INNOVATIONS AND SUSTAINABILITY ISSUES INVOLVED IN GREEN PROJECT MANAGEMENT

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ABSTRACT
The paper describes the attempt made in the direction of innovative approach to management and sustainability of Green projects concept. Green project concept involved the practice of increasing the efficiency with which building use resources-energy, water, materials, while reducing building impact on human health and the environment. Atmosphere above the earth has suffered high degree of pollution from buildings in recent times resulting in destabilization of ecosystem and ozone layer depletion which culminates in global warming phenomenon. In order to curtail the effect of negative impact of building on human health and environment, the complete building life cycle from design to post construction period should be thoroughly monitored. To this end, this study attempt, to describe innovative approaches to a sustainable Green project development including the attendant sustainability issues.

KEY WORDS: Innovation, Sustainability, Green Project.

I INTRODUCTION

The Inter Government Panel on Climate Change (IPCC) report estimates that by year 2020 the primary energy use for building sector will double, that the corresponding rise in carbondioxide emissions from building sector will ascend to 2700 million tonne from 1900 million tonne [1]. This fact made the conference in Geneva come out with millennium development goal, tasking each nation of the G-8 and their former allies, on the need to embark on proactive development that will counter the destructive wavelengths of emissions from earth surface to its atmosphere. A well designed building therefore, as green buildings are often designed to be, should have lower operating costs, higher net operating incomes with improved tenant retention and exerts less stress and emissions into the earth atmosphere..

II. GREEN TECHNOLOGY CONCEPT.

Green technology is an approach to building that minimizes harmful effects of building on human health and the environment. This is the practice of increasing efficiency with which buildings and their occupant utilizes energy. In a layman parlance, Green building should be the type that occupants will desire to occupy and will create delight when entered, serenity and health when occupied and regret when depart' Green technology birthed the concept of Green Building, they are often designed to meet certain objectives apart from those stated above, such as: protecting occupant health, improving employee productivity using energy water and other resources more efficiently [1, 3]. Green technology attempts to safeguard air, water, and emissions to the space from buildings such as: earth, ecosystem, biomass leverage, and an as well guides in the choice of eco-friendly building materials and construction practices.

III. EVOLUTION OF GREEN TECHNOLOGY.

Right from the era of industrial revolution in Europe, which one of the attendant consequences is the utilization of fossil fuel in driving automobile and manufacturing operations, tons upon tons of carbonmonoxide has been continually emitted into space which is harmful to the layer of air referred to as ozone layer, the ozone layer is the atmospheric layer that prevents ultraviolet radiation of sun from having direct impact on the environment or earth atmosphere which could lead to sunburn. With this phenomenon of ozone layer depletion, there is a need to re-engineer a process of restoring the depleted layers, and this can only be achieved by creating a system that releases minimum carbonmonoxide to the space. Research has indicated that 78% of a building occupants time is spent indoor and most often engage in activities that release ozone depleting gases into the atmosphere. So also, part of the environmental degradation phenomenon is the sick building phenomenon emerged, this refers to the harmful effect of design and construction defects on occupants resulting into sickness, polluted indoor air, gastro intestinal allergy, psychological trauma, hallucination and often isomina. The international code council was formulated by the G-8 countries and a code was developed to that extent, the code was named International green construction code (IGCC). The release of the public version of this code

marked the next step in the evolution of green construction [4]. The IGCC is designed to regulate the design, management and construction of new and existing commercial buildings and aims to significantly reduce energy usage and greenhouse gasses. It addresses land development and use including land allocation, biomass allocation, presentation, processing and utilization of natural and material resources. The IGCC initiative was launched in 2009 with cooperating sponsors, the America Institute of Architects (AIA) and ASTM International. AIA's support illustrates its long-time leadership in the sustainability movement, including the 2030 carbon neutrality challenge, and its emphasis is on the critical role of architects, builders and designers in the lifecycle of sustainable construction. However, the program has been successful with few examples of such Green Projects in Australia, Mexico, and United States of America.

IV. MANAGEMENT OF GREEN PROJECTS: ISSUES INVOLVED AND INNOVATIONS.

Innovation has long been seen as a significant driver of an economy and it central to social welfare and economic performance of any nation. More recently key players in the society, captain of industry have also looked at innovation as the key to making radical improvements in corporate environmental practices and performance. However, the study of innovations in the context of green project development could be approached from the [perspective of target (focus area of innovations), mechanisms (how the changes in the target area are effected), and impacts (how the innovations affect the environmental conditions.

a. Target: The audience or the area where the innovation is desired to bring change need to be settled. The target area can be organization, production methods, by-product generation, marketing methods/advertizing, organization and institutions.

b. Mechanisms: Once the area of focus is identified, the process of attaining the desired change through innovation has to be in put place, the process could be redesigning of a project, project modification redesign or practices or the creation of new practices.

c. Impact of Innovations on the Environment: Every innovation has negative or positive impact on the immediate environment. The innovation that bring about preservation of natural habitat is termed ecofriendly and could be termed good impact innovation and vice versa.

V. PERSPECTIVES IN INNOVATION IN GREEN PROJECT MANAGEMENT

However, the issue of innovation in green project management is viewed in this study from the perspectives of technological innovation and non-technological innovations.

a. **Technological-based Innovation**: The configuration design and production process involved in green project execution is basically technological oriented. Therefore, management of the quality of end-product is largely determined by the interplay of actors and the process adopt. Actors refer to the professional involved in the project design and configuration. However, technological-based innovations in this context consist of Energy conserving design and innovations.

b. Energy conserving design and innovations: Traditionally, industrial pollution should be addressed right from the production process rather than the end-of-pipe approach which has proved to be ineffective, thus pollution and energy conservation process should form part of production process of organization. Environmental impact programme on the product of the organization should be carefully observed throughout the product lifecycle, through integrating environmental strategies and practices into the management of the production systems. Negative environmental impacts resulting from building elements are basically assumed to occur as a result of energy consumption in construction, renovations and maintenance works. The negative impacts are attributed to the emissions released due to the energy and material used for heating cooling and lighting of building and the renewal of the element at the end of its lifetime [5]. Waste and indoor air quality issues are also connected to the emissions released during use and renewal of building element. Therefore the negative environmental impacts of the emissions and

resource depletion can be grouped as: global warning, mineral depletion water depletion, acidification, fossil fuel depletion, human toxicity, smog, insolation, radiation effect and others. The negative impacts of energy consumption and activities in the built environment can however be taken care of, through the following suggested innovative approaches: vine covered-solar house, solar-paneled house, compressed-earth block-walls house, rainwater harvesting, albedo, permaculture, agri-aqua-culture.

i). Vinecovered House: This is an innovation will keep off poisonous gas from surrounding of a building through carbondioxide gas emissions from house interior will be absorbed by the plant around the House. The idea behind this kind of house will be constructing ahouse that will be able to keep occupant free of any sort of heat stressor. Therefore the glass panes will be reflective type and solar reflective in nature. The house will as well have a waterfall, this is to absorb moisture from the air, dry air feels more comfortable, so there will be less need for air-condition. Therefore, this innovation will reduce energy consumption required in cooling house interior.

ii). Permaculture: This is the art and science that applies pattern found in nature to the design and construction of human and natural environments [3]. Sustainable living system can truly be achieved when such patterns and principles are applied to the built environment. The elements should be designed in a way that will not disturb the natural environment. A balanced ecosystem can be created around the house to allow for exchange of resources from plant to human and the living things around.

iii). Compressed-Earth House: This is the situation whereby compressed earth block-wall which have been reinforced with wire and parged with plaster, with about $2^1/_2$ inches space between the facing walls are used in house construction. Recycled polystyrene materials like nylon or pure-water sachet, or even recycled styro-foam can be used to fill the $2^1/_2$ inches gap.

iv). Solar Paneled House: Solar panel could be used as an alternative to power engine that combusts fossil fuels that result in environmental air pollution. Energy from the sun can be tapped by carefully installing the photo-voltaic system on the building for electric

energy power production for house hold use. The panels can be installed at locations that are not in direct angle with isolation effect, since the photovoltaic panel functions best at fairly high temperature.

v). Rainwater Harvesting: This is another new option which can reduce urban draining problems which is creating serious challenge to conventional supply programme, however it is limited in that, it does not include rainwater harvesting, utilization of waste water or any programme for ground water recharge, thus the need for its inclusion

In ancient Japan, India and China and some other Asian countries, tanks, canals, stepwells and check-dam were often built to store excess rain water in flood prevention. The importance of this system lies in the charging of surrounding soil with water for later collection, water supply, storing of water in area where the groundwater is already toxicfied or with polluted surface water [3]. The reviving of this dying old wisdom is necessary; it will help avoid over-flooding that tends to create heat aquifer when undergoing evaporation that often culminates in heat stress on the atmosphere and global warning.

b) NON-TECHNOLOGICAL BASED INNOVATIONS: STRATEGY FOR SUSTAINABLE GREEN PROJECT MANAGEMENT

Constructing sustainable engineering infrastructure is approached in different ways with different priorities in different countries ranging from ecological impact on the environment, economic, social cultural consideration, density and demography of population, availability of land and water, energy production and supply, loss of natural habitat to lack of adequate facility to handling and resultant waste processing. So also strategies that could be adapted varies, however the some of the proactive strategy recommend could be any of the following or combination of more than one. Integrated project delivery system, re-engineering of construction process, environmental quality of construction, new construction concepts, assembly and disassembly approach, public awareness, setting of benchmark for regulation and best proactive, research and development, capacity building of construction sector, and energy conservation.

(i) Integrated approach in infrastructural design and construction: (I. A. I. D. C.) Because there is tendency for design process to increase in importance and complexity, there is therefore an urgent need for an integrated approach requiring among others co-engineering partnership between designers, engineers, and manufacturers. This will engender work cohesion in changing design information for an optimized alternative. This will enable adequate feedback

for future design and improvement and as well information on best approach to maintain the existing infrastructure, so as to sustain them in from, structure and function.

(ii) Process management (P.M): Management and Organization of key factors that comes to play in sustainability issue is as important as the concept itself. The subject must engage other issues not only technical aspect, but as well social, legal, economic and political matter. A structuring of the maintenance problem must be done in such a way that the complex interrelationship can be modeled for communication purpose. Also, a system of measuring progress must be put in place so that the extent of progress achieved can be appraised. A management framework must be developed which allows for planning, design, construction, monitoring and feedback on sustainability, as a key element in the development occupation and maintenance of infrastructures.

(iii) Integrated project delivery system: Multi stakeholder research network **(I. P. D. S):** An integrated delivery system is needed if the sustainability of engineering infrastructure will be realizable. Key actors involved are to be galvanized, from federal government, state government, and local government to designer, client, manufacturers and suppliers. Research has revealed that public infrastructures are poorly maintained, the federal government then should ensure the development of clear national sustainable policies and plans, local governments on the other hand holds key responsibility for land use, planning and implementation of sustainability policies as formulated by the federal government. Designers, builders and clients are responsible for reducing construction energy in building as well as non renewable resources. Thus builders, management and designers, are also to be responsible for increasing the recyclable material contents of building, waste generation and detoxification to produce an eco-friendly by-products.

(iv) Re-engineering of the building and maintenance process: The penetration of new technology will lead to better output. New technology that involves better management of infrastructure development process through total quality managements and improved project coordination facilities as well as proactive maintenance system will be of immense value. This will help to large extent in having sustainable development.

(v) Improvement of environmental standard in construction and maintenance of engineering infrastructures: There should be a clear policy as regards standard obtainable in design, construction and maintenance of infrastructures. Paradigm should shift in the direction of "Green building Concepts." According to [1], Green buildings are designed to meet certain objectives such as protecting occupant health, improving employee productivity, using energy, water and other resources more efficiently and reducing the overall impact to the environment. In this vein however, Green infrastructure is being advocated. It is high time that construction stakeholders shift focus to the direction of Green infrastructure. The infrastructure that will have less operating costs through increasing productivity and using less energy and water; improved

public and occupant health due to improved indoor air quality and reduced environmental impacts.

(vi) Introduction of new construction and maintenance concepts: The penetration of new technology and design concepts, construction and maintenance of infrastructure, will produce an economic and environmental valid construction products. Therefore, synergic approach in this respect, among designers, builders, and material manufacturers is needed to produce advanced products. The development and incorporation of subsystems however should not be cost intensive, the application should be flexible and environmentally compatible and sustainable. New concepts in maintenance should be introduced; introduction of Total Maintenance Operation Management (T. M. O. M.) is advocated. T. M. O. M. is a technique that involves appraising techniques used in maintenance of an item, with a view to establishing an optimized approach better in term of quality, and fair in term of cost and as well pliable in the aspect of environmentally friendly by-products.

(vii) Incorporating eco-friendly construction materials: Studies reveals that people spent 80-85% of their time indoors, and most of the building materials often used in construction emits fumes and odour. The odour and emission from such are often poisonous, the effect can be carcinogenic or mutagenic, while other effects includes but not limited to the following: dizziness, memory loss, skin problem, respiratory tracts infection, migraine, headache, allergies of diverse kind, disturbance in biological functions and damage of cellular growth and genetics and destruction of ecosystem. Therefore eco-friendly materials are needed in construction work in order to sustain life and structure, which uses the construction products and bye products.

VI. CONSTRUCTION OPERATORS' PERSPECTIVE TO TOTAL MAINTENANCE TECHNIQUE MANAGEMENT [TMOM]

Total maintenance technique management, is a system that will make managing quality at different phases of development project or construction of infrastructure possible. The system incorporates the aspect of construction, design and maintenance to be able to provide an insight into ingredients for sustainable development. The detail of the aspects involved in Total Maintenance Technique Management (T.M.O.M.) from infrastructural user perspective is presented in the table (1) below.

Table 1: Analysis of Response on Total Maintenance Operation Management (T.M.O.M.) structure.

Total Maintenance Operation Management				
S/N	**T.M.O.M Principle**	**Total**	**M.I.S Val**	**RK**
A	**Quality Policy**			
	1.Policy of maintenance method to be used should be clearly defined	52	0.92	4
	2. Employee should be involved in decision making.	62	0.85	28
	3. Standard of works and operational quality should be clearly communicated.	55	0.91	7
	4. Quality assurance team should be formulated.	55	0.92	4
	5. Period retrospective check on successful implementation essential.	57	0.91	7
B	**Communication, Authority and Responsibility**.			
	1. There should be effective communication of information on work quality standard to the maintenance personnel.	61	0.88	16
	2. Management should convey meeting on quality in maintenance issue periodically.	57	1.00	1
	3. Policy implementation committee need to be established	59	0.54	32
	4. Delegation of responsibility is essential for over operation success	57	0.88	16
	5. Establishing line of command is essential.	54	0.89	14
C	**Work Environment**			
	1. Work environment should conform to international standard.	45	0.92	3
	2. Adequate ventilation, first aid and personal protective items should be available	55	0.91	7
	3. Work schedule should be flexible to minimize error and accident.	43	0.88	16
	4. Man-machine convenience should be given consideration	45	0.86	23
	5. Provision of incentive to enhance productivity.	55	0.91	7

D	**Manpower Training and Development**			
	1. Skill workers should be sufficient in companies/ organizations maintenance operations.	44	0.86	23
	2. Workshop, Conference should be organized for workers.	43	0.96	2
	3. Refreshers courses is essential for on-job development.	43	0.93	3
	4. Rotational of job-bits for workers job-experience universality	43	0.93	3
	5. Mechanization of production processes operation	48	0.92	4
	Measurement and Precision			
	1. Emphasis is usually on getting the work done correctly once and always	34	0.87	21
	2. Periodic measurement of maintenance quality management.	46	0.87	21
	3. Item repaired last long before developing faults.	42	0.50	35
	4. Fault developing period on maintained items are as follows:			
	Below 5 months.	47	0.55	34
	5-10 months.	48	0.85	28
	10 months and above			
F	**Performance Monitoring**			
	1. Conventional method of detecting faults should be in place	59	0.88	16
	2. Human-based inspection method should give way to conventional method	65	0.80	30
	3. Personnel should be taught fault recognition techniques.	55	0.91	7
	4. Personnel should be taught ways of assessing maintenance works done.	56	0.90	12
	5. Frequency of corrective operation (rework) should be noted as performance index	71	0.88	16
G	**RESOURCE ALLOCATION BUDGETING**			
	1 Resource should be allocated for works in every fiscal years.	50	0.86	23

	2 Financial allocation should exist for emergencies.	40	0.74	31
	3 There should be budget for routine maintenances.	48	0.90	12
	4 Progressive auditioning of operations.	51	0.86	23
H	**QUALITY COST OBJECTIVE.**			
	1 Minimizing Expenditure to maximize profit.	45	0.59	33
	2 Having maintenance expenditure base on machine/equipment age/utilization	50	0.85	23
	3 Allowing contingencies for tools and incidental: internals and external failure	50	0.90	12

SOURCE: 2005 SURVEY

LEGEND: MIS VAL -- Mean Score Value.

RK: Rank.

VII DISCUSSION OF RESULTS/FINDING

The cumulative figure of respondents' opinion as regards issues on application of Total Maintenance Operation Management principle in maintenance operation is presented in Table 1, the Mean item score is also calculated of the Data generated there from. However it was discovered from the table that: Sensitization of personnel i.e communication on the issue of quality as regards various maintenance operations top the list, with mean item score 1.00 that Management of organization should convey periodic meeting of the employee, which will provide a forum of discussion on quality issues; this will enable issues of bottlenecks in operation to be discussed and solved.

Manpower base of the organization needs be consolidated, through driving qualitative personnel development programme, this was ranked second (2^{nd}) with mean item score 0.96, that qualitative knowledge and skill could be acquired through workshop, seminar, vocational skill acquisition programme. Organization of refresher courses was ranked third (3^{rd}) with mean item score 0.93, this is essential to keep personnel abreast current technological development in their

area of discipline since organization at all facet in life has been the order of the day since the inception of concept of globalization .So also communication of main tenancy policy to all and sundry, mechanization of production processes operation and formulation of quality assurance team, were ranked fourth (4^{th}) with mean item sore 0.92. Hand/manual work tends to be monotonous and tedious, is slow and retards efficiency. Certain operation could be carried out more rapidly and efficiently if machine were used in carrying them out. The nature of maintenance policy in place should be well defined and communicated to personnel, this will enable them to share the vision burden, clear communication of the policy gives an organization focus and direction and results in a well structure that favors productivity.

As well important is the formulation of quality assurance team, this teams major preoccupation is check and control of the quality in production system. This culminates in a concept of self-driven team, they generate/originate ideas, formulates quality policy and set up framework for its implementation. So also, an organization that desires enhance output will hold in high esteem the upholding of standard work among its workers, thus from table 1, clear communication of standard of work and operational quality, periodic retrospective check on adherence to quality in maintenance operations, provision of incentives to enhance productivity and teaching of personnel the art and skill of fault recognition in maintenance operations, were ranked seventh (7^{th}), with mean item score value 0.91. The personnel need to be empowered, with skill and techniques useful in recognizing fault during maintenance works; this lessens the burden on supervisors, and would held forestall delay and unnecessary re-work.

Incentive provision is also essential in encouraging workers on to higher productivity, the incentive induces higher productivity, when well managed and administered. The incentives could be Financial incentive, Non-financial incentive or combination of both. The incentive nullifies dissatisfaction among workers and enables them to put in their best. An incentived maintenance workers will be effective at work, efficiency is high, waste is reduce and productivity per head is enormous. However, the incentive mentioned above alongside with provision of first aid and personal protective items are all means of eliciting higher productivity from workers. Periodic retrospective evaluation of result achieved as regards policy implementation is necessary; this should be observed, in order to determine the extent of success attained, in order to call for policy reformation or re-programming.

From the Table, Establishing line of command, Job-bits rotation, were ranked fourteen (14^{th}) with mean item score 0.89; Establishing line of command is necessary for effective instruction and information dissemination as well as job-bits rotation, this prevent exhaustion, job burnt-out, and work monotony, it also allows for experience universality.

In line with the above, is establishing flexible work schedule, delegation of responsibility, effective communication work/operations quality, and using conventional methods in fault detection for purpose of maintenance work, were ranked sixteen (16^{th}) with mean item score

0.88. Work schedule should be flexible, this prevents overwork, work fatigue and dissatisfaction that could lead to work accident or exhaustion, which is counter-productive, authority, needs be delegated for effective administration, and overall success. So also conventional method should give way to primitive fault detection method that are ancient and outdated, computerized fault detecting gadget should be employed e.g. calibrated electronic fault detecting devices.

Minimizing Expenditure to maximize profit is ranked thirty-third (33^{rd}) with mean item score 0.59, maintenance operation incurs expenditure by its nature, thus it is not profit oriented, thus adequate expenditure programme should be in place. Emphasis here should be getting the operation carried out correctly once and always, with periodic measurement of maintenance quality management to ensure consistency, this will enable items maintained to last before developing fault, to this end however, the suggested window fault detection period that could be abstracted is benchmarked at period of 10 month and above, this will tend to lesson expenditure.

VIII. CONCLUSION/RECOMMENDATION

With reference to the discussion above sustainable approach to maintenance of engineering infrastructures could be achieved using the following benchmarked parameters:

(a) Introduction of new construction and maintenance concepts.
(b) Integrated approach in infrastructural design and construction.
(c) Empowering workers through knowledge base consolidation approaches such as: Seminars Workshop, Vocational acquisition course, and Refresher course
(d) Clear communication of maintenance policy to all stakeholders.
(e) Incorporating eco-friendly construction material into building at building stage
(f) Formulation of quality assurance team to oversee various maintenance operations.
(g) Mechanization of production processes where necessary.
(h) Periodic retrospective check on process/success achieved at various policy and operations.
(i) Provision of good environment, well ventilated workspace, first aid and protective items.
(j) Site work environment
(k) Reengineering of building and maintenance process.
(l) Improvement of environmental standard in infrastructures construction and maintenance
(m) Provision of incentives (financial and Non-financial).
(n) Adoption of
(o) Teaching of maintenance personnel/crew the art and technique of fault recognition for purpose of maintenance.

(p) Provision of contingencies for tools and incidentals: internal and external failures.
(q) Provision of budget for routine maintenance.
(r) Teaching personnel ways/method of assessing quality of work married out.
(s) There should be effective communication of information on work quality-standard to personnel
(t) Delegation of responsibility
(u) Work schedule should be flexible to minimize error and accident.
(v) Using conventional method in fault detection during maintenance operation.
(w) Financial allocation should be put in place for emergency.
(x) Maintenance allocation should be ranged based on frequency of equipment utilization, and period of purchase.

If the above could be observed, productivity will increase among maintenance workers, accident will be reduced, incidence of rework and waste will be eliminated and there will be quality job output. Also, green projects such as Green Buildings will be achieved, Buildings and infrastructures that are eco-friendly in minimizing the negative environmental consequences by lessening changes to the local environment, through using recycled or recyclable materials, renewable energy system and management of attendant waste, this is needed in this generation if we to leave the world better than we met it.

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