ASSESSING THE LINK BETWEEN PUBLIC OPINION AND SOCIAL SUSTAINABILITY IN BUILDING AND INFRASTRUCTURE PROJECTS

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ABSTRACT

Increasing the use of social sustainability in the decision-making process for building and infrastructure projects requires that it be defined such that it can be evaluated objectively. One potential indicator of social sustainability in infrastructure projects is public opinion, which can provide a means to evaluate the level of social sustainability on a project based on personal values. Public opinion includes both support and opposition for a project. In this study, the causes or triggers for public opposition to a construction project are identified and then compared to principles of social sustainability to determine if they are related. Eight case study projects were used to identify common triggers of public opposition. The results suggest that common triggers of public opposition are related to land acquisition, escalating construction costs and the presence of endangered species on the project site. Eight of the twelve principles of social sustainability that were identified were determined to be related to public opposition. The results of this study suggest that public opposition could be used as a measure for some elements of social sustainability but that further research into other measures for social sustainability is necessary.

KEYWORDS:

social sustainability, public opinion, triggers of public opposition to building and infrastructure projects

INTRODUCTION

The topic of sustainability is often referred to in terms of environmental sustainability, economic sustainability, and social sustainability. Of these three pillars of sustainability, the first two – environmental and economic – receive the most attention.

The last pillar – social sustainability – is often neglected in decision making due to the difficulty in defining and evaluating this factor.

Economics often drive the decision making process for building and infrastructure projects – both for sustainable and conventional projects (Nieker and Voogd, 1999). When discussing

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economic sustainability, one is typically referring to the life-cycle cost of the project. A life-cycle cost analysis (LCCA) is often used for evaluating sustainable projects because it considers both the capital costs and the recurring operations and maintenance costs. The economic benefits of sustainable projects are generally achieved through lower operations and maintenance costs over the life of the project, which offset higher upfront capital costs associated with project design and construction (Fiksel 2003). LCCA can be considered an analytical method for evaluating economic sustainability, because it is based on analysis of project costs.

To evaluate the environmental sustainability of a project, experts rely on life cycle assessment (LCA) methods (Berardi 2012). LCA is an analytical approach for evaluating the environmental impacts associated with a product, including goal and scope definition, inventory analysis, impact assessment, and interpretation of results (SAIC 2006). Conducting an LCA can be time consuming and expensive due to the extensive data collection requirements; however, when done well, an LCA can provide valuable data on the environmental sustainability of a product to decision makers. Another approach for evaluating environmental sustainability is the use of multi-criteria systems, such as the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED). These systems evaluate the sustainability of a building project based on evaluation of criteria and assign points based on the extent to which the criteria are met. While these systems are simpler to apply than LCA, they are also limited in the extent that they address economic and social sustainability concerns.

The last pillar of sustainability – social sustainability – considers the fact that projects function not only as a physical environment, but also function to fulfill human needs and improve the human condition (Allen and Shonnard 2012). Increasing the use of social sustainability in the decision-making process requires that it be defined such that it can be evaluated objectively.

Industry and academia is already separating these three pillars in some respects, such as using LCA for environmental analysis and LCCA for economic analysis. While a holistic approach is valid for true sustainability, there is value in a more practical approach that provides measures for these three components individually.

2. BACKGROUND

2.1 Social Sustainability of Building and Infrastructure Projects

Social sustainability promotes social interaction and cultural enrichment, emphasizes well-being among all social classes, and respects diversity (Montoya 2011). Many decisions for sustainable development try to consider social aspects along with economic and environmental aspects. International organizations, like the United Nations, set goals for sustainable development on a global basis that include social factors such as poverty, access to sanitation or drinking water, government corruption, access to healthcare, and literacy (Allen and Shonnard 2012). While these are important social issues, they may not be the most appropriate factors for evaluating the sustainability of building and infrastructure projects in developed countries.

Hill and Bowen (1997) early on developed a list of seven principles of social sustainability specifically for construction projects (Table 1). These principles, and others like them, attempt to provide decision makers with a means to evaluate the level of social sustainability of an infrastructure project.

Table 1: Principles of Social Sustainability in Construction Projects. (Hill and Bowen 1997)

Principle	Description
Principle #1	Improve the quality of human life by ensuring secure and adequate consumption of basic needs.
Principle #2	Make provision for social self-determination and cultural diversity in development planning, and ensure that the operation of development (after the construction process is complete) is compatible with local human institutions and technology.
Principle #3	Protect and promote human health through a healthy and safe working environment. Plan and manage the construction process to reduce the risk of accidents, and carefully manage the use of substances, which are hazardous to human health.
Principle #4	Implement skills training and capacity enhancement of disadvantaged people to allow them to meaningfully participate in a project. Such training and participation should ensure that development of human resources is a lasting legacy of construction, in addition to the physical presence of facilities.
Principle #5	Seek fair or equitable distribution of the social costs of construction and, where this is not achieved, determine fair compensation for people adversely affected by construction operations.
Principle #6	Seek equitable distribution of the social benefits of construction, and where this is not achieved; determine fair compensation for people adversely affected by construction operations.
Principle #7	Seek intergenerational equity so that significant social, biophysical and financial costs of current construction are not passed on to future generations.

Subsequent research in the area (DETR 2000; Adetunji et al. 2003; Ashley, et al. 2003; Shen et al. 2005; Shen et al. 2007; Shen et al. 2010; Valdes-Vazques and Klotz2012) has also proposed guidelines to define social sustainability for building and infrastructure projects. Many of these studies use Hill and Bowen (1997) as the basis for developing criteria in order to define social sustainability. From these references, we have expanded the list of principles of social sustainability as presented in Table 2.

The use of social sustainability as a decision tool, however, is limited because there are no accepted means by which to measure it. Measurement is complicated by the fact that it is difficult to differentiate between the analytical, normative, and political aspects of social sustainability (Littig and Griessler 2005). In addition, different people may place a different level of priority on each of these three aspects (i.e., analytical, normative, and political).

Analytical approaches are often viewed as objective, since they rely on collection of data through observations or experiments and can be evaluated quantitatively. In terms of social sustainability, an analytical approach focusing on diversity may estimate the percent of people representing different ethnicities both before and after a project is completed. This data could then be used by decision makers to determine the social sustainability of a project. The limitation to analytical approaches is the quantity of data required for the analysis. Both economic and environmental sustainability rely on analytical approaches such as LCCA and LCA.

Table 2: Expanded Principles of Social Sustainability in Building and Infrastructure Projects(Hill and Bowen 1997).

Principle	Description/Further Explanations	Source
# 1	*Improve the quality of human life by ensuring secure and adequate consumption of basic needs;* • Adopt designs that increase the wellness and productivity of the end users;	Hill and Bowen (1997) Valdes-Vasquez and Klotz (2012)
# 2	*Provide social self-determination and cultural diversity in development planning, and ensure that the operation of development is compatible with local human institutions and technology;* • Determine the expectations of stakeholders early in the project; • Respond quickly to community concerns and perceptions; • Engage stakeholders (local government and end users) in design so that decision makers can understand and anticipate their needs; • Generate a stakeholder management plan that encourages interaction, integration and collaboration among stakeholders; • Establish partnering strategies for resolving interpersonal conflicts among project stakeholders; • Select a diverse design team including participants from various professions, genders, races, and firm sizes; • Use local designers, contractors, materials/suppliers for the project; • Analyze the impact of the project on the cultural, ethnic identity, population change, employment patterns, business practices and community infrastructure of the surrounding community; • Social inclusion, provide community amenities for the harmonization of new settlements and local communities;	Hill and Bowen (1997) Valdes- Vasquez and Klotz (2012) Adetunji et al., (2003) Ashley et al., (2003) Shen et al., (2007) Shen et al., (2010)
# 3	*Protect and promote human health through a healthy and safe working environment;* • Establish a plan to evaluate progress on Zero Harm or Accident targets for the project; • Include security considerations for the end users in the project design; • Establish requirements to assess the impact of the project on the health and safety of the final users; • Include health professionals in the design team to help analyze health impacts on the final users and the community; • Incorporate safety prevention techniques that prevent or minimize occupational hazards and	Hill and Bowen (1997) Valdes-Vasquez and Klotz (2012) Shen et al., (2005) Shen et al., (2007) Shen et al., (2010)

	risks during construction; ● Require education, training, counseling, prevention, and risk-control programs to assist workforce members, their families, or community members regarding serious diseases; ● Public safety strategy, provide warning boards and signal systems, safety measures and facilities for the public;	
# 4	*Implement skills training and capacity enhancement of disadvantaged people;* ● Design to consider the job skills of the women, young people, unemployed, disadvantaged, racial and ethnic minority groups in the area; ● Require a management plan for improving construction worker productivity;	Hill and Bowen (1997) Valdes-Vasquez and Klotz (2012)
# 5	*Seek fair or equitable distribution of social costs of construction;* ● Inform stakeholders of project constraints (e.g., budget, schedule, location, size, design and construction standards); ● Provide a plan to minimize disruption caused by the construction process (e.g. traffic congestion, dust and noise); ● Monitor and respond to incidents of corruption; ● Conduct a social impact assessment of the project, like the effect of the project on cultural, historical, and archeological resources;	Hill and Bowen (1997) Valdes-Vasquez and Klotz (2012)
# 6	*Seek equitable distribution of the social benefits of construction;* ● Incorporate social considerations (e.g. health, productivity, quality of life) into a return on investment analysis (ROI); ● Perform an asset-based design analysis of the surrounding community so that design solutions can convert social liabilities into assets; ● Create equal employment opportunities; ● Project implementation should be able to provide local employment opportunities, both direct and indirect; ● Benefits of improving living standard to local communities; ● Provide public service such as spaces and facilities beneficial to the development of local communities;	Hill and Bowen (1997) Valdes-Vasquez and Klotz (2012) Ashley et al., (2003) Shen et al., (2005) Shen et al., (2007) Shen et al., (2010)
# 7	*Seek intergenerational equity so that significant social, biophysical and financial costs of current construction are not passed on to future generations;* ● Train designers to help them address future hazards during the construction and maintenance phases of the project; ● Maintain and/or restore natural habitat important to the final users and the surrounding community;	Hill and Bowen (1997) Valdes-Vasquez and Klotz (2012)
# 8	*Select design and construction companies with a sustainability focus*	Valdes-Vasquez and

# 9	*Improve the image of construction*	DETR (2000)
# 10	*Respect to people – workforce and employee satisfaction*	Adetunji et al., (2003)
# 11	*Conservation of cultural and natural heritage* ● Land selection for project site should protect cropland and natural resources; ● Avoid negative impacts from project development on cultural heritage;	Shen et al., (2007) Shen et al., (2010)
# 12	*Infrastructure capacity-building* ● The project improves local infrastructure capacity, such as drainage, sewage, power, road and communication etc.	Shen et al., (2007) Shen et al., (2010)

Unlike economic and environmental sustainability, social sustainability is also influenced by normative and political aspects. Political influences are localized and difficult to predict due to continuous election cycles which can bring new political leaders to power and influence decisions based on potential votes. Normative influences on social sustainability are also important. Normative is a term used in philosophy and social sciences to reflect personal or shared values or norms. Normative statements are used to describe what is good/bad or right/wrong.

In terms of social sustainability, a normative statement might reflect the value a community places on a project, such as "we support a new community swimming pool because it will provide a place for children to play" or "we oppose a solar power plant because it will reduce open space." Normative influences reflect the values of a larger community and are less likely to change than political influences.

When evaluating the social sustainability of construction projects, analytical, normative, and political aspects should all be considered. However, the strength of a normative approach to evaluating social sustainability is that it can provide data for decision making early in the project development phase. Unlike an analytical approach, a normative approach would require less time and effort for data collection and analysis. And unlike a political approach, a normative approach is less likely to change as frequently as elections occur. The focus of this work, therefore, is in developing a normative approach to evaluating social sustainability.

2.2 Public Opinion in Building and Infrastructure Projects

Public opinion is a source that represents the normative influences of a community. The response of the public to an infrastructure project might be linked to the specific characteristics of the project, to current political issues or to the perceived environmental, safety, or health risk of the project. For instance, a construction project might experience public opposition due to its location or environmental impacts. On the other hand, the same project might have public support if it will provide well-paying jobs for local residents. Projects experiencing opposition typically undergo negotiation and even litigation processes that seek to increase the project support from the public. Public hearings are commonly used to inform the public and to get feedback from them.

The state of knowledge on forecasting and managing public opinion of construction projects is limited. In a study on public opposition to water projects, Hurlimann and Dolnicar (2009) developed a statistical model with data gathered from a survey deployed in Manson Lake in Australia, a community opposed to a water infrastructure project. The study found that trust in the water authority, the perceived risk, and public communication plans were

important factors for public opposition/acceptance. Kotler and Hillman (2000) found that trust in Japan's nuclear energy policy might be related to public opinion with regard to supporting nuclear projects.

A project or activity can be considered socially unsustainable if the social structures and/or behavior that are required to support it, either do not exist, or break down as a result of the project or activity (CFMS 2012). One potential indicator of social sustainability is public opinion, which can provide a means to evaluate the level of social sustainability on a construction project based on the level of support (or opposition). The word "sustainability" is not interchangeable with the word "supportable", but the level of public support in a project, might be a surrogate measure for social sustainability.

Public opinion issues in a construction project involve social groups endorsing, disapproving (i.e., proactive public opposition), or being neutral about a project. Consequently, in the case that public opposition is generated, the project might be presenting signs of being socially unsustainable. Conversely, strong public support for a project might indicate that the project has a high level of social sustainability.

Identifying a link between social sustainability and public opinion would allow one to measure the level of social sustainability in a project. This research begins the process by focusing specifically on one aspect of public opinion – public opposition. The objective of the research is to identify whether there is a link between the issues surrounding public opposition on a project and the principles of social sustainability identified in Table 2. If these two items are shown to be related, then public opposition could be used by decision makers as a surrogate for social sustainability. The advantage of this type of measure of social sustainability is that it could be used as an early indicator of sustainability for building and infrastructure projects. If potential issues are identified early, decision makers could use this information as a way to positively influence the sustainability of a project before significant expenditures have been made on design and construction. It should be noted, however, that this approach is focused solely on an early identification of potential social sustainability issues. A comprehensive analysis of project sustainability would also need to include further analysis of economic, environmental, and social sustainability issues and is reserved for future research.

3. RESEARCH APPROACH

The focus of this research is to evaluate whether there is a link or correlation between public opposition to a building or infrastructure project and the principles of social sustainability for these types of projects. If such a relationship exists, it could provide decision makers with a metric for assessing social sustainability based on the normative values of the surrounding community. The approach adopted for this research is to review the public opinion record for several building and infrastructure projects and compare these to the principles of social sustainability identified through the literature.

3.1 Identification of Case Study Projects

The public opinion records for eight case study projects listed in Table 3 were evaluated as part of this research. The cases were selected based on the amount of information publicly available for the building or infrastructure project and also to ensure that different types of projects were represented in the case study pool. Even though the entire project lifecycle is important for green building, this study is focused on the planning and construction phases of projects

Table 3: Description of Case Study Projects.

ID	Description	Location	Type of Project	Project completion date (or status)
A	Central Artery/Tunnel Project	Boston, MA, USA	Transportation	2007
B	Hoover Dam	Boulder City, NV, USA	Water	1935
C	Seabrook Station Nuclear Power Plant	Seabrook, NH, USA	Power	One reactor completed in 1990 Second Reactor cancelled in 1988
D	Oregon State Hospital	Junction City, OR, USA	Healthcare	Planning stages
E	Alaska Gas Pipeline	From Alaska to Calgary, Alberta, USA	Gas	Planning stages
F	Keystone Pipeline	From Hardisty, Alberta, Canada to Patoka, IL, USA	Petroleum products	Planning stages
G	Yucca Mountain Nuclear Waste Repository	Yucca Mountain, NV	Nuclear waste repository	Never completed
H	California Delta	Sacramento, CA, USA	Water	Planning stages

because those are the phases where design changes can be made to improve the sustainability of a project. This research focuses on early indicators of social sustainability in the hopes that improvements can still be made. Both building and infrastructure projects are included in order to demonstrate the generalization of this research.

The history of public opinion for a construction project is typically documented through public documents such as newspapers, online documentation covering a project's history, and legal documents resulting from litigation processes which suggest the use of a research method that allows for the analysis of textual databases. In this study, the triggers for public opposition are identified through analysis of the content of available literature.

3.2 Evaluation of the Relationship between Social Sustainability and Public Opinion

Matrix analysis and grounded theory are used to evaluate the relationship between the public opinion records for the case study projects and the principles of social sustainability. When using grounded theory, it is assumed that variables interact in complex ways. The basic idea of the grounded theory approach is to read multiple times the available textual database and label variables (called categories, concepts and properties) (Borgatti 2006). The number of categories used in this study is twelve, and the categories correspond to the principles of social sustainability as defined in Table 2. The triggers for opposition for each case study are evaluated with normative statements.

The evaluation considered whether or not a specific trigger of public opposition could be related to or caused by a deficiency in a given principle of social sustainability. In addition,

a reverse evaluation was performed to determine whether the triggers for public opposition would have occurred if a given principle of social sustainability was fulfilled for the specific case study project.

4. RESULTS AND DISCUSSION

4.1 Triggers for Public Opposition for Case Study Projects

Causes for public opposition to a project were identified through a review of the content of literature and a project's publicly available record. The source documents included web pages of environmental groups, newspaper articles and encyclopedias. Additional data sources might include the documentation of litigation processes, interview with project teams and stakeholders and public hearing documentation. Once the triggers were identified, they were grouped into common themes. These themes represent the most commonly-identified concerns for the case study projects. The public opposition themes are (1) safety impact, (2) economic impact, (3) disruption impact, (4) environmental impact, (5) location impact, and (6) public involvement impact. Safety impacts include concerns that development of the project might adversely affect the safety of workers or the surrounding community. Economic impacts include the potential that the project might raise taxes, consumer prices, or job creation. A disruption impact might be a concern that development of the project would negatively affect the current condition or performance of services such as utility lines or roadways. Environmental impacts concern the potential that the developed project will increase pollution in the area or adversely affect endangered species. Location impacts concern issues such issues related to land acquisition or project location. Public involvement impacts generally relate to a perceived lack of public involvement on the project. Table 4 shows the triggers of public opposition that were identified for the different case study projects. The items listed in this table are presented in terms of their impact on social sustainability. While they may seem to cross over to economic (e.g. tax impacts) the evaluation considers more the social impact of taxes on the population as opposed to the tax impact on the project's economic viability.

One of the most common triggers for public opposition was the issue of land acquisition, which was present for five out of the eight case studies. Many times, landowners are asked to sell their properties to make development possible. Endangered species and escalating costs were triggers present in four of the infrastructure case studies. It is important to mention that the triggers listed in Table 4 are specific to the case study projects listed in Table 3. Future research that considers multiple building and infrastructure projects of the same type is needed to develop a more comprehensive list of triggers applicable to specific project types.

4.2 Relationship between Public Opposition and Social Sustainability

After identifying the triggers of public opposition for each of the case study projects, each one of the triggers was evaluated in terms of the social sustainability principles in Table 2. The evaluation included whether or not a specific trigger of public opposition could be related to or caused by a deficiency in a given principle of social sustainability. The results are summarized in Table 5, which shows how the triggers of public opposition were seen to be related to the principles of sustainability.

Table 4: Triggers of Opposition Identified for the Case Study Projects.

		Case Study							
	Triggers for Public Opposition	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
1	**Safety Impact**								
1.1	Safety Issues			x		x	x	x	
1.2	Hazardous vehicles roaming at local streets	X						x	
2	**Economic Impact**								
2.1	Possible Tax raise			x	x				
2.2	Escalating cost	x		x	x	x		x	
2.3	Gas Supply and prices					x			
2.4	Economic interest issue		x						
2.5	Job creation					x			
3	**Disruption Impact**								
3.1	Existing utility lines disruption	x							
3.2	Disruption to existing facilities								x
3.3	Traffic restriction	x							x
4	**Environmental Impact**								
4.1	Pollution issue			x		x	x		
4.2	Water quality	x						x	x
4.3	Release of toxins by excavation	x						x	
4.4	Endangered species		x	x			x	x	x
4.5	Climate change issue								x
4.6	Flood control								x
5	**Location Impact**								
5.1	Project route/location					x			
5.2	Land acquisition	x		x		x	x	x	x
5.3	Historic heritage preservation				x		x	x	
5.4	Geological aspect							x	
6	**Public Involvement Impact**								
6.1	Public involvement	x		x		x			

If one of the triggers of public opposition were present in more than one case study project, the evaluation results were compared across projects to ensure that a consistent process was used to evaluate the relationship between public opposition and the principles of social sustainability.

As shown in Table 5, the triggers of public opposition identified in the case study projects aligned more closely to some of the principles of social sustainability than to others. Four of the principles of social sustainability were generally related across multiple themes of public opposition. These four include

- Improve the quality of human life by ensuring secure and adequate consumption of basic needs (Principle 1)
- Seek fair or equitable distribution of social costs of construction (Principle 5)
- Seek intergenerational equity so that significant social, biophysical and financial costs of current construction are not passed on to future generations (Principle 7)
- Improve the image of construction (Principle 9)

Table 5: Relationship between Public Opposition and Social Sustainability.

		Principle of Social Sustainability											
	Triggers for Public Opposition	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	**Safety Impact**												
1.1	Safety Issues	x		x									
1.2	Hazardous vehicles roaming at local streets	x		x		x		x					
2	**Economic Impact**												
2.1	Possible Tax raise					x		x					
2.2	Escalating cost					x		x		x			
2.3	Gas Supply and prices	x						x					
2.4	Economic interest issue	x				x		x					
2.5	Job creation	x				x				x			
3	**Disruption Impact**												
3.1	Existing utility lines disruption	x				x				x			x
3.2	Disruption to existing facilities	x				x				x			x
3.3	Traffic restriction	x				x							x
4	**Environmental Impact**												
4.1	Pollution issue	x				x		x					
4.2	Water quality	x				x		x		x			
4.3	Release of toxins by excavation	x		x		x		x		x			
4.4	Endangered species					x		x		x		x	
4.5	Climate change issue							x					
4.6	Flood control	x				x							
5	**Location Impact**												
5.1	Project route/location					x							
5.2	Land acquisition					x		x				x	
5.3	Historic heritage preservation					x		x				x	
5.4	Geological aspect					x							
6	**Public Involvement Impact**												
6.1	Lack of public involvement		x			x							

Other principles of social sustainability were related specifically to one of the themes of public opposition. Principle 2 (Provide social self-determination and cultural diversity in development planning, and ensure that the operation of development is compatible with local human institutions and technology) is closely linked to public opposition related to the lack of public involvement. Principle 3 (Protect and promote human health through a healthy and safe working environment) is closely linked to public concerns regarding safety. Principle 11 (Conservation of cultural and natural heritage) is closely linked to public concerns regarding damage to cultural sites. Lastly, principle 12 (Infrastructure capacity building) is closely linked to public concerns over disruption.

The remaining four principles of social sustainability were not found to be linked to public opposition. These principles cover aspects of social sustainability where people are less likely to generate public opposition. For example, principle 6 (Seek equitable distribution of the social benefits of construction) specifically relates to the benefits of a project which is more likely to result in public support rather than public opposition to a project.

4.3 Limitations of the Study

The results of the study indicate that public opposition could be related to some aspects of social sustainability, but not to all aspects. Therefore, public opposition cannot be used as the sole determinant of social sustainability, but rather, it should be a component of a larger system to measure social sustainability. The work here does not evaluate on what that larger system should be, but it might include other normative measures (e.g., public support for a project) or analytical measures (e.g., estimates of the social benefits produced by a project).

The results of this study are also limited with regards to the number of case study projects that were evaluated and was focused on the planning and the construction phases of the project. Future research in this area should validate the results by considering additional case studies and could employ the use of focus groups that would evaluate the triggers of opposition on different building and infrastructure projects. Other project-life cycle phases could be considered such as operation and decommissioning.

Although a rating system could be developed to quantify the fulfillment of the principles of social sustainability for comparing projects, project characteristics, such as type of project and project performance considering opposition could also be incorporated into the analysis. In addition, in this study public opposition is evaluated exclusively and independently from other factors that might also be correlated to social sustainability in building and infrastructure projects. Future research might consider expanding the proposed framework as other factors could be affecting social sustainability and might provide a holistic picture for measuring social sustainability. These factors could include: income level, proximity to project, gender, timeframes, project type, project characteristics, among others. Further, the amount of public opposition to a project might be affected by issues other than social sustainability, such as politics, controversial figures, and media related issues, and this should be explored further. Currently, there are few indicators or measures of overall social sustainability. In light of this vacuum, public opposition was evaluated as a potential measure of overall social sustainability. Further research may expand this approach to include other indicators or measures of overall social sustainability.

Lastly, this evaluation does not consider the impact of interventions such as early public engagement. The purpose of this study was to determine if there was a link or correlation

between public opposition and social sustainability. Even though they are both social and the former is a reaction to a violation of the latter, this study includes economic and environmental-themed oppositions and their effect in social sustainability. A natural follow-on to this work would be to compare cases where interventions were performed and to compare the public record of opposition to those cases where no interventions were performed. Further research investigating evidence of the principles' validity is also needed, including studying the effect of violating these principles and exploring their level of criticality.

5. CONCLUSIONS

This study investigated the correlation between social sustainability and public opinion (expressed by public opposition) for building and infrastructure projects. Triggers of public opposition were identified through public information and newspapers, and categorized for eight case study projects. These triggers were compared with the principles of social sustainability identified in the literature. The resulting data indicate that many, but not all of the principles of social sustainability are related to common public opposition triggers.

The results of this study could be used to develop a metric to measure certain aspects of social sustainability based on the public opposition generated for a project. The advantage of this approach is that public opposition generally manifests itself early in the development of a project, such that decision makers could use this information to modify project parameters to improve the social sustainability of the project. Even though, public opposition is not the only measure of social sustainability and may occur during any phase of the project's life cycle, it could be an "early" indicator which can be applied during the planning and construction phases when changes can still be made to a project to improve sustainability. For instance, public hearings can be designed to address specific concerns of the public related to social sustainability. Also, if the link between public opposition and social sustainability confirmed, as well as the correlation between project characteristics and public opposition, then project characteristics can be adjusted to increase the social sustainability of the project.

The limitation of this approach for evaluating social sustainability is that public opposition is most closely related to eight of the 12 identified principles of social sustainability. This means that using public opposition as a measure of social sustainability would only provide a partial picture. Other measures would be necessary to form a complete picture of the social sustainability of a project. These measures might include public support for a project or a variety of analytical metrics.

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