university, SEI publishes all survey data collected) makes their data exceptionally useful for campus sustainability research.

Because the presence of an office and sustainability staff members affects an institution's Green Report Card score, we needed to modify this measure. Using the component scores provided by SEI, we recalculated a sustainability score using their scoring for the non-structural categories only. We also excluded the scores related to the institution's broader investment procedures.

SEI only provides letter grades for the component scores, but we converted these on a 4.0-scale for the reassessment. Using the scores provided for: climate change and energy, food and recycling, green building, transportation, and student involvement, we created a modified SEI score that was an unweighted average. This gave us a measurement of sustainability outcomes over time.

Table 1 is an example of the modified SEI score for The College of William and Mary.

Table 1: Recalculated SEI green score for the College of William and Mary

Year	Climate Change & Energy	Food & Recycling	Green Building	Student Involvement	Transportation	Modified Score	New Grade
2008	0.0	2.0	2.0	n/a	0.0	1.0	D
2009	2.0	3.0	3.0	3.0	2.0	2.6	C+
2010	2.0	3.0	3.0	4.0	3.0	3.0	B
2011	3.0	4.0	3.0	4.0	3.0	3.4	B+

Results

A comparison of the recalculated SEI green scores for each campus is shown in Fig. 1.

Fig. 1: A comparison of the recalculated SEI green scores, 2007 through 2011
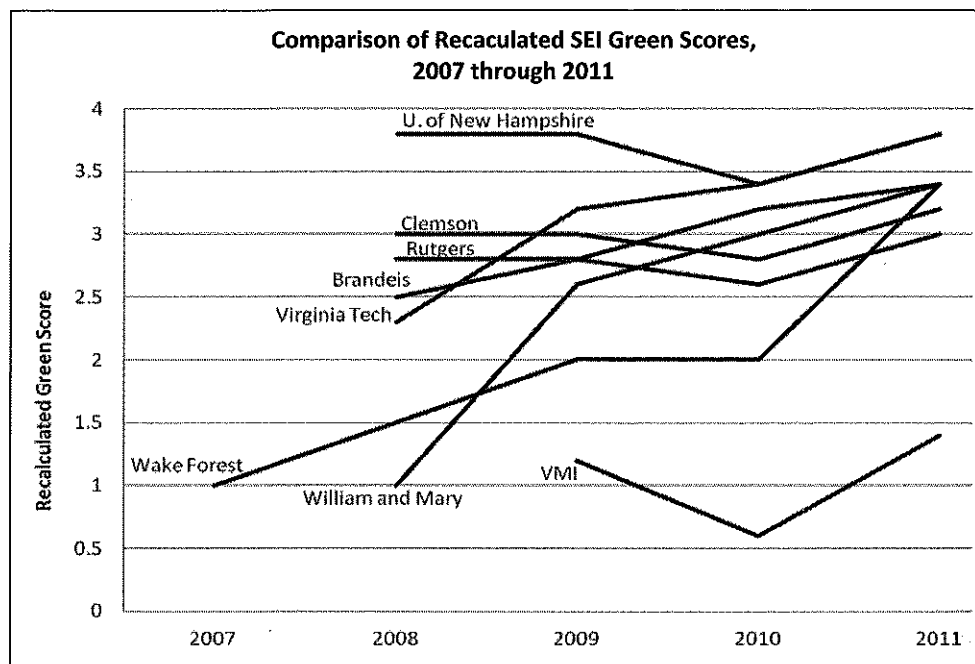
The highest scoring schools were the University of New Hampshire and Virginia Tech. Each received a score of 3.8 on a 4.0 scale for 2011. In the second tier, Brandeis, William and Mary, and Wake Forest all scored 3.4 out of 4.0.

The university with the second-to-lowest score was Rutgers University, which scored 3.0. Virginia Military Institute was the school with the lowest score. In 2011, Virginia Military Institute received a score of 1.4.

The institutions with the greatest increases over time were William and Mary, which went from a score of 1.0 in 2008 to a score of 3.4 in 2011, and Wake Forest which went from a score of 1.0 in 2007 to a score of 3.4 in 2011.

Quantitative analysis

A principle components analysis (PCA) was performed to extract correlated groupings of variables. The loading factors for each original variable in each principle component are shown in the Table 2. Values close to +1 or -1 indicate a strong association (positive or negative, respectively) with that component score.

The PCA produced three components that each had an eigenvalue of greater than 1, and were used in further analyses. The variables most strongly associated with variation in each of these first three components are identified in the table.

We used a multiple regression analysis to examine how each of the principle components independently explained variation in the schools' modified 2011 SEI Green Scores, and the rate of change in this score over time.

Table 2: Component matrix

Original variable	Principle component (Percent of original variation explained)					
	1 (35.0%)	2 (19.9%)	3 (14.0%)	4 (12.7%)	5 (7.94%)	6 (7.38%)
2010 Endowment	0.394	-0.620	-0.266	0.450	0.424	0.071
Public/Private	0.484	-0.532	0.272	0.505	0.211	-0.327
Enrollment	-0.101	0.402	-0.810**	-0.140	0.189	-0.028
Involvement, Staff	0.564	-0.528	-0.156	-0.572	-0.165	-0.112
Involvement, Faculty	0.294	0.826**	0.085	-0.154	-0.126	0.403
Involvement, Students	0.830**	-0.182	0.459	0.213	-0.049	0.080
Funding, Relative Amount	0.939**	0.122	0.278	0.019	0.108	-0.113
Funding, Reliability	0.971**	0.090	-0.076	-0.083	-0.082	0.147
Student Fee	0.270	-0.326	-0.001	0.438	-0.754	0.058
Top-down Initiation	-0.565	0.219	0.713**	-0.075	0.338	0.044
Bottom-up Initiation	0.755**	0.086	-0.570**	0.099	-0.261	0.100
Physical Space	0.765**	-0.257	0.229	-0.438	0.272	0.151
Scope	0.018	0.069	0.286	0.475	0.244	0.785
Program Size	0.806**	0.305	-0.233	-0.296	0.296	0.007
Age	0.500	0.550	0.362	-0.516	-0.141	0.104
AASHE	0.555	0.284	-0.452	0.555	0.070	0.250
STARS	0.843**	0.121	0.108	0.049	0.298	-0.385
PCC	0.192	0.594	0.452	0.424	-0.262	-0.218
Climate Action Plan	0.268	0.793**	0.072	0.298	-0.083	-0.439
Sustainability Action Plan	-0.335	0.654**	-0.303	0.306	0.322	-0.178

The first component consisted of seven variables: student involvement, relative funding, reliability of funding, a bottom-up initiation of the sustainability program, physical space, the program size, and participation in STARS. This first component explained 51% of the variation in the outcome; as the component increases, the outcomes measured by the modified 2011 SEI Green Score increase as well (Wald Chi-square = 4534.0, r^2 = 0.512, $P < 0.0001$). However,

under closer inspection, some of these variables appear less meaningful than others. Student involvement was measured by the original SEI score for later years, so student involvement is simply an endogenous variable and not a significant influence on the actual outcomes. A school's participation in STARS is likely more a factor of the program's size and funding and may appear in the first principle component due to that correlation rather than its impact on outcomes. STARS is meant to be a reporting system for institutions, and while four of the case study schools are participating, only one has reported so far. It is safe to assume that a school's participation in STARS better indicates their funding levels and their program size, because of the ability to pay the membership fee and the availability of staff to gather and submit the data. Therefore, we interpret the first principle component as being related to variables concerning relative funding, reliability of funding, a bottom-up initiation of the sustainability program, physical space, and the program size.

The second component was composed of the involvement of faculty and the existence of planning documents, specifically a climate action plan or a sustainability action plan. 17% of the variation in outcomes could be explained by this second component. The relationship shows that as faculty involvement increases and the institution commits to more planning documents, the modified SEI green score for 2011 increases (Wald Chi-square = 1518.6, r^2 = 0.171, $P < 0.001$).

Enrollment and the variables measuring top-down and bottom-up initiation comprised the third component. This third component explains 12% of the variance in the outcomes observed. Higher modified SEI green scores are associated with larger enrollments and less emphasis on top-down initiatives (Wald Chi-square = 1095.4, r^2 = 0.124, $P < 0.001$).

Discussion

For the institutions included in our analyses, the most effective institutional structure for campus sustainability would exhibit five characteristics: high levels of funding, reliable funding, a large program size, a dedicated physical space, and bottom-up initiation. This requires that a college or university make a significant investment if its sustainability program is to thrive but also that it builds from grassroots initiation and includes participation from students and faculty.

In the interviews, perhaps not surprisingly, funding was often cited as the limiting factor for sustainability programs. The economic downturn has made the creation or expansion of programs like sustainability particularly challenging. Little money is available for high levels of funding for sustainability programs, and in an uncertain economic environment it is difficult for schools to commit to reliable funding at any level. This is ultimately one of the most significant variables in a program's outcome. In some ways, times of financial constraint are the best opportunity to begin a program; sustainability is largely about increasing efficiency and doing more with fewer resources (Simmons and Moody 2010). Making a commitment to sustainability funding can be the most important step an institution takes to improve the sustainability program as well as the finances of the entire campus.

The number of personnel permanently associated with a program is a major determinant of the capacity of a sustainability program. Programs with a large staff will have a greater ability to address complex sustainability challenges and to implement wide-ranging policies. The potential for division of labor within the staff can also make a program more efficient. With only a small staff or a volunteer committee, the same few people will be left overseeing programs, implementing specific initiatives, and administering any budget they have, as well as numerous other tasks.

A dedicated space for the sustainability program gives a physical center for the campus' efforts and also serves as a tangible display of the school's commitment to sustainability. Schools with a physical office space or public area dedicated to sustainability are able to use that location to host programming that supports their sustainability goals. In institutions where the sustainability program does not have a specific, permanent location or where the space is limited to an individual office, the broader campus can have difficulties engaging the program.

Bottom-up initiation is a strong factor in a program's success and shows the campus-wide support for the program. The grassroots effort for creating or expanding a sustainability program must be met with a positive response from the administration in order to create an official sustainability program, but the real significance rests on the grassroots efforts. In only two schools did the administration begin a sustainability program without inspiration from the campus community, and neither program was among the highest scoring. Though the correlation was weaker, top-down initiation did have a significant relationship with lower scoring sustainability programs. This emphasizes the strong need for broad support and investment in the program rather than policies imposed from the upper administration.

Planning documents had an interesting effect on outcomes; they correlated with more effective sustainability programs overall, but they also were somewhat linked to slower improvements over time (Wald Chi-square = 3.81, r^2 = 0.204, $P = 0.051$). This may indicate that sustainability plans or carbon action plans exist in a mutually exclusive relationship with actual projects and programming, at least during the initial phases of a program. Multiple schools interviewed articulated this decision, saying they had spent the early years of the program crafting plans without taking much action.

Some characteristics of programs had no significant impacts on the outcome. The defined scope of a program did not appear to influence the outcomes of the program. There are exceptional cases where the scope of the program did impact the program's outcomes. Brandeis University did experience limitations due to its scope, however, and the University of New Hampshire had found it necessary to revise the scope of its program in order to have the most successful outcomes.

A program's age was unrelated to its modified sustainability score; relatively new sustainability programs apparently have no trouble catching up to their more established peers. Perhaps this is not surprising, given the relative youth of the majority of sustainability programs that we studied.

In the end, the most successful programs are found on campuses where both the institution and the grassroots have made a strong commitment to sustainability, investing money, time, and labor in the program. This institutional support is crucial for enacting effective sustainability initiatives.

Conclusion

Institutions of higher education can use the model we developed to determine the focus of efforts to improve their campus sustainability programs. Success does require serious investments in the sustainability program, and in a world of limited resources, our work can help colleges and universities ensure they are acting as effectively as possible in accomplishing their goal of sustainability.

In the spring of 2011, we presented The College of William and Mary with a series of recommendations derived from the model we created. From the five characteristics correlated to the most successful sustainability programs, we suggested that the administration: increase funding for the sustainability program, improve the reliability of sustainability funding, ex-

pand the size of the program, establish a dedicated space for sustainability on campus, and continue supporting grassroots involvement in sustainability efforts. With each recommendation we provided details for the application of our research in the context of The College of William and Mary. As of 2012, multiple of these recommendations have been adopted, and others are under consideration. This experience highlights the value of our research and sets an example for other campuses.

Our conclusions have strong potential to form the foundation for future research. Now that the variables characterizing campus sustainability programs have been identified among the institutions studied here, future research can evaluate this model on a broader scale. Our case studies provided an opportunity to analyze programs in detail, but we suggest that a wider survey of institutions of higher education would be the best next step in determining the most effective campus sustainability structures.

The variables identified could also be studied in greater detail. Funding, in particular, is a broad characteristic and institutions of higher education could benefit from better understanding the relationship between finances and sustainability programs. Our distinction of funding amounts and funding reliability is a start, but future research could consider what specific items receive funding through sustainability programs, or how programs are able to fund projects outside of their regular budget.

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