Proximal Redevelopment of Brownfield and Derelict Sites Near Institutions of Higher Education

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Authors' contributions

This work was carried out in collaboration among all authors. Author BNKJ designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors CJJ and SH managed the literature search and initial proofing. Author LHJ performed edits to the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

It is critical to educate higher education faculty about the importance of redeveloping brownfields into usable spaces for campus expansion. While there are many studies on the success of brownfield redevelopment, research is limited on how professors' perceptions on brownfield redevelopment can help their institutions to impact community initiatives and promote collaborative, environmental efforts. Hence, a need to design methods to collect, record and analyze professors' perceptions became fundamental in capturing the voices of participants and ensuring the accuracy of their responses. The first set of analysis methods included categorizations, descriptions and interpretations of qualitative data. The secondary method of analysis utilized descriptive statistics to measure the most important indicators that influence professors' perceptions to redevelop brownfield sites near their campus communities.

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Pseudonyms are used for the three universities across Jefferson County in the State of Alabama which provided access to their professors. Findings from the study showed that professors from two universities were knowledgeable and aware of the sociological and economic challenges in low income communities where brownfields are geographically located. Findings also indicated that Eta-One University was a recipient of an EPA Region 4 grant that focused on educating low income communities associated with the presence of brownfield sites in their area. Alpha-One University was eager to establish a special partnership initiative. Although Gamma-One University was located in a high crime and low-income community with potential brownfield sites, the faculty showed no interest in participating in the study. Therefore, challenges and factors that Gamma-One University faced were undetermined.

1. INTRODUCTION

There is a critical need to investigate the perceptions of professors' interest(s) in providing consultation and guidance in support of redeveloping derelict sites in at-risk or low-income communities near college campuses. Professors' perceptions can aid in determining the potential for revitalization to increase nearby property values. The challenge of promoting interests among community civic leaders begins with them becoming aware of the presence or potential presence of a hazardous substance, pollutant or contaminant in proximal distances of college campuses. The United States Environmental Protection Agency (EPA) describes these areas as brownfield sites [1].

Any organization initiating brownfield redevelopment near a college campus should first gauge whether there is community-level awareness about environmental hazards and most importantly, whether there is the will to forge a pathway towards sustainable development in that community. Therefore, the following framework proposed by Rhodes and Reinhold [2] is relevant to this research study because it illustrates an understanding of human responses to hazardous conditions and environments. This model's greatest significance speaks to understanding community identity and the need to assist a community in seeing itself as an active, sustainable ecosystem, which requires short term and long-term strategic initiatives.

The importance of communities also shows up in Ender's [3] research, in which she recognizes that a community should not only be a recipient of governmental aid in times of emergency, but rather, it should possess the self-sustained
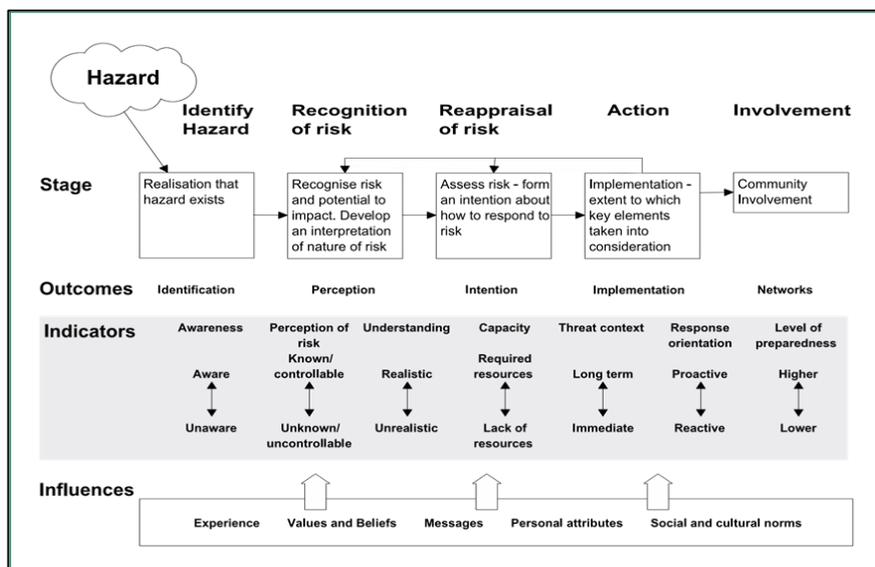

Fig. 1. The preparedness model [2,3]

capacity to identify and reduce hazardous exposures. Ender concluded that this is most effective when communities are self-aware and involved in planning, mitigation and preparedness efforts for successful redevelopment of brownfield sites.

In the model presented in Fig. 1, from left to right, the key steps illustrate the process whereby a hazard is introduced to a community. First, the community must become aware that a risk to human health and the environment exists. Environmental hazardous conditions are normally identified through community awareness and the scientific deployment of a soil screening test to identify and define contaminated site locations [4].

However, if a community does not have the available resource(s) or experience to identify potential environmental risks, outside strategies and solutions may complicate the resolution process. Second, the recognition of a risk is an important stage to effectively address hazardous conditions. Research by Adger [5] recommends reducing the level of risk through the assessment of both human vulnerability and resilience within a social ecological system. Human responses to vulnerable conditions may be influenced by actions, beliefs, and intentions that are all shaped by social structures. The convergence of these factors is an integral part of a community's recovery assessment, evaluation, and ongoing recommendations. Finally, the interest of a community becoming proactively aware about its "*invironment*" is essential to the ongoing interaction of its physical environment [6,7].

Therefore, active input from experts with diverse research experiences (e.g., university professors) should be inclusive throughout the planning, designing, and especially the implementation phase of redeveloping properties within proximal distance to a college or university. These institutions are composed of qualified research professors who can provide proper consultation; however, their expertise tend to be overlooked. To encourage motivation among interested or qualified professors, awareness through discussions can be brought to the forefront of institutions of higher education.

2. A REVIEW OF BROWNFIELD DEVELOPMENT NEAR UNIVERSITIES

From the college lecture halls to the technological and scientific workforce, research professors are continuously challenged to provide the research community with solutions that promote the transfer of knowledge from a classroom-setting to methods of application in addressing real-world problems. Moreover, professors are expected to demonstrate pedagogical skills that apply both methods of theory and practical applications. Transferring these skill sets from professor to student to learning communities promotes "application work," to address real-world problems in the workplace [8]. Therefore, the need for research professors to educate students and equip their learning communities with knowledge about the importance of brownfield redevelopment is paramount. According to McCarthy [9], brownfield redevelopment creates opportunities for all interested developers (private or public) to revitalize areas that were once thriving. Furthermore, McCarthy indicates that the potential impact of redevelopment can stimulate an increase in private sector investment, job creation, employment efforts, tax revenues (property and business), and environmental quality.

Redevelopment also decreases crime rates and urban sprawl. Supporting research comes from Cooper, Kotval, Kotval, and Mullin [10]. Their article focused on the redevelopment projects and collaboration of both institutions of higher education and neighboring properties. The authors investigated the common challenges around redevelopment that are experienced by private institutions throughout the U.S. case studies of various institutions were used to provide success indicators relevant to redevelopment initiatives. The study included the following four institutions: Northeastern University's Davenport Commons, Yale School of Forestry and Environmental Studies with the City of Baltimore, Johnson and Wales University, and Worchester Polytechnic University.

Fernández-Esquinas and Pinto [11] offer a methodological approach to understanding the potential impact of university resources on urban redevelopment. The authors explored the socioeconomic and financial benefits institutions of higher education bring to areas in need of redevelopment. Their strategic goal was to determine the level of interaction between institutions of higher education and surrounding communities on urban revitalization and regeneration. A meta-analysis of urban development research was used in the article.

The purpose behind this was to establish a conceptual framework inclusive of four-dimensional factors: physical infrastructures, human resources, economic development and civic engagement.

2.1 Special Partnership Initiatives

Higher education institutions are community-based entities that have the leverage, economic stability, and political networks to respond to brownfield sites. The ability of higher education to provide research in various disciplines is well respected by noneducational organizations and politicians, at large. Therefore, if higher education institutions can craft redevelopment initiatives that align with local policies and bring about societal recognition and change, they would become a more widely recognized voice for urban policy reformation at the local, state, and federal levels. According to McWilliams [12], research on environmental justice and industrial redevelopment reflects the need to include community-based groups in the regulatory, decision-making process. Cooper et al. [10] indicate that in the future both universities and cities will become more reliant upon each other's resources. In addition, united states secretary of housing and urban design states that, "the long-term futures of both the city and the university in this country are so intertwined that one cannot—or perhaps will not— 33 survive without the other" (p. 88) [10].

Indeed, the desire to bring together the academic research community with political partners in solving real world problems suggests that research professors (from a myriad of disciplines)at institutions of higher learning have a pivotal role to play in projects like brownfield redevelopment— particularly as universities expand their campuses. The concept of applied research is a realistic approach to creating community and institutional trust, and, most importantly, a sense of successful partnership and collaboration. In an article written by Ghoshal, Arnzen, and Brownfield [13], the perceptions of professors of business studies on learning alliance between business and business schools provides a platform for successful partnership initiatives that focus on "developing learning skills ... To help managers develop rich and sophisticated conceptual frameworks that allow them to generalize about important organizational and environmental events" (p. 51) [13].

3. MATERIALS AND METHODS

For this mixed-methods study, the perceptions of professors towards the redevelopment of brownfield(s) near their campus communities into usable greenspaces was investigated. In addition, we sought to determine whether or not those perceptions correlated with particular geographical locations of the universities and brownfield sites using a modified multi-attribute instrument, the Land Redevelopment Survey, designed by Kris Wernsted, Lisa Crooks, and Robert Hersh [14]. This approach allowed for an analysis of triangulated data. The purpose of interpolating a mixed method approach was to minimize biases, to provide an overlap of data, and to present a more authentic description in the analysis of data.

Using a two-phase approach, the primary method of data collection consisted of qualitative open-ended questions asked during a focus group. Conducting research among focus groups has a potential advantage over conducting numerous individual interviews: it provides a setting for in-depth discussion and interaction that may not have occurred within an individual interview, thus enriching and strengthening the quality of the discussion [15,16]. Participants were allowed the opportunity to share their feelings and experiences. The focus group interviews followed the alignment of the Morgan design [17,16] that is composed of a heterogeneous collection of participants (of approximately six to ten participants) and is reliant on a relatively structured interview. To investigate diversity in participants' verbal and written responses, open-ended questions were designed and patterned from a Land Redevelopment instrument, which gave definition to the variation of the statistical findings. Immediately prior to the focus group session, professors responded to the modified Land Redevelopment Survey (see Appendix).

During the focus groups, professors were first led to analyze photographic depictions related to either a brownfield site or a greenspace. This method of treatment was incorporated in the design to better understand the depth of familiarity of common features associated with properties that may show indicators of brownfield site potential as well as features associated with a greenspace. In support of this approach, a curriculum entitled *The Livability Curriculum Brownfield Lesson* by Jaclin DuRant [18], is a practical course of study adopted and implemented by the Department of Education for

the State of South Carolina. The curriculum was designed to teach students in Greenville, SC how to become familiar with brownfield sites; understand the challenges associated with brownfields; and to learn redevelopment efforts adopted by the city of Greenville (www.greenvillesc.gov). However, to address the recognition of brownfield sites, this study utilized depictions to investigate professors' abilities to recognize visual aesthetics associated with a brownfield site. They were asked: "What do you see in the pictures that make you think or feel the site(s) may be a brownfield or a greenspace?" Visual depictions were shown to the subjects to gather responses of their own interpretations (see Appendix). Also, the researchers modeled the questions to be considered during the focus group from the questionnaire (see Appendix).

At the end of the interviews, focus group respondents were asked to summarize three main idea(s) from the discussion, identify two captivating discussion points; and finally, to pose a question that remained unclear. According to Regier [19], the 3-2-1 teaching tool is an assessment-based strategy used to evaluate the student's level of comprehension and understanding about a specific unit or topic. However, this assessment strategy was adopted as a method of treatment to conclude ideas; to summarize the respondents' perceptions; and to bring forth questions that can aide future research studies. This method of written reflections also helps to examine and interpret the overall perceptions of professors on institutional redevelopment of brownfield sites.

Permission to conduct this study was obtained from three universities in the state of Alabama. The provost from each university sent an invitation to professors within all academic and professional disciplines who were available during the summer semester to participate in focus groups during which lunch was provided.

To maintain confidentiality at all stages in the research, the participants' institutions were coded: EO (Eta-One) University, AO (Alpha-One) University, and GO (Gamma-One) University. Two separate focus group sessions were held in conference rooms at EO and AO. Each one lasted approximately one hour and thirty minutes and was audio recorded.

Finally, participants provided individual responses to the survey items. The survey was administered through Qualtrics online database. It took the participants 10-15 minutes to complete the survey. Once the survey was completed, participants were given the chance to provide qualitative written feedback in the form of a 3-2-1 prompt to provide additional structure to the subjects' verbal commentary on their perceptions, feelings, or ideas within the focus group interview.

4. RESULTS AND DISCUSSION

Participants were coded to their respective institutions as: EO: 1 through 10; and AO: 1 through 10 and GO. A total of 20 professors, 10 from EO, 10 from AO (20% male and 80% female) provided their consent and participated. All participants held doctoral degrees in their respective academic disciplines. The years of professional experiences ranged from three years to twenty-five years (see Fig. 2).

Prior to the discussions, the professors completed the online survey. Transcriptions of the professors' verbal responses during the focus groups and quantitative output were concurrently triangulated and arranged into a matrix for further comparison of data. The most important indicators that emerged from the combined data analysis was land recognition, redevelopment importance, and job training and employment. The survey data was converted into an SPSS downloadable file for descriptive analysis.
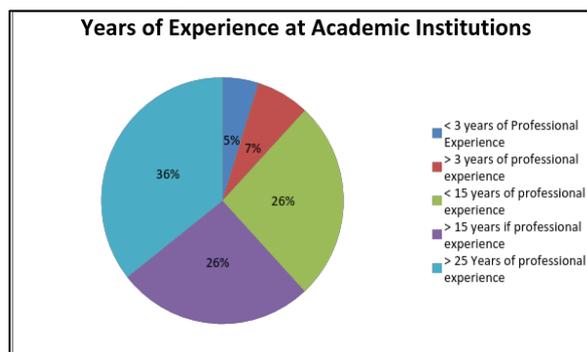

Fig. 2. A percent distribution of professors' years of experience at academic institutions ranging from < 3 years to > 25 years

4.1 Land Recognition

Professors' verbal responses showed the recurring theme, "industrial" to be the key indicator or distinct feature they searched for to validate their responses. Professor AO-4 suggested that the depictions were similar to a brownfield site:

> "Well, I think it is a brownfield because of its close proximity to an urban area. It's out-skirts usually have a lot of industrial companies and it just has that look; it looks like a redeveloped industrial site".

Whereas, professor AO- 2 stated:

> "It is a brownfield because it is a non-remediated industrial site. It has a garage that suggests it once was an industrial company that may have hold chemicals".

Other types of features used to recognize a brownfield site ranged from the "lack of trees and greenery" at a site, the physical "color' of a site, or the "nastiness" of the physical appearance of the site. However, statistical findings from the results showed that only 4.8% of professors have a strong familiarity with recognizing brownfield sites, whereas, 47.6% of professors stated that they were totally unfamiliar with recognizing brownfield sites. Table 1 provides a summary of the results. The mean score among professors regarding their general familiarity is (M = 2.12, SD = 1.288).

4.2 Redevelopment Importance

The category on redevelopment importance was significant because it presented three themes that correlated with the quantitative data: health disparities, aesthetic influences and redevelopment barriers and constraints. First, professors' perceptions on the importance of redeveloping brownfield sites presented the need to address the potential risk(s) brownfield sites may have to both public health and the physical environment. For example, professors indicated the potential for humans to become exposed to harmful chemicals from the presence of unknown chemicals or substances contained in cattle car trucks, or carcinogens and other hazards in the soils. Professor EO 1 stated:

> "Well, if it's a brownfield site, there is something there. To some degree, they would have to perform an assessment. For a brownfield site, it could be an abandoned

building where they can have lead, asbestos especially with the age of a building; it can be contaminated and can cause health problems. However, assessments to sites should be performed before renovation to projects like this can happen which positively supports the reuse of unwanted space".

According to the Model for Behavior Change [2,3], this response models a behavior for change and an understanding about brownfield redevelopment. In support of the model, the professor relates a brownfield site to something that actually exists in the physical environment and is potentially hazardous. Professor EO-1 also recommended an assessment to the site, which is the third step according to the Model for Behavior Change, previously identified in Fig. 1.

Another professor looked at how the existence of brownfield sites affect the healthcare and public health status of a community. For example, professor EO-5 stated, "This is how adverse impacts happen to people within '*that community*' (emphasis added by researcher) and that's when healthcare and health problems arise". Supporting research by Chilton, Schwarz, and Godwin [20] showed that brownfield sites have an indirect effect on healthcare and public health, while identifying socioeconomic and demographic indicators' as culprits to public health and healthcare, in geographic areas where brownfield sites are located [20].

Secondly, aesthetic influence in this research revolved around a want or a desire to achieve methods of redeveloping plighted areas where deprived socioeconomic areas exists. The analysis indicates that these influences reemerged across indicators. For example, professor EO-3 felt as though the need to redevelop brownfield sites located near the campus community would increase health awareness through the introduction of green infrastructures, thus, establishing a positive perception within and throughout the community. For example, when asked, "What type of greening ideas can transform your campus environment?" Professor EO-3 stated,

> "We can incorporate more campus jogging trails and more sporting facilities surrounded by public greenspace. Incorporating greenspace would eventually attract students and positively impact our student enrollment because students will want to attend our institution because the campus will provide a sense of community wellness".

Table 1. Descriptive Test Statistics for professors' perception based on general familiarity of brownfields

		Frequency	Percent
Valid	1	20	47.6
	2	5	11.9
	3	9	21.4
	4	5	11.9
	5	2	4.8
	Total	41	97.6
Missing	System	1	2.4
Total		42	100.0

Table 2. Descriptive test statistics for professors' perception based on the removal of eyesores

		Frequency	Percent
Valid	1	1	2.4
	2	3	7.1
	3	10	23.8
	4	9	21.4
	5	19	45.2
Total		42	100.0

Professor EO-1 recognized Eta-One College's outreach efforts to convert the property of a nearby abandoned high school into a community health and wellness center; and, professor EO-4 expressed the desire to create a campus community garden. Statistically, 90.4% of professors indicated a significantly high response rate that falls within the moderately important to very important range for reasons why they think it is important for the removal of eyesores. For example, Professor AO 10 stated:

"The benefit to this is that people can now live in areas and not have to see eyesores; thus, it may change the perceptions of people and motivate them to want to do the right thing for everyone, regardless of the city or socioeconomic background".

Table 2 provides a summary of the results. The mean to remove eyesores score among professors was ($M = 4.00$, SD = 1.104)

The perceptions of professors indicated a strong aesthetic attitude, '*want'* and '*desire*' for the removal of brownfield eyesores across the state and as a mitigating effect, to redevelop these sites into recreational sites and other types of greenspaces. The diverse views of professors provide a valid desire for '*change*' that is a beneficial indicator for communities across the state. In addition, research by Walker, Hipel, and Inohara [21] suggests that it is beneficial for cities to reuse brownfield sites and to invest in them as a means to motivate private development.

4.3 Job Training and Employment

Professors saw the need for job training and employment through grant funding as important to address an area-wide redevelopment agenda. An article by the Department of Commerce for the state of Oklahoma [22] reported that remediating brownfield sites brings positive economic returns. The authors acknowledged the passage of the Brownfields Voluntary Redevelopment Act as the reason for such success. The returns are based on indicators such as: employment, employment and payroll, property values, retail and sales taxes, state income taxes, federal income taxes; and federal returns of Investment. To support the research, professor EO-1 stated:

"The institution will be looking to address some key issues like: community individuals in need of GED training, skills for resume writing, and increased skills for verbal interview. EPA and City planners look at the economy in the North Birmingham area, where lots of the health care providers and companies were removed and relocated to the downtown UAB, Princeton or Brookwood areas. Also, most all of the popular grocery stores were relocated during the economic decline in the North Birmingham area;

consequently, this area of the city was stripped of its resources. However, we are trying to redevelop these brownfield sites to useable greenspaces, bring industries and businesses back to the community and make them more accessible to the people, with hopes that the property value will increase. We also want to increase and sustain economic growth and employment. We want to establish healthier residential living that is affordable. We want the job market to be more marketable and pleasing to the people in the community from that perspective. The training grant cycle will look at addressing the community soft skills needs and residential life planning needs as well as HAZWOPER training inclusive of general industry training, forklift training, and asbestos abatement. This grant will make the people in the community more marketable for the industry".

Statistically, professors perceived the importance of addressing the current challenges through an area-wide agenda; and to provide employment and job training to residents affected mostly by socioeconomic deprivation. For example, a combined score of 57.2% of professors indicated that redevelopment efforts should be addressed in their local area, ranging from important to veryimportant. Professors also saw the need to reduce redevelopment constraints by securing grant funds through the U.S. EPA. Statistical results indicate a combined score of 85.7% of professors perceive that the lack of U.S. EPA involvement would be a constraint, thus, making redevelopment efforts very difficult. In fact, the financial assistance of federal funds through the U.S. EPA afforded EO University the opportunity to conduct redevelopment efforts. The mean area-wide redevelopment agenda score among professors was (M = 3.64, SD = 1.206). Table 3 provides a summary of the results.

Thirdly, barriers and constraints are another indicator that impedes a community from advancing through brownfield redevelopment efforts. For example, Professor EO 2 asked her colleague an interesting question:

"Will our neighboring city located next to one of the United States' major steel corporation be factored into the grant funding study? This plant is in the backyard of one of the college communities and residential areas that is historic to the city of Birmingham".

However, Professor EO 1answered:

"I recently attended a Brownfield conference in Montgomery, AL held by the EPA. The city you are referring to was one of the municipalities that can apply for Brownfield site grants, but one of the major requirements is that the city has to be economically and financially sound. Based on current media sources, that city is not economically or fiscally sound. Therefore, I do not see how they can apply for a grant through the EPA. From my understanding the EPA performs a financial background check and if it does not appear to be promising for long-term financialreturns, they are not going to invest in your city. It is just like a personal credit check; "bad credit is worse than no credit".

In support of the verbal responses, the quantitative data presented an 88.1% response rate. A combined score of 66.6% of professors indicated unfavorable lending terms as a constraint in their local area, ranging from moderately important to very important. According to the Environmental Protection Agency Region 1 [23] website document entitled, "EPA New England FY 2016 Brownfields Grant Guidelines Workshop: Revolving Loan Fund Grant Presentation," it is clearly stated that only twelve awardees, nationally, will be granted up to $200,000.00 for a five-year revolving period to support revitalization efforts for brownfield sites. Moreover, those recipients must: "*Have a wealth of potential borrowers, sub-grantees and sites.*" In addition, the EPA has a ranking criteria or rubric designed for potential recipients. As a grant rubric criterion, the EPA requests potential recipients to provide the probability of receiving funds during the grant period; also provide proof of past projects similar in nature and their success rates to leverage efforts [23]. These types of stipulations make it difficult for communities in dire need of revitalization efforts to see the potentiality of revitalizing their communities, especially when they are facing multiple socioeconomic facets that do not meet the grant funding criteria.

4.4 Reflections

According to the written reflections, professors discovered that the focus group interview provided them with an enriched discussion of environmental problems surrounding the presence of brownfield sites in close proximity to

Table 3. Descriptive test statistics for professors' perception on redevelopment as an area-wide agenda

Q5-10		Frequency	Percent
Valid	1	2	4.8
	2	6	14.3
	3	10	23.8
	4	11	26.2
	5	13	31.0
Total		42	100.0

their campus communities. In reflection, the professors were able to determine a need for colleges and universities to work collaboratively to address community-wide efforts pertaining to the redevelopment of brownfield sites. They also discovered that communities benefit the most when institutional collaboration and partnership ventures are considered. In other instances, those elements decrease the competitive nature of grant funding opportunities and increases public awareness of environmental problems in the community.

Other examples of discoveries among professors were that the redevelopment of brownfield sites creates a valued added situation; institutions play the major role in educating the public; redeveloping brownfield sites into greenspaces creates a space for recreational activities and fellowship; and the creation of a greenspace can be a motivational factor to other areas. In fact, crime is a major issue associated with communities where brownfield sites are located. Moreover, an interdisciplinary group of experts in their respective fields generated a very interesting and multifaceted discussion around the need for colleges and universities to redesign and update their program curricula and to use teaching approaches that focuses on addressing community redevelopment efforts where brownfield sites are located.

Most professors expressed interest in finding ways to successfully carryout special partnership initiatives between other institutions to obtain redevelopment funding through state and federal agencies. Others found it interesting that Eta-One University is the leading institution to initiate a prominent role in the community to bring about awareness pertinent to brownfield redevelopment efforts.Finally, each professor also posed a question about the current status on redevelopment efforts transforming brownfield sites into useable greenspaces.

- What methods of action local cities conduct to evaluate and identify areas that are brownfield sites and what clean-up efforts are being performed?
- What educational role could their institution play in brownfield redevelopment?
- How can we bring brownfield redevelopment issues into the classroom in a meaningful way?
- What are the reasons why greenspace is so successful in the twenty-first century?
- How do you find accurate and current information on a brownfield location?
- How will brownfield redevelopment ultimately benefit Alabama and the United States?
- How could a sustainability course be developed for the Law School?
- How can our institution create a collaboration that connect us with what is happening to institutions like Eta-One University?

5. CONCLUSION

First, professors' abilities to recognize a brownfield site was based on their general familiarity which relates to "the degree to which you come in contact with a redeveloped brownfield or the ability to identify a brownfield site." Findings conclude that the recognition of brownfield sites were based on common visual features associated with a brownfield. This association holds validity pursuant to the Alabama Land Recycling and Redevelopment Act, Code of Alabama 1957, § 22-30E-4 [24]. According to 335-15-1-02 of the Act, a brownfield is defined as,

> "A *real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant or contaminant.*"

This definition provides key indicators to aid the visual recognition of a brownfield site. These indicators are either identifiable objects that may appear to be "hazardous substances" or potential "pollutants." The Act also defines these indicators as:

"Hazardous substance" means any substance included on the List of Hazardous Substances and Reportable Quantities, codified as 40 CFR Part 302, Table 302.4, in force and effect on the effective date of 335-15-1 and subsequent revisions thereof, or any substance listed on the List of Extremely Hazardous Substances and Their Threshold Planning Quantities, codified as 40 CFR Part 355, Appendix A, in force and effect on the effective date of 335-15 and subsequent revisions thereof" [24].

Whereas a,

"Pollutant includes but is not limited to dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste" [24].

Secondly, concluding evidence on the importance to redeveloping brownfield sites implied that professors possessed the knowledge of self-awareness and preparedness to address the challenges associated with brownfields. The significance of the Model for Behavior Change identifies that understanding a risk relies on the influence of one's beliefs and values [3,2]. The perceptions of professors illustrate the capacity to change behavior in response to a potential risk. This is an advantage to communities in need of proper planning and mitigation efforts. Therefore, the perceptions of professors regarding the redevelopment of brownfield sites also brings forth a sense of happiness and fulfillment to address redevelopment challenges, specifically, sociological and economic challenges.

Third, professors perceive that securing federal funds is a solution to developing a job training and employment initiative, thus reviving economic equity and creating social equality. A practical move toward this goal is creating a sustainability pathway as recommend by Kappa Delta Pi Honor Society [25] sustainability model.

Sustainable development involves the process of conceptualizing the three-pillars into a Venn-diagram model, which represents the overlapping relationship between all three aspects; while simultaneously sharing their interrelated constituent elements [26]. First, social sustainability refers to individuals' well-being (e.g., health, shelter, educational advancements, ethical practices, and conservation of culture heritage, etc.) and their pursuit for social advancement and physical changes within a community; however, social equity can be restricted by elements of its environmental conditions [27]. Second, economic sustainability has to do with community advancement in effectively and efficiently increasing employment opportunities; supporting the diversification of business growth and opportunities (in urban settings); and developing long-term financial security in target areas [28]. Finally, environmental sustainability is the final pillar which focuses on the land resource management of ecological and biological diversity (see Fig. 3).

5.1 Inclusivity in Sustainable Development

Inclusivity in sustainable development is a planned process that develops long-term, environmental goals. According to the Sustainable Development Goals (SDG) established by the United Nations [29], there is a global push to ensure cities and human settlements are inclusive, safe, resilient and sustainable. To support this effort, the United Nations (UN) created a conceptual Goal-11 to address redevelopment efforts in urban cities. Sustainable Development Goal 11: *Sustainable Cities and Communities* was established (among 16 other targeted goals) by the technical agencies of the UN to address environmental, social and economic urbanization challenges [30].

The practice of inclusivity in sustainable development for cities in dire need of revitalization begins with identification of stakeholders in a community, especially institutions of higher education. In Birmingham, Alabama the city established a comprehensive plan [30] with goals and clear objectives that strive to maintain its vision of "*A downtown city center that provides jobs, taxes, and is the center of business and cultural facilities for the whole region.*" In this report, the University of Alabama at Birmingham (UAB) was identified as the catalytic driver behind

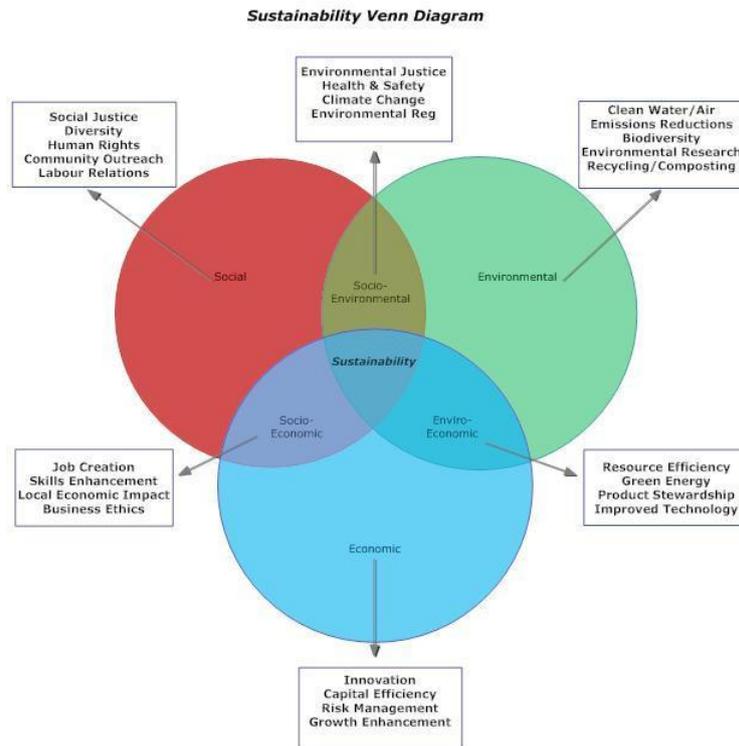**Sustainability Venn Diagram**

Fig. 3. Kappa Delta Pi [25] lessons on global sustainability issues

the downtown economy that adds uniqueness to the city. The success in redeveloping the downtown Birmingham district is just one example that depicts the importance to include institutions of higher education as a public-private partner throughout and within a city's master plan.

While UAB played a pivotal role in the development efforts of the downtown Birmingham district, some institutions positioned in proximal distance from UAB exhibited dispositions contrary to the sustainable developmental effort. Case in point, both Alpha-One (AO) and Gamma-One (GO) Universities are geographically positioned in the western region of the city limits. Results from the study revealed GO's lack of interest in sharing their views on redevelopment efforts within the city limits. It was alarming to discover that GO, a predominantly white institution (PWI) uniquely positioned in a socio-economically deprived region agreed to participate in the study. However, these participants did not attend the sessions related to the research endeavor. The significance of GO's participation was to provide the wider research community on various reason(s) why experts at the institution think it is important for the city or state to redevelop

contaminated properties in their direct vicinity. Moreover, to discuss ways of initiating sustainable development practices that promotes the removal of eyesores, reduce public health risk, reduce environmental risk, diversify business mix, promote green space, and most importantly, to identify if GO is an identifiable stakeholder and a contributor to the sustainable city of Birmingham area-wide redevelopment agenda thus, promoting to a public/private partnership initiative.

On the other hand, AO was classified as an historically black college/university (HBCU) and provided strong support for the research study. Incidentally, the data from AO showed that communities like the Western side of Birmingham should be annexed into the brownfield redevelopment opportunities with ongoing partnership initiatives. AO's emerging theme to redeveloping brownfield sites is the accessibility of financial resources. The final category looked to the availability of funding as a constraint or a barrier to the redevelopment of brownfield sites.

Recommendations for Future Research

1. To investigate the effectiveness of state environmental policies to address

brownfield redevelopment projects in the state of Alabama.

2. To compare sustainable planning trends in urban designs across urban and suburban regions in the state of Alabama

3. To investigate successful economic and sociological indicators that are practical in nature and relevant to addressing disparities across low-income cities

4. To determine whether brownfield sites are regional areas of uncertainty or are they areas that are segregated by political design and neglect

5. To explore whether there is a progressive trend in the redevelopment of current brownfield sites and to identify if they are moving with aggressive strides

6. To annex the western region of the City of Birmingham into the Comprehensive Master Plan [30]

7. To address redevelopment strategies in the western region of the city that includes African Americans and other minority ethnic groups

8. To implement strategic goals in institutional plans that will increase and motivate colleges and universities to become actively involved in repairing the sociological, economic, and political frameworks in low-income communities

9. To investigate the difference in perceptions between local government and institutions of higher education in cities where brownfields are located. This recommendation is posed because it was determined that Gamma-One University may show a disinterest in redevelopment efforts. Although they are located in a community that is socially and economically deprived, a professor from this institution indicated that not only is he not motivated to participate in a brownfield redevelopment study but he is not aware of brownfield sites. For example, a professor from Gamma-One University communicated in a written text,

    "I have no motivation to complete a survey on a subject I have never heard of".

10. To design effective teaching strategies and student learning goals to address brownfield redevelopment across the academic curricula

11. To design an accountability plan for institutional and community-wide wellness

CONSENT

All authors declare that 'written informed consent was obtained from the subject(s) for publication of this article and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Fig. 4. Available: http://mygreenbirmingham.com/2014/03/20/5-ways-uab--is-creating-a-more-sustainable-campus/

Fig. 5. Available: https://*www.adem.stat.al.us*

Fig. 6. Available: https://blog.unmc.edu/intramural/2015/10/23/disc-golf-course-and-green-space-coming-to-campus/
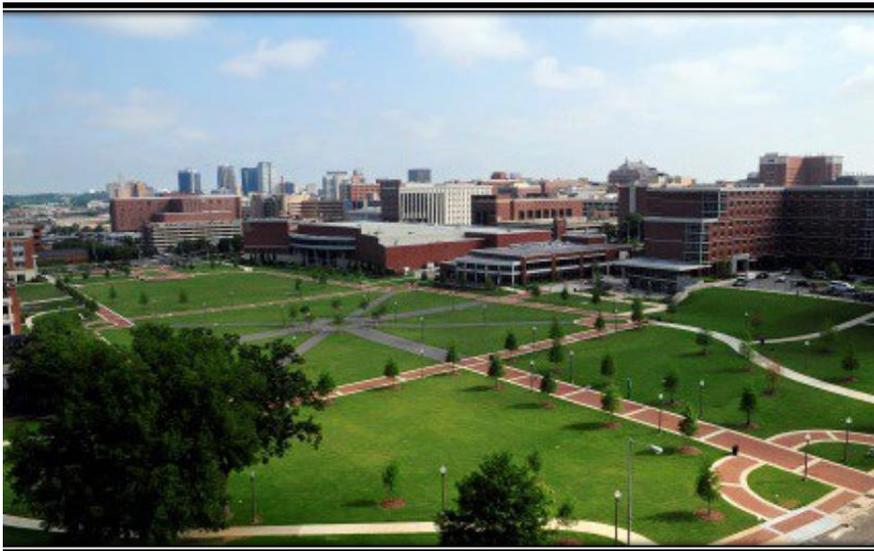
SURVEY INSTRUMENT

Q1 Check the region of the state in which your institution is located. (Counties were listed for each region)

- ○ Northern Region
- ○ West Central Region
- ○ East Central Region
- ○ South West Region
- ○ Southeast Region

Q2 Check the discipline which best describes your area of expertise. (Discipline were listed for each category)

- ○ Humanities
- ○ Natural Sciences
- ○ Social Sciences
- ○ Formal Sciences
- ○ Professions & Applied Sciences

Q3 How many years if professional working experiences do you have (including your current position and previous positions)?

- ○ Less than 3 years (1)
- ○ More than 3 years (2)
- ○ Less than 15 years (3)
- ○ More than 15 years (4)
- ○ More than 25 years (5)

Q4 Please characterize your general familiarity with brownfield sites in your local area (select your answer).

- ○ Completely unfamiliar (1)
- ○ Slightly unfamiliar (2)

❍   Moderately familiar (3)
❍   Familiar (4)
❍   Strongly Familiar (5)

Q5 You may have heard various reason why some people think it is important for communities across the state to redevelop contaminated properties. Please indicate your view of importance for each of the following reasons why contaminated properties should be redevelop in your local area, using a scale of 1 (not important) to 5 (very important).

Appendix Table 1. Questionnaire survey on important for communities

	Not important (1)	Slight important (2)	Moderately important (3)	Important (4)	Very important (5)
Remove eyesores (2)	❍	❍	❍	❍	❍
Create jobs (4)	❍	❍	❍	❍	❍
Reduce public health risk (5)	❍	❍	❍	❍	❍
Reduce environmental risk (6)	❍	❍	❍	❍	❍
Diversify business mix (8)	❍	❍	❍	❍	❍
Promote green space (9)	❍	❍	❍	❍	❍
Part of area-wide redevelopment agenda (10)	❍	❍	❍	❍	❍

Q6 The Alabama Department of Environmental Management (ADEM) is the principal state agency with the responsibility for overseeing cleanup at sites that are classified as a brownfield. The final questions relate to the ADEM's role. Since the mid-1990s, the approach that ADEM has taken on the redevelopment of brownfield sites has changed as legislation and regulations have evolved. Please indicate, to the best of your knowledge, the change in the behavior of ADEM with respect to contaminated properties in your local area over this time period. Select 1 for less agreement with the label on the left, 5 for most agreement with the label on the right, or 2, 3 or 4 for intermediate positions. In comparison to the mid-1990s, the behavior of Alabama Department of Environmental Management with respect to contaminated properties TODAY is:

Appendix Table 2. Questionnaire survey on agreement

	Less (1)	Rarely (2)	No Change (3)	Often (4)	More (5)
Trusting to private parties (1)	❍	❍	❍	❍	❍
Easy to work with (2)	❍	❍	❍	❍	❍
Fair (9)	❍	❍	❍	❍	❍
Thorough (12)	❍	❍	❍	❍	❍

Q7 Across the state, various factors may make it difficult for developers to redevelop brownfield sites. Please rate the level of constraint in your local area of each of the following items. Use the scale of 1 (not a constraint) to 5 (very important constraint).

Appendix Table 3. Questionnaire survey on important constrain

	Not a constraint (1)	Slight constraint (2)	Moderate constraint (3)	Important constraint (4)	Very important constraint (5)
Lack of cooperation from local government (1)	❍	❍	❍	❍	❍
Community opposition (2)	❍	❍	❍	❍	❍
Unfavorable lending terms (3)	❍	❍	❍	❍	❍
Possible U.S. EPA Involvement (4)	❍	❍	❍	❍	❍

Q8 The Alabama Department of Environmental Management may face a number of constraints to overseeing cleanups at sites in your local area that are contaminated. Please indicate the importance of each of the following possible constraints to the ability of the ADEM to oversee cleanups in an effective and timely fashion.

Appendix Table 4. Questionnaire survey on political background

	Not a constraint (1)	Slight constraint (2)	Moderate constraint (3)	Important constraint (4)	Very important constraint (5)
pressure from political leaders (4)	❍	❍	❍	❍	❍
lack of authority (5)	❍	❍	❍	❍	❍
lack of support from the general public (6)	❍	❍	❍	❍	❍
lack of inter-agency coordination (7)	❍	❍	❍	❍	❍

QUALITATIVE INSTRUMENT

1. Tell us about the Brownfield Grant Award Ceremony?
2. Are all of our brownfield sites within this geographical location contaminated?
3. How can your experiences relate to similar Brownfield sites like the ones presented?
4. Will STEM or STEAM students be able to participate in the training initiative?
5. How can you connect your institution to other college communities that were successful in converting brownfields to greenspaces for campus expansion?
6. How can you replicate ideas for your institution that are identical to other college communities that were successful converting brownfields to greenspaces for campus expansion?
7. Take a look at the multiple-choice illustrations. Tell me, what do you see and give reasons to support your choice.
a. Anyone want to comment on the first illustration?
8. What benefits would a redevelopment project like UAB's bring to your institution, if replicated?
9. What about the second illustration? Why?
10. What about the third illustration? Why do you think it is?
11. Why do you think a brownfield redevelopment project is important?
a. Why do you believe the level of reluctance exists in some communities to redevelop?

12. What would you recommend if financial assistance is provided for a brownfield conversion project?
13. What about the last illustration?
14. Do you believe there is a variation in experiences with redevelopment of brownfields between private and public institutions?
15. Has anyone ever seen a brownfield site converted to a greenspace?
16. What influences do professors possess that may change the negative perception of a brownfield sites and to aide in conversion efforts to a greenspace?
17. How do you think local institutions located near brownfield site(s) should look at a brownfield redevelopment project?
18. Do you believe research collaborations like the one you are participating in today can be beneficial for the college community?

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