WASTE MINIMIZATION THROUGH EFFECTIVE CONSTRUCTION MANAGEMENT IN THE BUILDING INDUSTRY

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Abstract

Waste, analogous to loss, forfeiture, expense, cost and detriment is a common phenomenon in all aspects of human existence, including the construction industry. Its direct eminence is felt on time, energy, resources, effort, output etc. It is on this note that this paper is considering savings in construction through waster minimization that spread from conceptual through handling over stages of project development. The paper however, identified the two broad stages in Construction Management (pre-contract and post-contract), and spelt out responsibilities of the parties involved in these stages. Further discussion was made on types and classification of waster according to the two broad stages in reference and measures suggested towards minimization. The paper finally concluded by making recommendations regarding training and other devices through which site management could be improved and waste drastically reduced in the building industry.

Introduction

Waste, inevitability in all human endeavours, comes in different forms and dimension. In the Building Industry, its manifestation is mainly felt in time, materials and human (labour) resources, which eliminate into cost escalation and profit loss in project execution/administration. Of the three identified components, waste from construction material is the most significant, evident and difficult to eradicate. Olateju and Olusola (1997), out material component of a building project at 30 - 60 of the total cost. An excerpt from a Builder's Field Guide published by the NAHB. Research Centre, USA claimed, "8,000 lbs of waste are typically thrown into the landfill during the construction of a 2,000 square foot home". BRANZ (2002), has it that "*In Auckland alone, about 146,000 tones of construction waste is dumped in landfill every year. "*

This paper is therefore, paying more attention to the reduction of material waste with particular reference to its solid industrial state in the building industry in order to:

- Save costs
- Reduce unnecessary use of materials
- Improve work habits
- Enhance the environment, and
- Sustain standard of living through savings now and in future.

Effective Construction Management through efficient and well-articulated design teamwork is however, viewed a major tool in achieving the above set goals. This, the paper believes would address waste minimization in materials, time and human resources at the pre-contract and post-contract stages of building projects. According to R. S. Means (2002), "Owners are beginning to realize that the value of the team's time spent coordinating early in the design process is likely to be returned several times over in lower construction and operation costs." A "third stage" of contract administration so to say, is being highlighted as operational and maintenance costs by the author.

A general overview of parties in the Construction Management team (design team) vis-a-vis' their responsibilities, waste classification, types, waste minimization measures and recommended suggestions, further constitute relevant issues for discussion in the text.

Stages in Construction Management *Pre-Contract Stage*

Esenwa (2004), analyzed eight different operations at this stage to include:

i. Inception/Project Planning - where project briefing, project consideration, organization setup and appointment of Architect or a Project Manager is

established.

ii. Feasibility - where site studies, right of ways, right of light, easement and other preliminary investigations such as geological records, soil conditions, sewer lines, etc. are made.

iii. Outline proposals - sketch plans relating general approach to layout, design, etc. are put in place.

iv. Scheme Design - all briefs and decisions on the project are made including-planning arrangement, constructional method, outline specifications, costs and obtainment of all proposals.

v. Detailed Design - final decisions on all design mattes are made, including specifications, construction and cost of any part or component of the building (working drawings).

vi. Production Information - where Clients are to make decisions and take action on matters of such details in the agreed brief, while Consultants obtain specialist quotations and/ or agreed Prime Cost (PC Sums) including contract particulars for preliminaries.

vii. Bills of Quantities - production of complete document and arrangement to obtain tender.

viii. Tender Action - adoption of either open or selective tender to appoint contractor on the job.

Post-Contract Stage

Three broad operation analyses were made to include:

i. Project Planning - involving signing of contract documents, handing over of site to contractor by the Client through the Architect and preparation of program of works.

ii. Operations on Site - involving honouring of certificate, preparation of progress and early appointment of maintenance staff by the Client.

iii. Completion - handling over for occupation, defects rectification, settlement of final, accounts and honouring of final certificate.

General Overview of the Design Team vis-a-vis their Responsibilities

R.S. Means (2002), highlights the functions of the Design Team as follows:

- Owner / developer vested with legal power to improve-the property. He prepares the brief; appoint the prime consultant and takes responsibilities for the finances.
- Architect ascertains the owner's requirements, creates the building design and administers the construction contract.
- Landscape Architect affects sustainability of the grounds and also impact energy use by sitting and planting to provide shade and / or wind breaks.
- Structural Engineer integrates a variety of design requirements including window openings and need to withstand physical forces.
- Civil Engineering decides issues of site sustainability.
- Mechanical Engineer calculates energy use and thus, informs all other team members of the life-cycle energy use implications of design decisions.
- Electrical Engineer in addition to designing an efficient system integrate use of innovate sources of power, such as co-generation or solar energy.
- Plumbing Engineer saves resources with fixture and pipe layouts and material selection and also by specifying low-flow fixtures and minimizing pumping power.
- Interior Designer has an opportunity to specify recycled furniture, furnishings and fixtures as well as appropriate colour and reflectively, which allow a lower lighting level and furniture-upholstery options that are durable and comfortable over a wider range of temperature.

Lighting Designer makes decision critical to both occupants' well-being and life-cycle energy use.

HVAC Consultant recommends right-sizing the system or using innovative methods such as displacement ventilation or solar or geothermal heat that can save energy and improve indoor environmental quality.

Environmental Building Consultant would make recommendations regarding the impact of building materials as they are produced and the waste they generate in the construction processes and over their product life cycle.

Waste Management Consultant might have ideas on how to minimize construction waste and also how to enhance the facility's recycling capacity over its life.

Contractor and the trades should be consulted early, not only to ensure the constructability of the design, but also because the trades are often the best source of ideas for innovative improvement.

Commissioning Agent should be involved from the pre-designed phase, beginning with the end in mind.

Classification of Waste

Here, wastes are being classified according to their origination from the different stages of contract administration.

> Waste at the Pre-Contract Stage

These are conceptual-bound wastes originating from:

Client:

- Indecisiveness of the Client in brief specification leading to amendment, demolition, alteration, etc in the course of construction.
- Insufficient clarification of land matters leading to chaos, wanton destruction of life and property, project abandonment, etc.

Architect:

- Architect's choice / analysis of grid, forms, space, shapes and dimensions leading to multiple off-cuts.
- Improper integration of all other Consultants' output before commencement of construction resulting in amendments, alteration and demolitions.

Architect/Client:

- Wrong specifications/insufficient knowledge regarding availability and serviceability of products leading to alteration, fluctuation and excessive maintenance.

> Waste at the Post-Contract Stage

There are mainly construction-bound wastes originating from human, material and time resources.

Human Resources

- Inappropriate use of skilled and unskilled labour.
- Excessiveness and redundancy in labour.
- Low labour efficiency and productivity. Olomolaiye (1984), in his findings revealed that an average of 44%, 51% and 56% of carpentry, bricklaying and iron bending workers' time respectively are spent on productivity, while their remaining time is either spent being idle, taking instructions or waiting for materials.

Material Resources

- Sourcing and quality control in material procurement.
- Material transportation.
- Material storage

• Material fixing

Time Resources

- ❖ Additional interest on loan.
- ❖ Failed target.
- ❖ Price fluctuation.

> **Wastes at the Post-Occupancy Stage**

These are mainly operational and maintenance-bound wastes.

Operational Costs

- ❖ Costs accruable to ill-functional/designed building services operations.

Maintenance Costs

- ❖ Frequent replacements due to poor workmanship and / or poor quality material.

> **Wastes from Other Sources**

These include natural-bound wastes such as wind, hurricane, earthquake, erosion, etc; war and other disaster-bound wastes.

Types of Construction Wastes

Construction waste, which can extensively be classified - domestic or industrial, comes in three basic forms of solid, liquid and gases. As stated earlier in the introduction, this paper is limiting discussion to building material waste in its solid form.

According to Butler (1992), construction wastes are of two broad divisions - *Direct waste and Indirect waste*.

Direct Waste: This category of waste related to complete loss or irreparable damage to goods/materials in the course of:

- ❖ Transportation as loss/damage in transit.
- ❖ Storage as per the result of poor stacking, pilfering and vandalism; and
- ❖ Installation with respect to fixing, removal and dressing.

Other types of waste in this category include:

- ❖ Cutting / conversion waste - off-cuts/dressing from wood, sheets boards, etc.
- ❖ Design waste arising from dimensional inaccuracies {especially in pre-fabricated components).
- ❖ Inaccuracy waste - arising from wrong measurements, setting and generally poor workmanship from tradesmen, apprenticeship and labour on site.
- ❖ Make-up waste - in the form of hacking, felling, rendering and plastering to fit.
- ❖ Excess material wastes, which include left over resulting from over estimation, excessive batching, over supply, unfavourable weather conditions, etc.

Indirect Waste: This category of waste refers to all materials misused or used in excess of provisions in the contract bill in the form of:

- ❖ Substitution waste - due to excessive availability of the substitute (even when it is of higher grade) on site.
- ❖ Negligent waste - due to incorrect judgment, over-design, insufficient in formation/misin formation.

Waste Minimization Measures

Discussion was focused on measures required to ∧ improvement on the roles of the construction team as stipulated below:

- Client / Developers should endeavour to properly articulate their desire in the design brief, appoint competent Consultants and generally resolve all outstanding issues on land transactions before commencement of project.
- The initial step in a construction waste reduction strategy is good planning. Design should be based on standard sizes and materials ordered accurately.
- Use of high quality materials such as engineered products reduces rejects. Likewise, use of prefabrication where possible should be considered as this generates less material waste.
- Ensuring accuracy in drawings and supporting information.
- Buildability and serviceability should always be considered in all project design.
- Tender consideration to merge quality and cost considerations.
- Ensuring proper site organization / layout to reduce time and labour waste on site.
- Ensuring proper storage systems, security, record keeping and stocking.
- Adequate knowledge of material sourcing, quality identification / control, safe transportation, etc required by the procurement management team.
- Employment of skillful and highly efficient tradesmen to ensure quality workmanship and yield high productivity,
- Thorough supervision by Consultants to ensure non-compromise of quality and standard.
- Waste materials to be re-used / recycled as much as possible.

Recommendation and Conclusion

As much as construction waste cannot be totally eliminated, it can be drastically reduced. It is therefore advisable that the 5R principles of reducing material waste should always serve as guide in all construction work.

- ✓ Reduce by producing less waste in the first place.
- ✓ Reuse materials again where possible.
- ✓ Recycle by separating materials for easy sorting.
- ✓ Recover
- ✓ Residual disposal of non-recyclable or re-usable materials safely.

The following recommendations are however, suggested as further means of ensuring waste minimization and improving Construction Management.

- Construction Management course should be introduced into the curricula of all construction professions at all levels on the tertiary institutions.
  - More awareness should be created on the waste recycling in the construction industry through organization of seminars and training by the construction professions.
- Technology for waste re-cycling to be improved upon.

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