

# Project Management and Sustainable Development How to Create Sustainable Development Benefits During Solar Energy Panel Construction

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**Abstract:-** Projects are generally initiated and executed to achieve strategic goals and visions. These goals and visions may not include benefits for future generations and may lead to adverse effects. The benefits of future generation as a results of project execution are the Sustainable Development benefits. They are serious problem that project organizations and stakeholders face during and after project execution to make visions a reality. Life expectancy is directly influence by environmental quality and stakeholder income. To achieve better and quality life, environmental considerations and income generation activities must be integrated into Sustainable Development creation strategy during Project planning. This will ensure that the Project is guided and executed in a manner to enhance the satisfaction of stakeholders and future generations. The purpose of this study is to discuss the concept of Sustainable Development Co-creation with key stakeholders as co-creators, study how Sustainable Development benefits are created and show how these benefits can be evaluated at the close of a solar power project.

**Keywords:-** Strategy, Stakeholders, Sustainable Development, Visions, Goals.

## I. INTRODUCTION

It is an unimpeachable fact that industrial growth over the years has prompted the need for energy supply to cater for industries and the growing rural communities. Whilst Hydro generation is insufficient in terms of capacity and costly with respect to construction, thermal generation with its consequent environmental effects is expensive to operate. There is the need to adopt renewable energy to augment the already existing capacity. The adoption and utilization of renewable solar energy goes hand-in-hand with SD goals for socio-economic welfare of stakeholders within the catchment areas when the project is finally rolled onto operations.

The traditional project management approach which utilises the concept of project goals achievements, seeing projects as meeting its scope, time, cost and quality objectives, has led to failed projects in terms of SD issues over the years. The addition of Socio-economic and environmental objectives are important (Kaysi, 2013). This calls for the need to blend project management principles with practical approaches that will move project management in line with sustainable development.

In project management, high level documents such as the project charter is often created by top management. At this level of decision making, sustainability is not always an integral part. Before the Rio De Janeiro conference, SD issues were not included in Ghana's natural resources exploitation. The conference therefore, brought change of organisational strategic planning with knowledge and understanding (Ministry of Environment Science and Technology, 2012) of SD issues. The inclusion of Sustainable development activities into project management goals highlights the important complexities of project management. Hence, to achieve sustainable development goals, the project manager is expected to possess skills that will deal with organizational factors above his control.

Experience over the years also shows that project characteristics and deliverables which makes them attractive as a results of organizational objectives does not equally bring about benefits when analysing them from the perspective of sustainable development. As an example, small solar projects with very short installation duration may not fully account for sustainable development beyond the project life cycle but may meet their objectives of time, cost, scope and quality. Here again, even though the project is successful from project manager's view of meeting its objectives, it is not attractive to other stakeholders as its benefits cannot be sustained above certain period. This led to growing debates among prominent project practitioners (Luca, 2016) focusing on SD issues. To ensure real sustainability from projects, a holistic approach should be adopted, embodying collections of totalities of key stakeholders and identified experts ideas and findings, case studies, researches and interactions. For this paper, the approach is basically research involving my industrial experience and other expert advices from areas other than Ghana where commercial solar panels are in service.

## II. THE CONCEPT OF VALUE CO CREATION FOR SUSTAINABLE DEVELOPMENT

To co-create a service in project management involves the creation of features that will add value and benefits to the final product with the support of consumers. Co creation can therefore be seen in Service Dominant logic as a function of organization-customer interactions (Adrian et al, 2007). These interactions are expected to create new and unique products and services. In recent times, customers have shifted from consumption-oriented behaviours towards value co creation. Value co creation is not

determined totally by the supplier, but interaction among stakeholders (Aurelio et al, 2015). Hence their interactions with producers for satisfactory services. Co-creation is related to the nature of the firm or industry the project is being carried out. It can also be said that successful value co-creation could come as a result of better value propositions (Samuli et al, 2016) that seeks to seriously engage actors in the proposed service.

SD co creations can be seen from joint invention and shared production as value creation strategies. Its opportunities are linked to;

- Technological advancement with their corresponding technical breakthrough
- Customers lifestyle changes and preference and
- Social and environmental needs

The concept of co creation is quite new in the management of projects. To effectively ensure co-creation benefits, external stakeholders with enormous experience are required to provide expert judgement and advice in order to support the project progress.

Even though these stakeholders are strongly needed during requirement documentation and analysis phase, they should not focus all their attention on product design but should promote joint participation to create common understanding (Ertekin, 2009) and buy-in. This has the ability to enhance team work and reshape their thinking that will make them innovate through interaction. Interactive reasoning and ideas will lead to quality SD service co-creation.

In other to create environmental sustainability, one have to keep the environment at a level such that it will have no adverse effects on living creatures. It is the avoidance of destruction of environmental resources so as to maintain an ecological equilibrium for all living organisms. One can use the triple bottom line to describe SD as people, planet and profit (PPP) (Slaper, 2011). Sustainability combine socio-economic and environmental balance.

Co-creation for sustainable development involve research and/or stakeholder participation through projects to add value to the final service or results for a lasting benefit to stakeholders and society as a whole.

### III. SUSTAINABLE DEVELOPMENT VALUE CO-CREATION METHODS

For this paper under discussion, research show that SD co-creation methods fall under the following categories;

#### ➤ *Collaborating Co-creation.*

In this type of co creation, stakeholders are continuously involved in the whole project management life cycle. They conduct thorough analysis of requirements based on user experience and innovate ways to execute the project for benefits that will improve their living standards in addition to its intended purpose. This allow them to

create innovative ideas that will add significant value to the final product or service. This type of co creation is sometimes achieved through open sourcing (Iscenco, 2015). It should be noted with the keenest interest that co creation with respect to solar energy construction in particular is still at its embryonic stage.

#### ➤ *Research Co-creation*

With research co creation, the artefact to be constructed or service to be rendered is often in the hands of a research team. This team then perform thorough analysis of product requirements or service based on experiments. They work for research as the basis for value creation (Norwegian Institute of Food Fishery and Aquaculture, 2012). The ideas created will then go a long way towards adding value to the final result.

#### ➤ *Collaboration and Research Co-creation*

This method of co-creation can be seen as the hybrid of Research and collaboration. Whilst stakeholders add features base on experience towards the useful enhancement of the final product. Open sourcing is employed to collect data from the public about other benefits of the final deliverable. Data collected is then combined and used with the research data from producers to arrive at final decisions.

Co-creation mostly involves the creation of additional services that are environmentally friendly and economically viable during and after the project. This has the tendency to enable value addition to improve living standard of stakeholders from generation to generation.

## IV. IDENTIFICATION OF STAKEHOLDERS

In project Management, the identify stakeholders process is always used in the identification of stakeholders. Identifying stakeholders should occur iteratively and must be maintained for the entire life cycle of the project. To effectively integrate SD into this project, it is always pertinent to identify and include stakeholders (Internal or External) as early as possible (Tammer, 2009, Baharuddin et al, 2013) throughout the whole project management life cycle. Firstly, key internal stakeholders directly involved in the execution of the construction project are identified. They are made to further identify other known stakeholders. The stakeholders should be opinion leaders, family heads, chiefs, clan heads, government agencies and selected persons of the general public. These stakeholders should be classified and interviewed with questionnaire. Such questionnaires should contain information such as;

- Personal information such as age, education and occupation
- Its impact on environment and the ecosystem and
- Its expected impact on their socio-economic wellbeing

The above stakeholder identification applied emanates from PMBOK which defined a stakeholder as any person, group of persons or organisation who can affect or have interest in a project, or whose interest will be affected by

the activities of a project. This has gone a long way to prove its effectiveness as a standalone method due to the following reasons:

- People within the project catchment zone may have no experience with respect to SD Co-creation benefits applicable to the said project area of interest. For example, during an interview with an experienced friend, a question raised was “what other benefits can a solar panel bring if not electrical power?”
- External experts might be willing to also participate by giving out information for the success of the project sustainability on grounds of knowledge sharing but without any project interest.

In view of this, it will be convenient to collect information from all over the world. This is possible with the help of social networks. Social networks are important tool that support participatory planning processes. Experts are able to identify other stakeholders they maintain professional relationship in the field of SD for solar panel.

## V. INTEGRATING SD INTO COMMERCIAL SOLAR PANEL INSTALLATION

The primary aim is to add energy to the national Grid to serve the surrounding communities and stabilised the energy grid to prevent it from oscillatory behaviours. However, involvement of stakeholders should have the ability to create other benefits. The benefits to be created in terms of value addition to the final deliverable should not be significant to cause scope creep since the success of any project increases with a reduced scope creep (Suma & Madhuri, 2013). To achieve this benefits, the mind set of stakeholders should be tuned for behavioural changes (Silvius & Schipper, 2010), towards seeing the final results as value-addition creator. Co-creation for SD can be very difficult with solar construction projects as they involve multiple supply chains of contractors and sub-contractors with varying and conflicting value-addition requirements. Involvement of stakeholders who are critical thinkers is therefore highly recommended due to the continuous planning, adaptation and iterative nature of the project.

The customer and the contractor as key stakeholders (Mathur et al, 2007) are always expected to build mutual and healthy relations early enough for harnessing and maximizing the opportunities that comes with the project. Equally important is outsourcing to seek expert support and advice through the electronic media (internet, telephone etc.). Construction projects generally has the ability to create value leading to SD if properly and well planned (Sodagar and Fieldson, 2009) before execution but this calls for application of best practices, thorough research, execution methods and adaptation as a results of changing stakeholder requirements.

## VI. INTEGRATING SD INTO PROJECT MANAGEMENT PROCESSES AND PLANS

The integration of sustainability issues into project processes and project management plans is the most important but difficult to implement. This is because the major parts of the integrations usually begins taking place in the planning phase. Planning phase for SD issues requires rigorous work and effort (Zaitali, 2014). Errors made during project planning can be very expensive to correct at the long run. Careful and strategic planning is therefore necessary at this phase.

During Project initiation (Gareis et al, 2014) and planning (Alias et al, 2014), the project manager and his team members are expected to include relevant sustainability issues. Continues identification and engagement of stakeholders throughout the project will iterate and adapt both project and sustainability requirements to optimal achievable levels. This should form part of the total project scope. Identified stakeholders are to further seek external expert ideas worldwide, this will make them refine requirements to proper standards and put them into cohesive hole.

The project manager should ensure Quality SD deliverables, in terms of skills and incentives to apply and further innovate when the project is completed. This is because irrespective of how good technical training programs are, they will be of less practical value to the trainees when they are unable to apply and utilise them. To effectively develop skills for sustainable development (Kamis et al, 2017), human resource trainers within the project should be assigned to continuously educate project participant on the economic impact of sustainable development. The education must have the ability to generate interest to participate in the project for the purpose of skills development of the youth. Key stakeholders and employees are expected, by their education, to convince the youth to arouse their interest to follow them for training purposes. This is highly possible in a typical traditional rural African setting and should be done without extra cost and schedule constraints. Then, by constant monitoring of trainees using skills matrix (Paritkar and Parchure, 2016) checklist, their competences can be recorded for further decisions.

It should be noted that by integrating Solar Panel installation into project management plans, the project manager is not expected to be left for project completion within the specifications of the triple constraints (scope, time and cost) and quality, but is joint with other key stakeholders in a group-style fashion (Lund and Eskerod, 2008). Such a fashion should have key characteristics which include but not limited to;

- Routine meeting of key project stakeholders for mutual discussion and agreement of iterative findings pertaining to the project. These finding will include Risk identification, analysis and quality issues for

stakeholder satisfaction necessary for project continues existence.

- Issues of possible environmental degradation to ensure that, the project, while meeting its objectives, is performed in an environmentally friendly manner to prevent the environment’s adverse effects on living organisms.
- Issues related to cost. Even though, it is expected that the SD benefits should come without extra cost, one barrier to realize the benefit could be the budget. From research, the budget of a solar project in particular is expected to be divided into strategic components. These components are;
  - The project execution budget component which should include about 65% to 70% of the total project budget.
  - An amount calculated based on risk opportunities to be realised during project execution.
  - An amount to be calculated based on negative risk with consequent adverse effect to the project.
  - A small percentage of the total budget for stakeholder trainees to motivate them to learn and apply their knowledge before and after project completion. This amount should be as small as possible since some of the installation tools will be available for participants after

the project. This should be given them as a form of motivation to learn and innovate for their future.

**VII. CREATING SD VALUE IN COMMERCIAL SOLAR PROJECT**

Value creation and Management leading to sustainable development provides highly structured approaches (Evans et al, 2017) to service or product development during project management. If value is well created, then, the probability of achieving optimal project results at an optimal cost will eventually emerge.

The best framework to be adopted is to look at SD value creation from problem solving perspective. This has the ability to ensure that final deliverables are in compliance to project and stakeholder requirements. Value creation for sustainability has a bright future due to that fact that it minimises if not eliminate waste (Gertsakis and Lewis, 2003) that can be measured in monetary terms. It provides analysis framework of what the final deliverable does with both tangible and intangible benefits.

SD value creation is being increasingly accepted into project management and must be a continuous process and an integral part of overall project management.

**VIII. SUSTAINABLE DEVELOPMENT CO-CREATION BENEFITS**

What are the SD co-creation benefits with respect the solar energy panel construction under research? And how are they co-created? A research model built diagrammatically is used to analyse the benefits as shown in fig a.

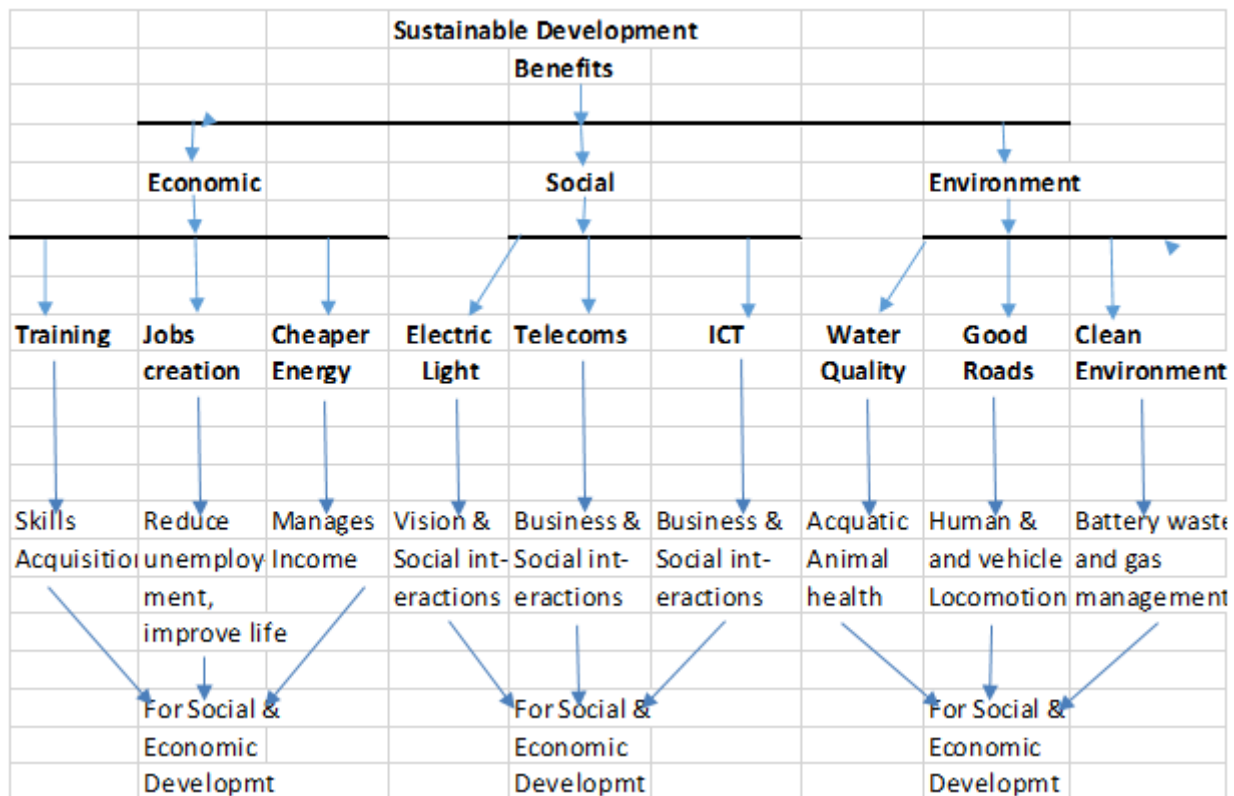


Fig 1

Fig 1 is a model highlighting SD benefits. These benefits are analysed from a socio-economic and environmental point of view for the research under study and can be stated as follows.

➤ *Economic Benefits*

Economics benefits includes, skills acquisition from training programs. These skills can be utilised by participants after the project for income generations. Example is the installation of mini household solar plants which produce cheaper energy. Trained stakeholders can further impact knowledge to others and the cycle may continue from generation to generation. Job creation will lead to employment to generate income. All these are necessary for the socio-economic wellbeing of stakeholders.

In Africa, especially Ghana, energy consumers often place very high value on power reliability, many researchers have highlighted on the cost and economic impacts of power transmission failures in the past and the role that Solar Energy could play in blackout reduction (National Renewable Energy Laboratory, 2014). In principle, power system disturbance that leads to blackouts are often caused by high power demand, equipment failure and errors as a results of human activities. The deployment and installation of solar panels will not necessarily eradicate total blackout but will go a long way towards reducing it significantly due to their distributed nature.

Future employment creation is further enhanced by co-creation and development of tourism sites. Sustainable tourism, defined as tourism that takes full accounts of future socio-economic and environmental impacts whiles guaranteeing natural and cultural resources maintenance (Niedziółka, 2014) will address industry, host communities, visitors, and environmental needs. The three dimensions of SD can therefore be well addressed by a well-designed and well-managed sustainable tourism site. This can further create decent employment and business opportunities.

➤ *Social Benefits*

With cheaper power from the solar panel (Aggarwal and Aggarwal, 2014) and subsequent ones installed as a result of skill acquisition of trainees, there will be an improved Telecommunication and Information and Communications Technology Facilities with the capability of connecting the community to the rest of the world. These improvements will bring about virtual interactions leading to improvement in social lives (Guil-Bozal et al, 2018). Electronic businesses (e-business) will also be introduced (Kunjir and Gage, 2016 Khan, 2014) to augment the existing traditional methods.

Human-Human communication will improve with free-flow of quality information through the internet with little distortion. Finally more value will be added to the educational standards of the community.

Installation of mini solar panels will brighten the community with light (Kabir et al, 2017), this will further improve the educational standards of the community, expose and reduce criminal activities.

There will be an improvement in health services through the procurement and deployment of health facilities which are advance in terms of operations and performance to the surrounding communities. Since most advanced health facilities are powered by direct current and voltages (DC) (WHO and World Bank, 2015), the advance equipment's can be procured to harness the cheap DC current and voltage from the batteries during operations.

The project should also include female participation at all level to ensure gender balance (Dr. Lohani and Prof. Aburaida, 2017 Bayeh, 2016). Gender equality here, which will lead to women involvement in projects stakeholder decisions, will reduces discrimination on their part and helps then develop their talents. Well educated women impacts effective knowledge to their offspring faster than their male counterparts.

➤ *Environmental quality Benefits*

The installation of solar power will lead to reduced emissions of toxic gases such as sulphur dioxide nitrogen dioxide and carbon-dioxide gases (SO<sub>2</sub>, NO<sub>2</sub> and CO<sub>2</sub>) (Tsoutsos et al, 2003 Chikaire et al, 2010) which are present in crude-oil-fired generation systems. Since health is related to CO<sub>2</sub>, SO<sub>2</sub> and NO<sub>2</sub> emissions, the health of stakeholders within project operating areas will be improved.

To be able to meet key sustainable development goals with respect to solar power plants, it will be convenient to determine suitable primary locations for Solar panel project. These location must be suited for development into tourism sites (Prinsloo, 2013) and Agricultural growth using irrigation technology, livestock watering, electric fences, pest control, aquaculture aeration pumping and fish and poultry lighting (Campen et al, 2000). All these will improve on the living standards of stakeholders.

For successful tourism creation, it is possible to mount the solar panels above river water surfaces to minimise water exposure to direct solar radiation. River water quality will be easily obtained from solar panel shading and can easily be measured. Tilapia Fishes by nature are exothermic creatures and therefore evolves heat. This makes them cold blooded (Thompson et al, 2004). Any cold but optimal water temperature surrounding them promotes the elimination of metabolic waste (Singh et al, 2013), and controls the speed of eggs production (Faruk and Anka, 2012) and maturity. Several diseases are also kept at minimal levels at cold temperatures (Saad and Azmai, 2014). All these are necessary for the proper growth of fish and other aquatic animals. The growth and increase in fish population will bring more revenue to the fishermen thereby improving their socio-economic lives.

**IX. PANEL AND BATTERY BANK MANAGEMENT DURING AND AFTER PROJECT**

SD is measured by the triple bottom line, that is social, economic and environment, it will be seen from the study and analysis that social and economic welfare are further improved by environmental quality within panel operating areas.

Although, solar panels are classified as green and clean energy (Mishra et al, 2013) with socio-economic and environmental advantages, according to scientific research, its major required materials are Arsenic, Cadmium and polysilicon which are classified among cancer causing chemicals, other heavy metals are Lead, mercury, beryllium etc. These, combined with toxic gases from the battery bank will expose humans and living organisms to varieties of hazards (Fthenakis et al, 2008) leading to undesirable health issues. During panel installation around the river bed, since the stakeholder are not part of the physical equipment manufacturing team in the industry, their knowledge of the material quantities and qualities used in the manufacture of the panel components will be low. As a safety precaution, it is advised that the solar panel be erected on top of a concrete re-enforced structure to allow rain water diversion from the river. This, although, will increase the cost, the increase should not blind one to the

enormous benefits to be realised as it will prevent possible leakage of these heavy metals and toxins from the panel into the river when rainfalls, thereby polluting it and creating hazards at the long run.

Another issue of concern is the disposal of the panel after its useful lifespan. The toxic emissions emanating from the panel with their consequent health hazards at it time of disposal may unknowingly be inhaled by humans. Research by renowned world health bodies’ shows that some human diseases are as a result of exposure to toxins in the environment (Chistiani et al, 2015). This is so because most of the garbage are often disposed at the local garbage dump, hence, the exposure risk. Panel gadgets are to be disposed in accordance with environmental guide lines and standard regulations.

The emission of toxic gases from the battery banks at the time of production of electric power by the solar panels also leads much to be desired. Over the years, extractor fans are used in the battery banks to suck toxic air to the external surrounding. This proved effective but we proposed constant monitoring of emitted hydrogen gases to ensure that they are within the environmental threshold. Then, the battery banks can be discarded or recycled appropriately when their useful life span elapsed.

**X. ACCESSING SUSTAINABLE DEVELOPMENT BENEFITS IN SOLAR PROJECT**

The best method of accessing SD benefits is to create a checklist of sustainable development goals within a check sheet. These list will be the reference point upon which SD benefits will be accessed.

<b>Economic</b>	<b>Social</b>	<b>Environmental</b>
Small-scale business growth	Basic ICT growth in the surrounding communities	Panel Waste monitoring, recycle and disposal
Materials and resources Reusability	Improvement in Telecommunications	Air quality
Skills acquisition by trainees	Improvement in health	Water quality
Tourism	Reading and learning habits base on cheap power	Road quality
	Human Rights and Gender balance	

Table 1

SD value, measured in monetary terms, is given by the mathematical relation

$$SD = \frac{\text{Benefits}}{\text{Cost}}$$

Cost ≠ 0

Cost = The cost of implementing sustainable goals in project and

Benefits = Sustainable benefits of the project

In general, an SD value of less than 1 (SD < 1) shows that SD goals are not met and an SD value of greater than 1 (SD > 1) shows that sustainable goals are met. An SD of 1 (SD = 1) indicates no sustainability.

It is very difficult if not impossible to measure sustainability indicators from financial perspective immediately after project completion. Especially with solar project under research. In the light of this, it will be highly convenient to rely on stakeholder respondents and questionnaires during a survey to collect data for SD analysis. The method uses stakeholder and expert responses as co-creators to measure SD benefits.

Before project begins, a cross section of stakeholders should be selected for survey. These stakeholders are to give data that will serve as baseline information in which sustainability can be measured when project completes. It should be noted that not all SD parametric Indicators can be

directly measured immediately after project completion. The few measurable ones pertaining to this project are as follows;

- Skills acquisition by trainees (Entrepreneurs and small-scale business emergence)
- Gender balance and human rights (Female Inclusiveness)
- Air quality and
- Water quality

In order to measure sustainable development base on stakeholder input to questionnaires before and after project works, the SD calculation is remodeled. If skills acquisition by trainees is to be accessed for example, questionnaires with discrete values 4, 3, 2, and 1 attached to answers are given to a cross section of stakeholders for their response. Such question should reads;

How will you rate the technical skills level of trainees?

- Very high (Weight 4)
- High (Weight 3)
- Moderate (Weight 2)
- Low (Weight 1)

$$SD_i = \frac{\sum (\text{Weighted Respondents Score after project ends})}{\sum (\text{Total number of Respondents})}$$

This should be computed for each SD goal within the Economic, social and environmental SD sector to obtain a score. A target value set as a minimum criteria to achieve SD benefits should be used to ascertain whether SD goals are achieved or not.

SD benefits for a particular sector is then quantitatively evaluated as follows;

$$SD (\text{Any Sector}) = \frac{\sum_{k=1}^n SD_i}{n}$$

k = 1, 2, 3, 4.....n  
n = Total number of sector

questionnaires

For SD benefits

$$SD (\text{Any Sector}) \geq 3$$

Whereas issues of environmental sustainability for water and air quality can be directly evaluated by adopting scientific approaches (measuring water temperature before and after project work, making comparison for analysis, and determining air quality by continuously measuring hydrogen discharge levels from the battery banks in the room), the remaining indicators of sustainability can be realized during project operations and are mostly determined by allowing a grace period when the project is finally rolled onto operations.

## XI. CONCLUSION

This paper provided a noble approach to the co-creation of SD with specific reference to Solar Power panel installation. The methods discussed are based on personal research, expert interviews and basic industrial experience. It provide a roadmap to meeting sustainability requirements and the creation of value. It would be convenient to say that we, the stakeholders all have our role to play when it comes to SD co-creation. Basic ideas with Small actions, collectively taken, may leads to big changes eventually. It can be done with the help of quality contributions of stakeholders and institutional capacity builders.

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