

METHODOLOGY TO RAISE AWARENESS OF SUSTAINABLE PRACTICES IN PUBLIC PROCUREMENT OF CONSTRUCTION

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Abstract

Public procurement has the potential to influence the market in terms of sustainability. For this reason, public procurement in the construction industry is increasingly taking into account social and environmental criteria for awarding infrastructure projects. Universities should raise awareness among students promoting activities that foster sustainability. Therefore, this article proposes a methodology to study sustainable practices in public works procurement. Students assume a public role in order to select the key criteria to be included in the tender procedure. The aim of this research is to boost the awareness of students about the importance of the tender stage to achieve high levels of sustainability through the selection of the construction companies. Students choose the most important environmental and social criteria for a highway project. Besides, they propose an indicator and a metric for each criterion. This activity has been applied to graduate students of the Master of Planning and Management in Civil Engineer at the Universitat Politècnica de València. Students belong to more than 10 different countries of Europe and Central and South America. This active-learning method encourages future professionals to carry out sustainable practices in construction. In addition, this multicultural approach invites to share different points of view and sustainable practices from different countries.

Keywords: Learning methodology, sustainable practices, multicultural approach, public procurement.

1 INTRODUCTION

According to a study carried out by the Centre for European Policy Studies [1], the construction sector has a very low acceptance of sustainable public procurement. This aspect is critical considering that this sector consumes 40% of the energy of our country, generates approximately 40% of the waste, and implies a huge volume of recruitment (580 billion euros in infrastructure during the period 1995/2012). According to the World Economic Forum [2], during the last decades, thousands of trillions of euros have been invested, worldwide, in the construction of infrastructures, assuming approximately 1.4% of the GDP World. The construction employs approximately half of the resources that man consumes of nature and it is considered that 25% of the waste comes from construction and demolition [3] and more than 70% of the world's energy moves around this sector, which makes it one of the most influential sectors in climate change.

On the other hand, construction is the sector that employs more people, exceeding the 70% worldwide [4]. Numerous studies show that construction sector is the basis for regional and national economic development [5], being responsible for maintaining stable economic growth, employment and promoting social progress [6]. For all this, authors such as Myers [7] and Bratt et al. [8] emphasized that the construction sector is one of the main sectors in which sustainability is firmly established. In addition, Brown et al. [9] stated that public procurement is the determinant agent for promoting the integration of sustainable initiatives and transparency in the construction sector.

That is why both research [10-12] and academic areas [13] are increasingly focusing their efforts to include sustainable criteria. Universities, as education centers of future professionals, should raise awareness among students promoting activities that foster sustainability. To this end, innovative methodologies have been proposed allowing students to acquire competences in construction management [14, 15]. Active-learning methods can also be used to foster critical thinking regarding sustainable practices in construction [13, 16].

Therefore, this communication presents a methodology to study sustainable practices in public procurement with the objective that students of the Master of Planning and Management in Civil Engineer at the Universitat Politècnica de València increase their awareness about the importance of the tender stage to achieve high levels of sustainability in construction works.

2 OVERVIEW OF THE ACTIVITY

The activity proposed corresponds to a simulation of a tender procedure for the construction project of a highway that connects the neighborhoods of northern Zone and viaduct of Alcoy (see Fig. 1). The objective of this activity is that students assume a public role in order to select the environmental and social criteria to be included in the tender procedure. Besides, they must propose an indicator and a metric for each criterion. The final tender procedure must meet the criteria to achieve a sustainable construction of the highway. This activity also allows evaluating some competences regarding project management. Such activity has been applied to graduate students of the Master of Planning and Management in Civil Engineer at the Universitat Politècnica de València.



Figure 1. Construction project of a highway located in Alcoy

Firstly, the professor explains the construction project and the objective of the activity. Then, the professor provides several social and environmental criteria (see Table 1 and Table 2), as well as their definition to avoid possible confusion. Then, students must select the three most important social and environmental criteria according to their point of view and propose an indicator and a metric associated with each selected criteria.

Table 1. List of social criteria

Cultural Heritage	The "Cultural Heritage" criterion focuses on all those actions that favor the protection of Cultural Heritage ⁽¹⁾ in the area where the project will be developed.
Employment	The "employment" criterion considers aspects related to the creation of new jobs, the recruitment of vulnerable personnel ⁽²⁾ or under conditions of social exclusion ⁽³⁾ , the promotion of stable jobs in enterprises, the collaboration with other companies in the sector, etc.
Safety and Health	"Safety and Health" criterion is aimed at implementing measures and developing the activities necessary for the prevention of work-related risks to guarantee the safety of both the workers and the population that can be involved in the development of the project.
Training	The "Training" criterion includes those actions aimed at increasing the level of knowledge in technical and/or sustainability-related issues (environmental, social and economic impact of the actions).
Impact on Users	The "Impact on Users" criterion aims to minimize the possible inconvenience that the population may experience due to the development of the project (mobility, services, etc.)

Local Participation	The "Local Participation" criterion seeks to give preference to local entities for the development of the project and/or promote entrepreneurial initiatives that favor local development through collaborations with local entities or local personnel during the development of the project.
Public Participation	The "Public participation" criterion includes those actions aimed at integrating the opinion of the population in the decision making of the project.
Professional Ethics	The "Professional Ethics" criterion refers to the set of policies or actions aimed at improving the development of professional activities through the implementation of anti-corruption policies, gender equality, practices of non-discrimination in hiring processes, fair working conditions, etc.

(1) According to UNESCO, "Cultural Heritage" considered:

-Monuments: architectural works, monumental sculptures or paintings, archaeological elements or structures, inscriptions, caverns and groups of elements, which have an exceptional universal value from the point of view of history, art or science

-Groups: groups of constructions, isolated or assembled, whose architecture, unity and integration in the landscape give them an exceptional universal value from the point of view of history, art or science

-The places: man's works and a mixture of man and nature, including archaeological sites that have an exceptional universal value from the historical, aesthetic, ethnological or anthropological point of view.

(2) Vulnerable personnel: young people newly incorporated into employment, disabled people, unemployment people, etc.

(3) Social exclusion conditions: young people over eighteen years and under thirty from Child Protection Institutions, people with drug problems or other addictive disorders that are in the process of rehabilitation or social reintegration, penitentiaries, etc.

Table 2. List of environmental criteria

Energy	The "Energy" criterion encompasses all those actions that favor the responsible consumption of energy promoting its control and optimizing its use.
Emissions	The "Emissions" criterion includes aspects related to the development of actions that promotes the control and minimization of pollutant emissions and particles (CO ₂ , polluting gases, dust, odors, etc.).
Waste	The "Waste" criterion refers to the minimization of the waste and the proper management.
Water	The "Water" criterion includes actions aimed at ensuring the protection of the hydrological system and the quality of water.
Flora and Fauna	The "Flora and Fauna" criterion refers to the actions aimed at protecting the vegetation and faunal species from the actions carried out and minimizing the impact due to the development of the project.
Management	The "Management" criterion focuses on the implementation of environmental management and monitoring systems and/or the implementation of sustainability certificates that allow the control of the project's performance
Materials	The criterion "Materials" refers to the minimization of the consumption of raw materials, increase in the use of recycled materials, as well as the use of materials with environmental label.
Landscape	The "Landscape" criterion refers to the integration in the natural surroundings and the minimization of the impact due to the development of the project
Noise and Vibration	The "Noise and Vibration" criterion refers to the control and minimization of the noise and vibrations that the project actions can generate to the environment.

3 ANALYSIS OF RESULTS

This section presents a discussion and analysis of the results obtained. The 39 students are between the ages of 22 and 35. According to Fig. 2, 79.5% of the students age between 22 and 27, years old. Nearly all of the students are graduated in Civil Engineering and most of them have less than three years of experience. Particularly, 59% of the students have less than three years of experience, 26% have between three and six years, 13% have between six and eight and only 2% have nine and more years of experience. Students belong to 13 different countries of Europe and Central and South America (see Fig. 3). Although the Master degree takes place in Spain, the highest percentage of students is from Ecuador (11 students), followed by Spain, France and Peru with five students.

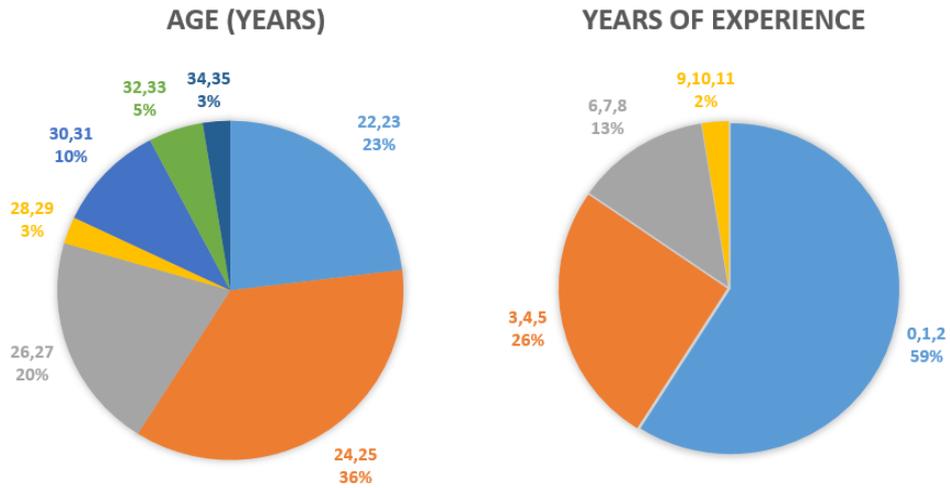


Figure 2. Age of students and experience of students in construction.

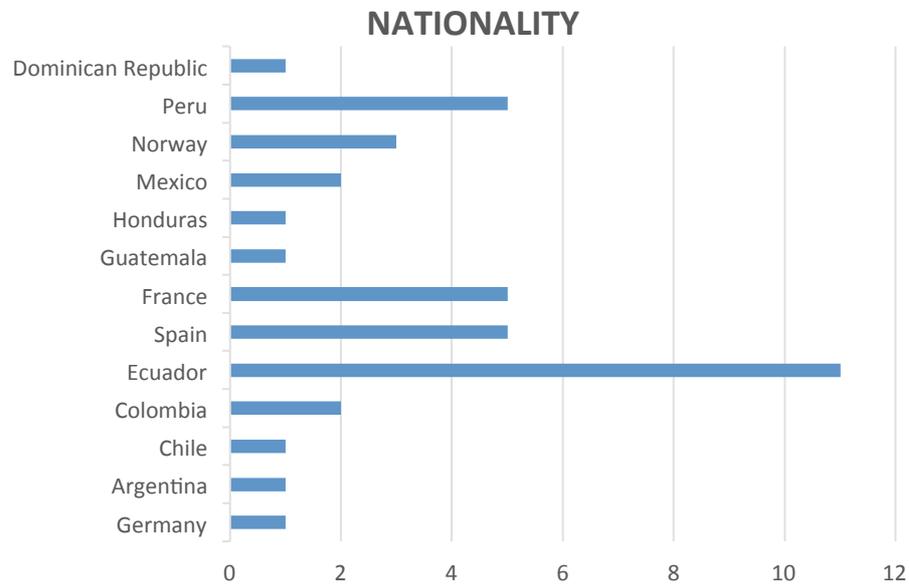


Figure 3. Nationality of students

The results of the survey show the most important criteria considered by the students for the highway case study. The highest percentage corresponds to “Employment” criteria. Fig. 4 shows that 70.27% of the students considered that “Employment” is one of the most important criteria. “Local Participation” and “Safety and Health” are also valued with a percentage of 54.04% and 45.95%, respectively. Fig. 5 depicts the results of the environmental criteria. In this case, “Water” and “Waste” are considered by 56.76% and 51.35% of the students. Besides, “Materials”, “Energy” and “Flora and Fauna” are also considered by more than 35% of the students.

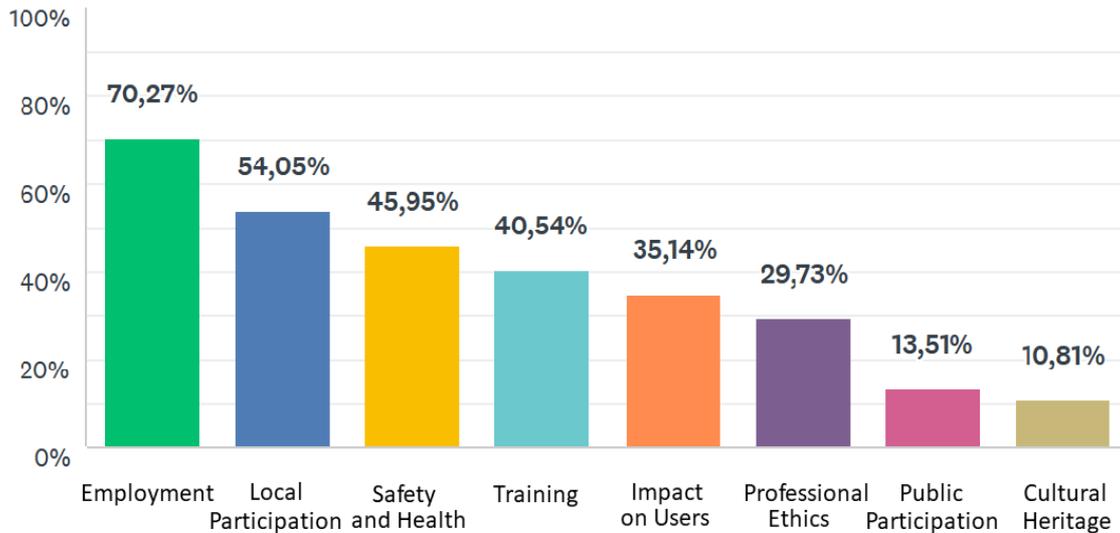


Figure 4. Results of social criteria

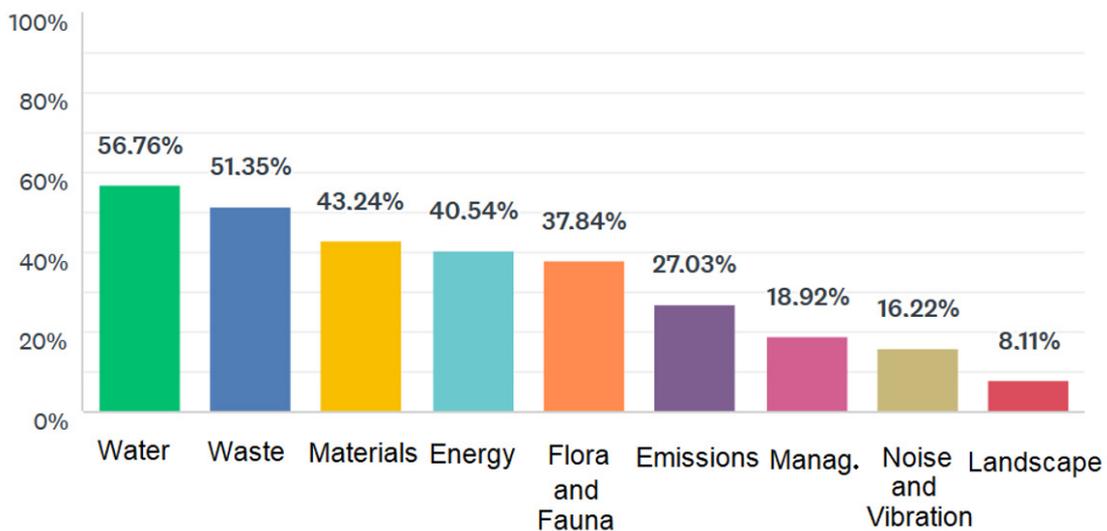


Figure 5. Results of environmental criteria

Additionally, this study shows the most popular indicators and metrics associated with each criterion (see Fig. 6). Three indicators are selected for “Employment” criterion: the number of new contracts, the percentage of people with disabilities and the percentage of workers with an age under 30 years. “Safety and Health” is generally evaluated as the percentage of budget allocated to protection measures related to health and safety. The most popular indicators of “Local Participation” are the percentage of local contracted companies during the execution of the project and the percentage of local workers. The students propose that “Public Participation” can be evaluated as the commitment to conduct talks and meetings to approach the project to the population, “Professional Ethics” as the commitment to minimize corruption and meet equality policies and “Cultural Heritage” as the commitment to protect cultural heritage to verify that the work does not affect a protected area. Regarding “Impact on Users”, students consider that the indicator can be the alternatives presented to decrease the impact on users and the metric the percentage of impact reduction. “Training” criterion is generally evaluated as the budget allocated to training.

Employment	New contracts (n) Percentage of people with disabilities (%) Percentage of workers with an age of less than 30 years (%)
Safety and Health	Percentage of budget allocated to protection measures related to safety and health (%)
Local Participation	Percentage of local contracted companies during the project (%) Percentage of local workers (%)
Public Participation	Commitment to conduct talks and meetings to approach the project to the population (yes/no)
Impact on Users	Presentation of alternatives to decrease the impact on users (% reduction)
Professional Ethics	Commitment to minimize corruption and meet equality policies (yes/no)
Cultural Heritage	Commitment to protect cultural heritage to verify that the work does not affect a protected area (yes/no)
Training	Budget allocated to training (€)

Figure 6. Indicators and metrics for social criteria

Fig. 7 summarizes the most popular indicators and metrics for the environmental criteria. Students considered that the most convenient indicators to evaluate the “Energy”, “Emissions” and “Noise and Vibrations” criteria are the proposals for their reduction, quantified as the percentage of reduction. “Waste” reduction can be measured as the percentage of waste reused and “water” criterion as the maximum level of the hydrological pollution control system. In addition, the percentage of assigned budget to plans for the management and protection of vegetation and animal species is assigned to “Flora and Fauna” criterion and the percentage of assigned budget to plans for environmental management and monitoring system is taken to “Management” criterion. Finally, “Materials” is associated with the percentage of resources from recycled materials and “Landscape” is related to the area affected by construction works.

Energy	Proposals for the reduction of energy consumption (% reduction)
Emissions	Proposals for the reduction of emissions (% reduction)
Waste	Waste reduction (% waste reused)
Water	Hydrological pollution control system (maximum level)
Flora and Fauna	Plan for the management and protection of vegetation and animal species (% assigned budget)
Management	Plan of environmental management and monitoring system (% assigned budget)
Materials	Percentage of resources from recycled materials (%)
Landscape	Area affected by construction works (m ²)
Noise and Vibration	Proposals for the reduction of noise and vibration (% reduction)

Figure 7. Indicators and metrics for environmental criteria

Another interesting aspect is the opinion of the studentship regarding the usefulness of the activity to reflect on sustainable practices in tender procedures. Students answered on a Likert scale 1 to 5 according to the level of agreement. Results show an average agreement of 3.83, meaning certain level of positive agreement. Indeed, the most frequent answer is the agreement on the usefulness of the activity. Fig. 8 shows a histogram of the responses distribution.

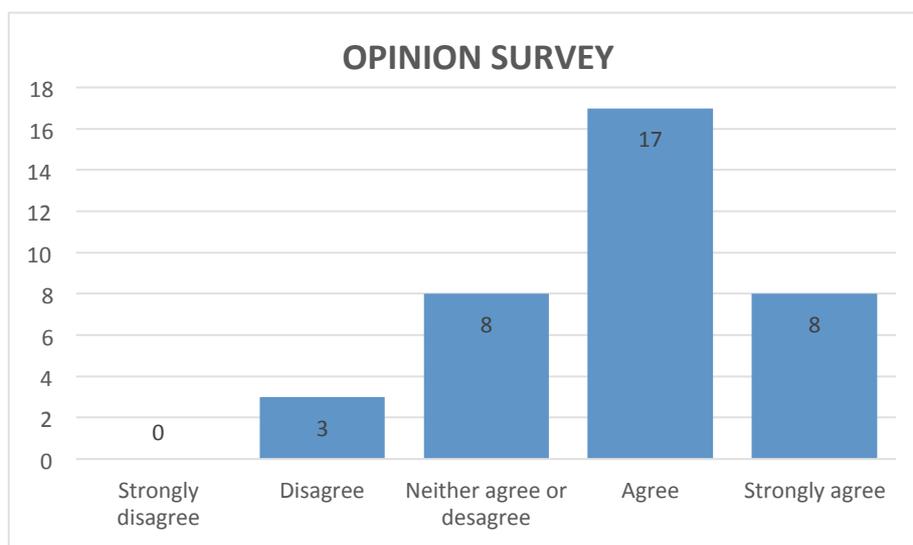


Figure 8. Histogram of the students' responses for the usefulness of the activity

4 CONCLUSIONS

This communication presents a methodology for the development and assessment of the social and environmental criteria for awarding infrastructure projects, based on a group work activity. Students must select for a highway case study, the most important criteria to be considered in a tender procedure. Besides, they must propose an indicator and a metric to evaluate each selected criteria. This activity is applied to graduate students from 13 countries that study the Master of Planning and Management in Civil Engineer at the Universitat Politècnica de València. Results show that there are some criteria, like “Employment” and “Local Participation” for the social sustainability and “Water” and “Waste” for the environmental sustainability, that are selected by more than 50% of the students. Besides, this study selects the most popular indicators suggested by the students. An important outcome of this study is that an opinion survey reveals that most of the students agree that the activity proposed is useful to reflect on sustainable practices in tender procedures. This is of interest to conciliate the teaching method, the student’s satisfaction, and the objective of promoting sustainable practices in construction sector.

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