

# How to Calculate and Integrate a Cumulative Social Impact Index in Engineering Projects for more Sustainable Outcomes

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## ABSTRACT

The decision-making process concerning with designing and implementing a planned intervention or project relies often times on economic and technical arguments, expressed as data, indicators, models. This paper argues that projects could benefit out of taking into consideration, aside from this economic and technical dimensions, also aspects regarding the social impact of that respective intervention or project. For the past over 40 years, with applicability especially in engineering domains, Social Impact Assessment (SIA) has been developing tools, methodology, and distinctions to support this idea. SIA implies identifying and managing social impacts generated by planned interventions.

This paper is aiming to propose a model that allows integrating all positive and negative social impacts into a single cumulative social impact index. In order to do this, the process requires identifying the social impacts expressed as variables. The challenge in the attempt to use social data is the fact that these variables, which describe the main dimensions of the social context and/or express social processes of change (for example), differ in nature. There could be qualitative or quantitative data, variable with different measurement units and different weights. The model proposes ways to solve these and other challenges, resulting in a general methodology that (following provided guiding principles) could be used by any planned intervention that has a social impact. In addition to this, the model implies the use of participative tools, involving stakeholders into this process.

While the process of obtaining all the data integrated into this index is complex, the outcome is a dichotomous variable that is easy to read. Taking into considerations social impacts contributes to increasing the project's sustainability and reducing possible risks that could emerge if these aspects are disregarded.

## INTRODUCTION

This paper presents a conceptual model designed to facilitate integrating social impacts within the decision making processes of planned interventions or projects<sup>[1]</sup>. The decisions processes we make reference to could be concerned with the development, designing, features, implementing, and resources allocation for any planned intervention, project and public policy. This model was proposed as part of the doctoral research undertaken by the author<sup>[2-9]</sup>.

The vast majority of projects that make use of Social Impact Assessment (SIA) methodologies are projects that produce a change within the physical environment and as a result propose a different use of the natural resources in that area or

are affecting the traditional use of natural resources and our environment, such as: inhabitation, agriculture, culture, traditions, spirituality, etc.).

SIA is defined as “the process of analysing (predicting, evaluating and reflecting) and managing the intended and unintended consequences on the human environment of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions so as to bring about a more sustainable and equitable biophysical and human environment” [10-17]. SIA has been used in projects concerned with: mining exploitations, building roads, bridges, dams, etc. In the same time, the theoretical distinctions regarding SIA do not limit the applications of these tools and methodologies only to the above-mentioned domains. One could infer that there could be other domains that could benefit from SIA. As a result, the proposed model that integrates social impacts identified and measured as proposed by SIA can be used in a wide range of domains, planned interventions, projects, public policies, etc.

The model proposes to design social impact assessment indicators, as proposed by the social impact assessment approach, but furthermore, the novelty proposed by this model is to integrate all these data about social impacts into a cumulative index. The aim of this being to make it easier to take into consideration the social impact of planned interventions and project for more sustainable outcomes and reducing the risks that could be otherwise generated by not considering social impacts. Besides aiming to identify and consider all relevant social impacts, the model implies a consultative process with stakeholders in a manner that brings them closer to the decision making process. This will include stakeholders in the way social impacts are considered and evaluated.

The proposed methodology for considering the social impact in a cumulative way, by calculating a cumulative social impact index, implies the followings:

- Identify relevant social impacts of planned intervention and design the relevant measurements for them (e.g. variables that measure social change)
- Design participative methods and instruments for consultations with stakeholders in order to establish in their perception which are the relevant social impacts and which is the weight for each of these
- Calculate the cumulative social impact index
- Take decisions considering also, among other technical and economic indicators, the cumulative social impact index

The novelty brought about by this model consists of the following:

- The way the social impact variables relevant to the project are being selected
- Converting the value for each of this variable from their natural measurement scales to a conventional scale proposed by the model, such that each social impact values is represented on the same scale for comparative purposes and in order to be able to consider all values in calculating a cumulative index
- A weight for each of the social impacts is being proposed such that not all the impacts are included in equal shares in calculating the cumulative index
- Cumulating the values of all these social impacts into a single value, the cumulative index integrates all social impacts generated by a planned intervention and is being considered in the process of making decisions regarding that respective planned intervention
- The model can be applied in a wide range of domains, all planned interventions that generate social impacts could consider using this model, and not only limited to the technical, engineering domains in which traditionally social impact assessment is being used

## **WHAT ARE SOCIAL IMPACTS?**

SIA aims to measure and manage the social impacts generated by a planned intervention. Social impact refers to “the consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society”. The term also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society<sup>[3]</sup>.

This process involves the measurement of social change, identifying how the social context fluctuates between different states before, during and after a planned intervention. In order to perform these measurements, the social context is operationalized into a relevant set of variables. The social scoping of the project is being defined in **Figure 1**. For each project or planned intervention, several themes or relevant categories for measuring social change are being identified.

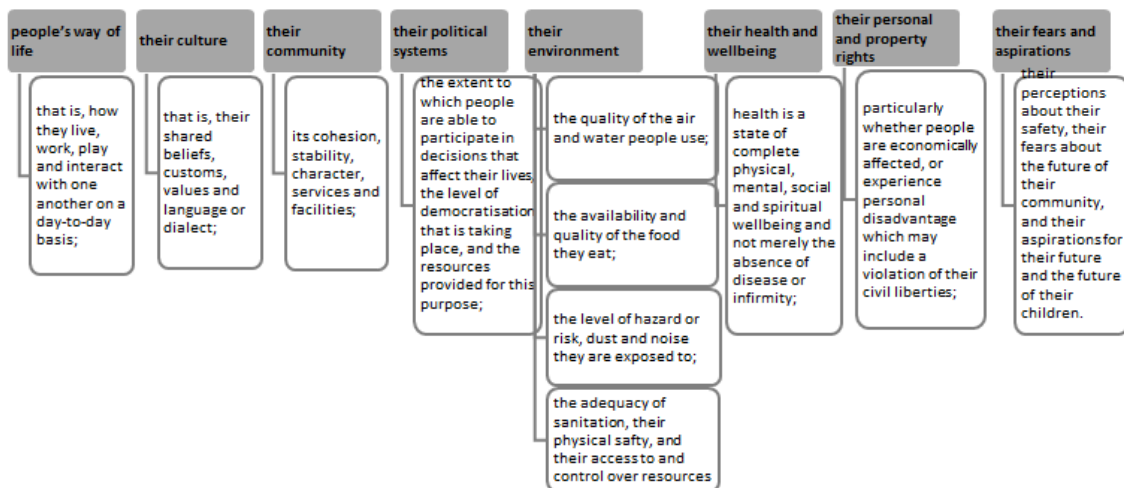


Figure 1. Social Impacts source: Figure based on enumeration from 16.

### Calculating a Cumulative Social Impact Index-A Conceptual Model

SIA process aims to assess or anticipate the social consequences of a planned intervention<sup>[10]</sup>. “Social Impact Assessment (SIA) can be defined in terms of efforts to assess or estimate, in advance, the social consequences that are likely to follow specific policy actions (including programs/ projects and the adoption of new policies), and specific government actions. It is a process that provides a framework for prioritizing, gathering, analyzing, and incorporating social information and participation in the design and delivery of developmental interventions. The SIA ensures that the development interventions: (i) are informed and take into account the key relevant social issues; and (ii) incorporate a participation strategy for involving a wide range of stakeholders. Social Assessment (SA), on the other hand, is a process that provides a framework for prioritizing, gathering, analyzing and incorporating social information and participation in the design and delivery of development operations”

Measuring social impacts is a measure or anticipation of social change. Each planned intervention or project aiming to take into consideration social impact is due to operationalize social impacts into measurable variables. The value for these variables can be measured before, during and/or after the intervention. As social impact assessment can be performed ex-ante or ex-post. If performed ex-ante, the SIA methodology will aim to anticipate the social impact generated by the intervention. If performed ex-post, SIA will use data about the initial value of those respective variables before the intervention, provided that there is access to such data. Measuring and analyzing the social impact variables throughout the planned intervention will supply information with regards to the social change generated by planned intervention. The social impact could be positive or negative. The final aim is to increase the positive social impact and to diminish or mitigate negative social impacts.

An analysis that presents a collection of positive and negative social impacts does not make it easy for the decision makers to consider the social impact in a cumulative manner. As the variables presenting social impacts and the generated social change are different in nature and cumulating all these aspects cannot be performed if their value is expressed on their natural measurement scales and the variable are different in nature. Following this train of thoughts, this model is aiming to integrate all these social impacts and to facilitate for decision-makers to consider them all when designing, managing, implementing a project.

1) Calculating the cumulative social impact index requires a succession of operations described below

Knowing the value of each variable representing social impact (or the variable measuring social change) on its natural scale at different relevant moments in time (for example, before, during, and/or after the planned intervention)

Establishing that a planned intervention had a positive or negative social impact implies a comparative measurement. This refers to comparing the values of the variables representing relevant social aspects before and after the projects provides a measure of the produced social impact **Figure 2**. Comparing the values of a social impact variable before and after the planned intervention will allow establishing the direction and the magnitude of the impact. For each social impact variables at least two values are required, the value before and, respectively, the value after the planned intervention.

$$\Delta_v = v_{t0} - v_{t1}$$

**Equation 1-Social impact**

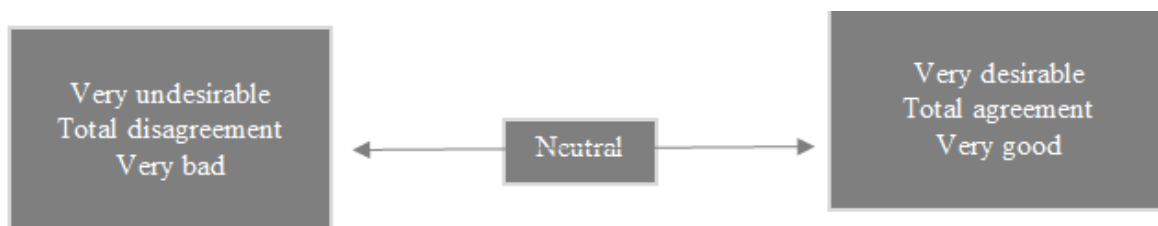
$\Delta v$ =Social impact or the difference between the value of the variable before and after the planned intervention.  $vt_0$ =the initial value of the variable, before the planned.  $vt_1$ =the final value of the variable, after the planned.

Possible sources of data for these variables:

- Collecting primary data
- Secondary data from other relevant studies, official statistics, etc
- Ex-ante or ex-post estimations/ prognoses (consultations with experts and/or stakeholders)

2) Establishing an evaluation scale for the project

The evaluation conventional scale proposed by this model is a Likert scale, distributing symmetrically its values as illustrated in the figure below.



**Figure 2.** Symmetrical distribution of values on likert type scale.

This scale provides a way to have a similar measure for all variables and so integrating the values of these entire variables in calculating the cumulative social index will be possible. In addition to this, the evaluation scale will provide the context for a reference value in relation to which the value of the cumulative social impact index can be interpreted. The scale will have a total of 5 values, a neutral value in relation to which the other positive and, respectively, negative (in terms of meaning) values are distributed.

3) Converting the values of the variables representing social impacts from their natural scale value to the conventional scale proposed by the project

Converting the values of the variables from their natural measurement scale to the conventional scale proposed by the model implies answering the following questions:

- Which is the maximum value for the analyzed variable? And which is the minimum?
- Considering the edges of the interval, the minimum and maximum value, where is the current value of the variable (at the analyzed time  $t_0$ ) situated on the conventional scale?

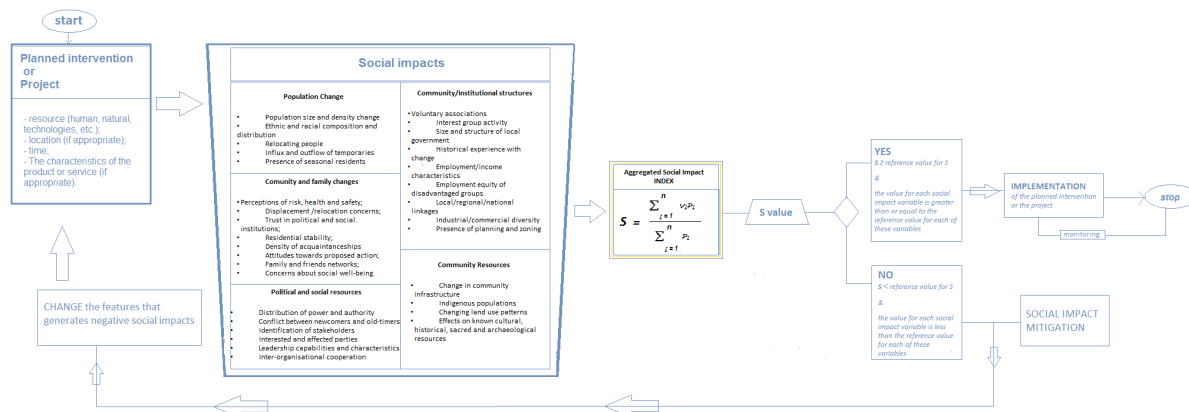
Concerns and clarifications regarding converting the variable to the conventional scale proposed by the model:

- Some variables might not have a linear variation in which case the values they take will be distributed in intervals, establishing a correspondence between these intervals and the values on the model scale
- Values higher or lower than a certain limit might not produce any further significant impact, for example, and the extreme values might need to have as ceiling certain reference values when making the interpretation or the conversion to the conventional scale
- Some variables represent positive (in terms of meaning not mathematically) traits of the social context, while others are negative aspects. The conversion process proposes a relation of direct proportionality between the scale of the project and the natural measurement scale of the variables that represent positive traits of the social context, and indirect proportionality with the variables that represent negative traits. For example, unemployment represents, in general, an undesirable aspect, so the lowest the percentage of unemployment the greater the value that unemployment gets on the conventional scale of the model and the other way around [11-18]

1. Establish the weight of each variable within this model measuring a cumulative social impact index.

This model also takes into consideration the fact that not all considered variable have the same weight. They contribute differently to the social impact, as a result, they should be considered differently in calculating the cumulative social impact index **Figure 3**. Each social impact variable will be allocated a weight proportional to the importance of the social aspect represented by that respective variable, considering also the context of planned intervention. For example, if levels of education in community or job creation for local manpower are more relevant in a certain context their weight is going to be greater. Conventionally, a weight of “1” is going to be allocated for a variable of average importance,

following from this value weight is going to be allocated to each of the variables considered in the model. For allocating weights to the considered social impact variable, both social impact experts and consultative meetings with stakeholders are going to be employed.



**Figure 3.** A conceptual model for a cumulative social impact index due to facilitate integrating social impacts into decision-making processes (The list of the categories of social impacts is an illustration made based on classification presented in 3.

## CONCLUSION

This paper presents a model aiming to support projects, planned interventions to better consider social impact on their decisions regarding development for more sustainable outcomes. The process of calculating the cumulative social impact index integrates elements of social research and participative tools and the result is a dichotomous variable easier to be integrated into the decision about designing and implementing a project [19-21]. The model makes the presumption that all concerns regarding social research methodology and participative methodology are taken into consideration when collecting data to calculate the social impact index. Each project requires a tailor-made approach in mapping stakeholders, identify the social impact variables, measuring them and establishing their weight. The problems this project is aiming to solve are:

- Taking into consideration all variables that describe social change referred to as social impact, the aspects brought about by a planned intervention
- Proposes a formula that aggregates all the values of the above-mentioned variables into an index easy to interpret, addressing the challenge that these variables differ in nature and scale of measurement

In the same time the model is not an easy fix, some of the challenges this project will face include:

- Some of the values of the considered variables need to be estimated, either estimating what the value might be in the future after the planned intervention or to estimate what the value was before the intervention if initial measuring has not been made
- The model implies a linear variation of the variables and, the process of converting the measurement of the variable on the conventional scale proposed by the model will also normalize
- Establishing the social impact variables and their weight relies also on a consultative process with stakeholders; the degree of complexity in this regard varies from one project to another

In the same time, the model moves the SIA (Social Impact Assessment) conversation forward in terms of considering all social impacts, in a comprehensive view. The consultative process proposed brings stakeholder closer to decision makers.

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## REFERENCES

1. Barbour T. Guideline involving social assessment specialists EIA process. Report prepared for department of environmental affairs and development plannins. Western Cape Province. 2007.
2. Burdge J. Utilizing social impact assessment variables in the planning model. Impact Assessment. 1990;8:85-99.

3. Interorganizational committee on principles and guidelines for social impact assessment. Principles and guidelines for social impact assessment in USA. *Impact Assess Proj Apprais*. 2003;21:231-250.
4. Kytte B and Ruggie J. Corporate social responsibility as risk management: A model for multinationals. Beech Tree Publishing 10 Watford Close Guildford Surrey GU1 2EP. 2005.
5. Laedre O, et al. Determining sustainability impact assessment indicators. *Impact Assess Proj Apprais*. 2015;33:98-107.
6. Lehmann A, et al. Integration of social aspects in decision support based on life cycle thinking. *Sustainability*. 2011;3:562-577.
7. Lieplapa L and Blumberga D. Using of indicators for environmental impact assessment in latvia and necessity for indicators validation. 2011.
8. Mitchell RE and Parkins JR. The challenge of developing social indicators for cumulative effects assessment and land use planning. *Ecol Soc*. 2011;16:29.
9. Redd L. Methods for assessing and evaluating social impacts of programs. 2013.
10. Rietbergen MJ and Narayan D. Participation and social assessment: Tools and techniques. Washington DC: The Worl Bank. 1996;1:359.
11. Rolf CC. Beyond accuracy how models of decision making compare to human decision making master thesis in cognitive science lund university Sweden. 2005.
12. Rotarescu E. Mathematical modeling in decision making process under conditions of uncertainty in HR training and development. *Revista Notas De Matematica*. 2011;7:46-56.
13. Sala S, et al. A systemic framework for sustainability assessment. *Ecological Eco*. 2015;119:314-325.
14. Sayce K and Norrish P. Perceptions and practice: An anthology of impact assessment experiences. 2006.
15. Sloomweg R, et al. Function evaluation as a framework for the integration of social and environmental impact assessment, *Impact Assess Proj Apprais*. 2001;19:19-28.
16. Vanclay F. International principles for social impact assessment. *Impact Assess Proj Apprais*. 2003;21:5-11.
17. Vanclay F. Conceptualizing social impacts. *Environ Impact Asses Review*. 2002;22:183-211.
18. Vanclay F. The potential application of qualitative evaluation methods in European development: Reflections on the use of performance story reporting in Australian Natural Resource Management. *Regional Stud*. 2013;1326-1339
19. Vanclay F, et al. Social impact assessment: Guidance for assessing and managing the social impacts of projects. Fargo ND: Int Assoc for Impact Asses. 2015.
20. Weber M, et al. Cumulative effects assessment linking social ecological and governance dimensions. *Eco and Society*. 2012;17:22.
21. WB, Guidelines for sustainable development assessment. 2004.