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Achieving Optimal Resources Utilisation through Efficient Integration of Project Management Systems and Techniques – An Overview

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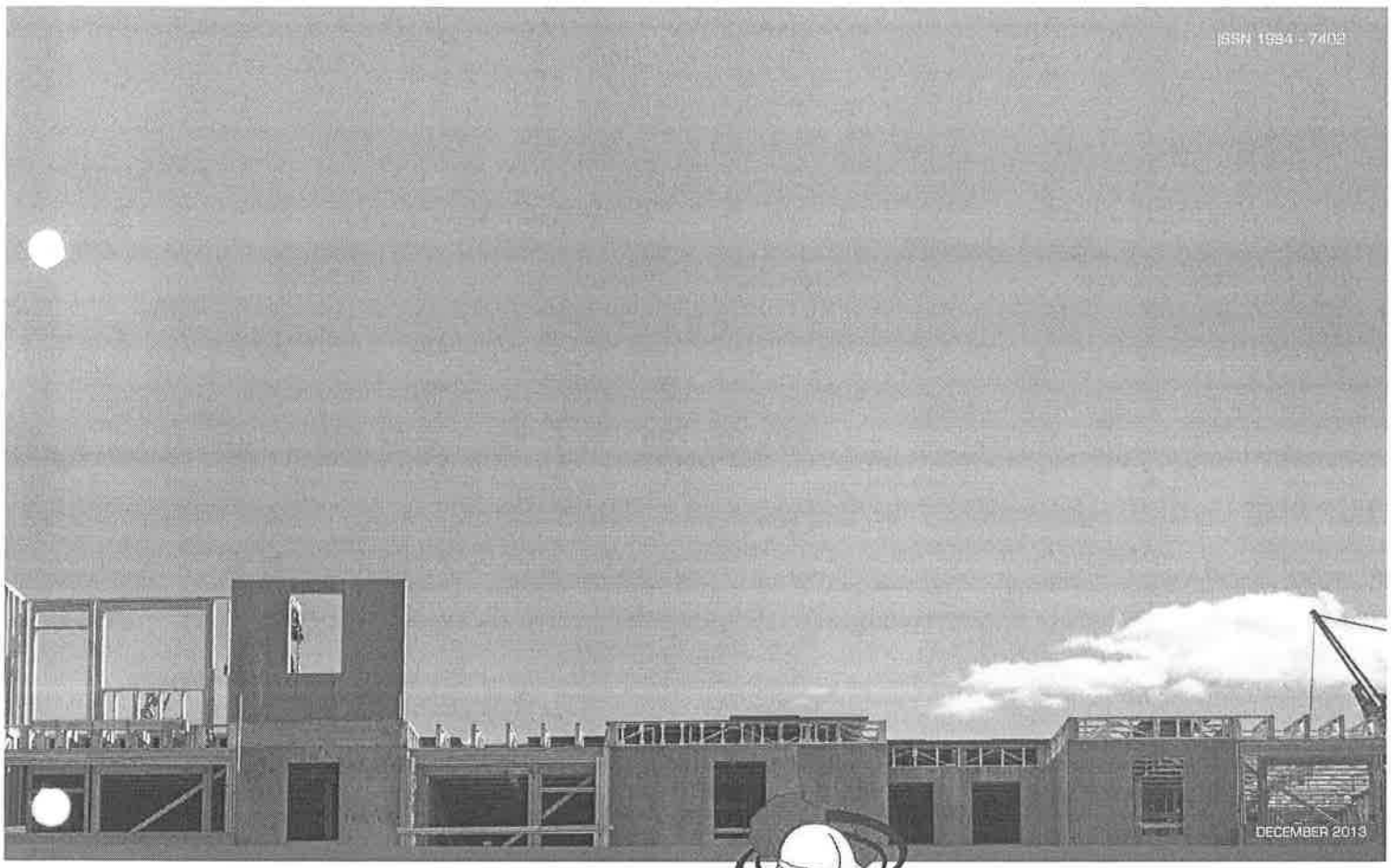

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FROM THE PRESIDENT'S PEN

Dear ASOCSA members, Councillors and Industry Stakeholders

We had a successful 7th Built Environment Conference and I would like to extend a special word of thanks to PPC for its support of this event.

I would also like to welcome our new Councillors:

- Prof Ayman Othman from the British University in Egypt (BUE), who is also the Deputy-editor of the *Journal of Construction*
- Prof T Mentz, the Head of School of the Built Environment at the University of Pretoria who is also the new Chair of the Heads Meeting
- Prof Cristina Trois, Dean of the Faculty of Engineering at the University of KwaZulu-Natal
- Mr Michael Border from the Central University of Technology
- Mr Henry Pretorius from the University of the Free State
- Dr S Mashamba of the National Council of Contractors (Zambia)
- Mr S Moipolai of SITLS, a private member
- Mr A K Mahomed from the Durban University of Technology
- Prof Andre van Graan of the Cape Peninsula University of Technology

Please visit the ASOCSA website at www.asocsa.org to see photographs of everyone.

The 8th Built Environment Conference will be held in Durban from the 23rd -25th July. The conference flyer is available on our website for further information.

I trust that 2014 will show improvement and growth for the Construction Sector in all spheres, consulting, contracting, materials and plant suppliers, and hope to see many of you in Durban in July.

May you all be richly blessed!
Ferdi

F O Fesler
President
ASOCSA
Johannesburg
December 2013

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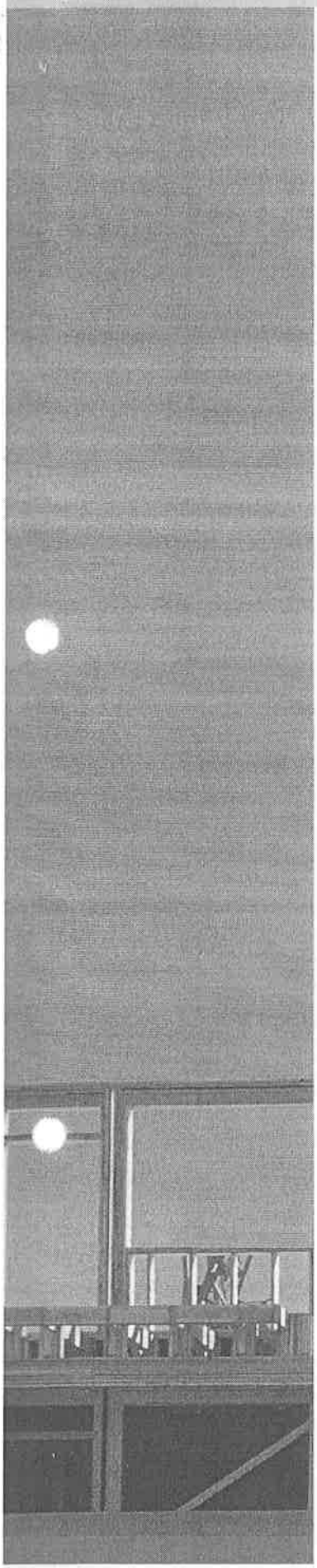

JOURNAL OF CONSTRUCTION

VOLUME 6 NUMBER 2

CONTENTS

EDITORIAL

Towards achieving excellence in construction and overcoming sustainability challenges, the 7th Built Environment conference held in Cape Town from 28 - 30th July 2013, gathered a distinctive group of researchers and practitioners from developed, developing and underdeveloped nations to deliberate fundamental problems and constraints that affect the development and sustainability of the Built Environment.

This last issue of the current volume of the Journal of Construction (JoC) contains four papers, which cover various topics in construction contributed by authors from Africa. Firstly, Agumba and Haupt analysed in their paper the Health and Safety (H&S) constructs and practices that small and medium construction enterprises apply to improve the H&S performance at project level in South Africa. Secondly, Aiyetan in his paper assessed the factors that are responsible for achieving client satisfaction in building project delivery in Lagos State of Nigeria. Thirdly, Lowies, Hall and Cloete examined in their study the influence of behavioural aspects, in particular, heuristic-driven bias and frame dependence, to the decision-making process in a property investment context. Finally, Fapohunda evaluated in his study the different project management systems and techniques, and presented a model towards achieving optimal resources utilisation through efficient integration of these management techniques.

Special thanks to each of the contributing authors and respected reviewers (Aiyetan, Haupt, Oladapo, Othman and Ralegaonkar) for their contributions to the papers in this issue of the Journal of Construction.

Ayman Ahmed Ezzat Othman, Deputy-Editor
The British University in Egypt (BUE)
Cairo, Egypt
March 2014

Since ASOCSA is a registered Section 21 Company all donations are fully tax deductable.

ACHIEVING OPTIMAL RESOURCES UTILISATION THROUGH EFFICIENT INTEGRATION OF PROJECT MANAGEMENT SYSTEMS AND TECHNIQUES - AN OVERVIEW

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ABSTRACT

Purpose: Management of a project is the responsibility of all construction project personnel working within the project province; striving for the successive and successful achievement of the project objective(s). The construction project managers strive to maintain the progress and mutual interaction of various parties involved in project initiation and execution to ensure that the risk of failure is reduced. Thus, maximisation of resources utilisation during the construction process could only be achieved through effective implementation of various management techniques. Thus, this study evaluates different project management systems and techniques, and presents a model towards achieving optimal resources utilisation through efficient integration of these management techniques.

Methodology and Design: This paper review literature and evaluates different construction management techniques and knowledge areas and the effect these techniques on resources utilisation during construction production process. The study establishes the significant of the techniques towards achieving stakeholders' satisfaction and presents a model towards achieving optimal resources utilisation through efficient integration of these management systems.

Findings: During construction production process, site managers are required to be significantly proficient in three groups of abilities: as it is manifested in this paper, the success factors of a site manager are the ability to integrate all management techniques effectively; the ability to utilise all construction resources, (materials, manpower, plant and equipment) economically; and the ability to deliver the construction product(s) within the project scope, project budgeted cost, delivery time, quality and stakeholders' expectations satisfactorily.

Originality/Values: Efficient utilisation of construction resources depends greatly on efficient integration of several management principles and techniques by the site manager. These make the competency of the construction site manager on resources utilisation crucial for project success.

KEYWORDS

Construction management, Construction project, Construction production process, Construction resources, Management techniques, Project managers, Resources utilisation.

INTRODUCTION

Project management is a carefully planned and organised endeavour to accomplish a specific one-time effort. It includes the development of a project plan, definition of project goals, objectives, tasks and specifications, and stipulation of how the project goals will be achieved timely, [1]. Therefore, project management is the implementation of the project plan, to ensure the project stays on its 'critical path' through adequate monitoring and control. That is, to plan and manage the project according to the pre-determined targets at the inception of the project.

Project management usually follows phases with various titles for each phase: feasibility study, planning, implementation, evaluation and maintenance. To achieve the best from a project, the management of projects requires a thorough knowledge of modern management techniques, [2, 3, 4], as well as an understanding of the current design and construction processes, [5].

The management of projects has a specific set of objectives with constraints: delivery of the project within budgeted cost, time frame and quality. While the relevant technology, institutional arrangements or processes differ, the management of all projects has much in common; including the management of projects in specialities or technology domains, (such as in aerospace, pharmaceutical and energy developments). However, project management is distinguished from general management by its mission-oriented nature. The discipline of project management aims at defining and achieving targets, at the same time, optimising the use of financial, human, materials and natural resources. However, project management is generally terminated when the mission is accomplished.

Management of a project is the responsibility of all the construction project personnel working within the project province; striving for the successive and successful achievement of the project objective(s), [1]. Thus, the Project managers strive to maintain the progress and mutual interaction of various parties involved in project initiation and execution to ensure that the risk of failure is reduced.

Project managers can be found in all industries. The numbers of project managers grow rapidly since all industries and organisations realise the immense importance of project managers in project success. As project-based organisations have started to emerge; thus, project management is becoming established as a professional career path and a way of controlling business, [2]. The rapid growth arises due to the need to execute complex works where high technicalities are required for the success and in the use of scarce resources efficiently.

SAs highlighted in much literature including APM [6] and Haughey [2] the essential features of project management are:

1. Project management is not an easy task;
2. Project management has a definite beginning and end. It is not a continuous process;
3. Project management uses various tools to measure accomplishments and track project tasks. These include Gantt charts, Critical Path Methods, (CPM) and Program Evaluation and Review Techniques, (PERT) charts;
4. Projects frequently need resources on an ad-hoc basis as opposed to organisations that have only dedicated full-time positions; and
5. Project management reduces risk and increases the chance of success.

Among the fundamental tasks of a construction project manager indicated in APM [6], OGC - 2 [7] and PMI [5] reports are:

1. Specification of project objectives and plans including delineation of scope, budgeting, scheduling, setting performance requirements, and selecting project participants;

2. Maximisation of resources utilisation through efficient procurement of labour, materials, and equipment in according to the defined schedule and plan;
3. Implementation of various operations through proper co-ordination, monitoring and controlling, planning, designing, estimating, contracting and constructing of the entire process; and
4. Development of effective communications and mechanisms for resolving conflicts among the various participants.

All construction products require to be delivered (within scope, on time and at minimum cost), to meet the project quality objectives. These factors form the classic time, quality, cost triangle as illustrated in Figure 1. Thus, a project is deemed to be efficient and effectively implemented when the project is delivered on time, within cost, scope, and meets the customer quality requirements, (where quality is a constant factor).

These four factors have to satisfy customers' expectations, (Figure 2). However, there are no two customers' expectations that are the same; but, at the point of any project completion, the majority of the customer expectations require to be met. If there is unlimited money and time for a project, management of the project becomes easier, but several projects have limited time frames and are to be executed within a budgeted cost. Thus, effective and efficient time and cost management are paramount for project success. It is therefore pertinent to implement effective construction site management systems during construction production process.

Construction Site Management is the act of carrying out construction processes from inception to completion on site. The management involves planning, co-ordinating, controlling, organising and forecasting a viable operational system for project execution, [1, 8]. Management of the construction site also involves the act of motivating the participants and maintaining efficient and effective communication between the stakeholders. These functions are manned by the construction site managers, whose responsibility is to execute the project successfully on behalf of the client and/or the organisation.

In practice, a construction project is rigorous and difficult to manage due to the characteristics nature of the industry. Fluctuating workloads, complex and non-unique projects, a mobile workforce, different sub-contractors and suppliers, various regulatory bodies, and changes in government policy pose hindrances in effective implementation of site management principles and techniques. However, the historical dividing line between design practice and the production process is becoming more blurred due to the increase in the use of different new innovative and contract methods. Such methods are managing contracting, construction management in risk, turnkey project arrangements, partnering and the supply chain systems; instead of the old traditional system.

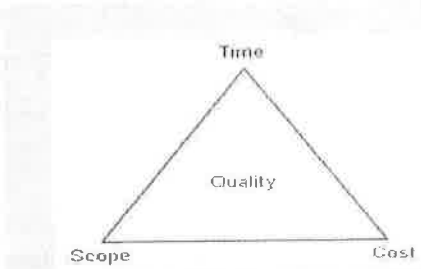

Figure 1: Project's Delivery Objectives Triangle, [2].

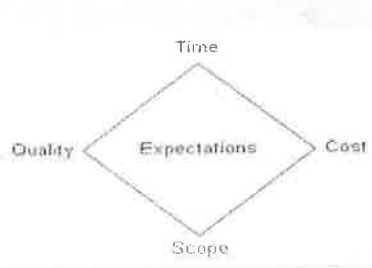

Figure 2: Stakeholders' Expectations Diamond, [2].

Practically, maximisation of resources utilisation during the construction process is achievable through effective implementation of various management techniques, [9]. Thus, towards efficient site management, the major areas requiring site manager's knowledge to Dinsmore [10] and Wideman [8] and as stressed in APM [6] and PMI [5] are:

a) Integration management: this is to ensure that the various project elements are effectively co-ordinated;
b) Scope management: this is to ensure that all the work required and only the required work is included;
c) Time management: this is to provide an effective project schedule for project delivery;
d) Cost management: this is paramount in order to identify needed resources and maintain budget control throughout the construction process;
e) Quality management: to ensure functional requirements are met and delineation of construction non-conformances;
f) Human resources management: to develop effective project personnel, team work and interactions for construction operation process;
g) Communications management: to ensure effective internal and external communications and feedback from all the stakeholders;
h) Risk management: to analyse, mitigate and foresee potential risks and change that may arise during the construction process; and
i) Procurement management: to obtain necessary resources from both internal and external sources as input and convert these resources effectively and efficiently towards output, that is, the construction products.

Other important management systems of required of site managers are materials, machinery and knowledge management systems. These principal knowledge areas form the basis of the Project Management Institute's certification programmes for any site manager in the construction industry, [5]. Thus, this makes it a necessity to evaluate different construction management techniques and knowledge areas and the effect on resources utilisation.

METHODOLOGY

This paper reviews literature and evaluates different construction management techniques and knowledge areas and the effect of these techniques on resources utilisation during the construction production process. The study establishes the significance of the techniques towards achieving stakeholders' satisfaction and presents a model towards achieving optimal resources utilisation through efficient integration of these management systems.

SITE MANAGEMENT TECHNIQUES TOWARDS EFFICIENT RESOURCES UTILISATION

There are several significant management techniques towards achieving efficiency and effectiveness in construction products delivery. Some of the most important are: Knowledge Management; Human resources management; Materials management; Plant and machinery management; and Time management. Also, there are Cost management; Quality management; Risk management; Communications management, and Procurement management. This section evaluates these management techniques and relates their importance in achieving optimal resources utilisation during the construction production process.

Knowledge management

This management system describes the processes that enable an organisation to exploit knowledge and learn from its people. This results in efficiency, an enhanced project implementation, reduction in wasteful resources and cost, and contributes to greater innovation and more success in winning new business. Knowledge management deals with creating, securing and capturing, in addition to coordinating, combining, retrieving and distributing the knowledge, [11]. Noteworthy, knowledge sharing principles between different projects are essential management tools in gaining competitive advantage over competitors, through avoidance of waste and advancement in innovation.

2. Maximisation of resources utilisation through efficient procurement of labour, materials, and equipment in according to the defined schedule and plan;
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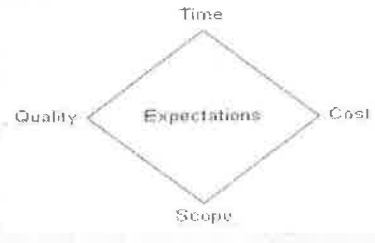

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During project construction, it is necessary for a construction site manager to harness the experience of others; which helps to prevent mistakes that were made in past projects. Re-using experience also limits having to problem-solve from scratch, that is, already-solved problems do not need to be solved over and over again.

The key activities of achieving optimal resources utilisation through the KM sequence (Figure 3) are effective:

Knowledge acquisition

Knowledge to be shared has to be acquired. In view of the construction phase, most information and knowledge comes from the job site. Therefore, knowledge collection on a job site plays an important role in the first phase. In the main office, the content of knowledge collection is the same as that in other industries. During knowledge acquisition, most work is done in the main office because all the information or tacit knowledge sent back from the job site can be transferred to explicit knowledge.

Knowledge extraction

Some knowledge that must be extracted for reuse and storage may reside in the heads of experts and engineers. This issue typically arises in the context of certain problem-solving situations. Mechanisms are required to collect such new experiences when they become available.

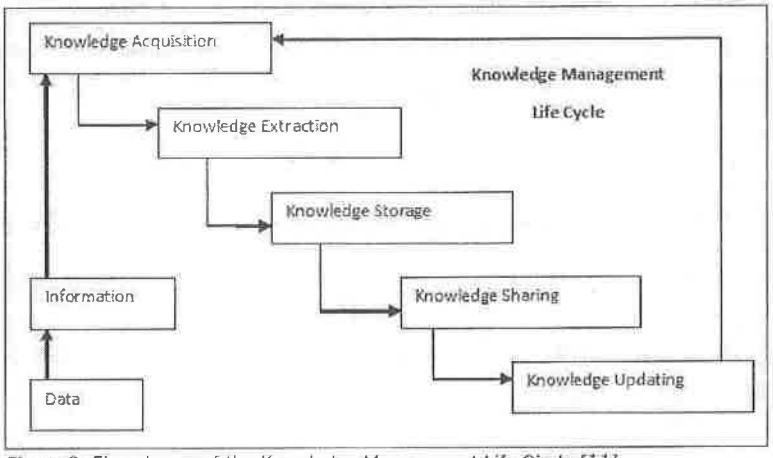

Figure 3: Five phases of the Knowledge Management Life Circle [11].

Knowledge storage

The collected knowledge can be stored for future reuse. During knowledge storage, all information and knowledge are centralised and stored in the knowledge bank (central database) to avoid redundant knowledge. In order to store all information and knowledge in the system, the data must be electronic and be in a standard format for each type of file; such as a specific document format or vector drawing format.

Knowledge sharing

Knowledge sharing is the ultimate goal of knowledge management. After the development of knowledge management, only people who need related-knowledge concerning select projects can access and select appropriate knowledge for reuse. When required, the specific knowledge can be reused and adapted to a new project to solve new problems.

Knowledge updating

Available knowledge and experience need to be updated continuously. During problem-solving reused experience can be evaluated in the context of the new problem to be solved. The evaluation can be in terms of the appropriateness of the selected experience, or in terms of the accuracy and actuality of the retrieved experience. Such evaluation is important to continuously improve the process of experience reuse. Invalid knowledge must be identified and be removed or updated. Knowledge updating can be triggered by a negative experience evaluation or can be performed as a precautionary measure.

Lin and Tseng [11] affirmed five major phases in the knowledge management life cycle; these are: knowledge acquisition, knowledge extraction, knowledge storage, knowledge sharing, and knowledge updating. Figure 3 illustrates the generic of the phases of the knowledge management life cycle. Knowledge to be shared has to be acquired. In construction, most information and knowledge comes from the job site. Therefore, knowledge collection on a job site plays an important role during knowledge acquisition. However, most storage is in the main office, where all the information or tacit knowledge sent back from the job site is transferred to explicit knowledge.

Human Resources Management

Dinsmore [12] stressed that, *"at least fifty percent of the problems that exist in projects are either totally or partially behavioural in nature, while the percentage could be as high as seventy five percent in some project set ups"*. This makes human resources management, (HRM) paramount in project management systems. Humans co-ordinate, manage, delegate, perform, process, decide, approve, solve problems and carry out all the project activities. Thus, the HRM processes require making effective use of people who are involved in the project.

The questions on how to blend project elements and human behaviours outlined by Dinsmore [12] are:

a) What is the best way to blend the talents of key project personnel?
b) How can it be done most effectively to meet project needs?
c) Who should be involved?
d) Should the programmes be extended to various project levels and include all major participants and parties?
e) When should blending be done and who should do it?

In respect of these, the success or failure of project execution depends on the knowledge, skills and abilities of the site manager to effectively and efficiently integrate human resources with other construction resources, (materials and machinery). However, since a human resource is a resource that does lead to wastage of other resources, it makes human resources management vital for efficient project success. Though, in theory, the management of people is not different from the management of other resources in organisations, [13]; in practice, the differences are in the nature of the resources, such as: mobility, adaptability and flexibility.

A human being is potentially a complex creature; whose behaviour is influenced by many diverse factors. This originates from either the individual or the surrounding environment. Bratton and Gold, [13] assert that the behaviour and performances of human resources are functions of at least four variables: ability, motivation, role perspective and situational contingencies. Thus, the three principal processes for efficient human resources management as indicated in PMI, [5] are:

a) organisational planning: identifying, documenting and assigning project roles, responsibilities and reporting relationships;
b) staff acquisition: getting the human resources needed to be assigned to projects and working on the project as a team;
c) team development: the process is to develop individual and group skills that will enhance project performance.

Noteworthy, several managerial problems are technical in nature; many are attributable to human behaviour, while a good number have both technical and behavioural characteristics. However, 'man-made' problems can only be solved by man. Therefore, among the major tasks of a site manager is to lead the site personnel adequately towards achieving the project objectives within the constraints of cost, time and quality. Thus, adequate integration of the people involved, the systems and the techniques are paramount during construction.

Materials management

The largest percentage of construction cost goes on materials as input resource [9]. Thus, efficient utilisation of this resource is of great importance in project success. Materials handling, procurement, inventories, fabrication, integration and implementation require special attention. Poor management of materials leads to large and unavoidable extra costs during the construction process. However, management of materials is not just a concern during the construction stage or where the construction is taking place; rational decision making about procurement of materials is required during the planning and scheduling stages [9]. To save production time during the construction process, sufficient time has to be scheduled for materials delivery at the initial planning stage. Thus, the availability of materials when required greatly influences the delivery of those projects with a tight time schedule constraint.

Materials purchased early hold capital, and in several cases, these materials deteriorate during storage or are stolen. However, delays and extra expenses are incurred if materials required for a particular activity are not available when needed. Therefore, for effective and efficient use of materials, site managers need to ensure their timely flow. The accrued benefits of effective materials' management are:

a) Reduction in material delays;
b) Timely availability of materials consequently leads to improved productivity; and,
c) Improvement in inventory management that leads to a reduction in interest charges, thereby saving costs.

Thus, for a site manager to be assertive in materials management, as emphasised in APM [6] and PMI [5], the following skills have to be developed in addition to other site manager's qualities:

a) A broad knowledge of materials procurement and delivery;
b) Skilful in stock control procedures and techniques;
c) Materials utilisation and wastes control; and
d) Good inventory control such as purchase costs control, order costs and holding costs;
    i. Purchase cost: this is the unit cost of a material from an external source including transportation and freight costs;
    ii. Order cost: the order cost reflects the administrative expenses of issuing a purchase order to an outside supplier;
    iii. Holding cost: this cost is primarily the result of capital costs, handling, storage, obsolescence, shrinkage, and deterioration.

The site manager needs to introduce efficient construction materials planning systems into management techniques in order to determine what components are required on the basis of materials delivery lead time [11]. In addition to this, the manager needs to calculate the periods when a specific component must be available. These will enable the site manager to determine what to order, the quantity to order, time to order, the schedule of delivery and the quality standard. In other words, an efficient materials management system will ensure better handling of raw materials, eliminate project delays and reduce the time activities take, thereby resulting in a reduction in construction costs.

In summary, the main objective of a materials management system in construction is to ensure that the right materials are available in the right quantity and at the right time; to meet the demand on schedule during construction production process.

Cost management

Projects could not emerge without finance or cost implications; these make the effective management of cost and finance paramount for any project success. Finance or cash flow can be regarded as an unproductive input by itself, but it enables production to occur. The conversion processes of finance are concerned with evaluating the demands for finance, matching these to the available funds and allocating the most suitable finances to the uses which will serve the organisational objective best.

Management of project cost includes all necessary processes required to ensure that the project is completed within an approved budget. It also encompasses [6]:

a) Construction resources planning: To determine what resources and what quantities of each should be used to perform project activities;
b) Cost estimating: To develop an approximation estimate of the costs of the resources needed to complete project activities;
c) Cost budgeting: To prepare overall cost estimates to be allocated to individual work items and activities; and
d) Cost control: To control changes to the project budget as the case arises.

Lack of adequate cost control and management to ensure that sufficient cash is available for project implementation could result in bankruptcy or liquidation during the construction process, in some instances, causing project abandonment.

Cost control is concerned with influencing the factors that create changes to the cost baseline to ensure that changes are beneficial; to determine the cost baseline, and manage the actual changes, when and as the changes occur [5]. Also, cost control includes the searching of the 'whys' of positive and negative variances, while these must be properly integrated with the other control processes such as change control, schedule control, quality control, and risk change control to enable construction cost management to be efficient. It implies that efficient cost management systems and techniques are essential for a project's success.

Quality management

Quality management encompasses all activities of management functions that determine the quality policy, objectives and responsibilities; and implementing these by means of adequate quality planning, control, assurance and improvement within a predetermined quality system, [4, 7, 15].

Quality management in construction includes the processes that are required to ensure that the project will satisfy the needs for which is being undertaken or proposed. The need for total quality management in the construction production processes have been clearly explained by diverse authors, [16, 17, 18, 19]. It has been argued that whether total quality management is making an impact on an organisation or is just a passing fad, it remains a debated issue within construction management circles. Imperatively, an effective and efficient quality management system is an important competitive weapon for any organisation's survival.

The three major quality management processes that require attention, [5], are:

a) Quality planning: to identify which quality standards are relevant to the project and determine how to satisfy them;
b) Quality assurance: to evaluate overall project performance on a regular basis during the construction process in order to ensure confidence that the project will satisfy the relevant quality standards stipulated at the outset; and
c) Quality control: to monitor specific project results and to determine that these comply with relevant quality standards set in order to identify ways of eliminating causes of unsatisfactory performance or short-fall of any activities.

Therefore, a construction quality management system addresses both the management of the project at stake and the final product expected of the project in process. Failure in the quality requirements of any project causes negative consequences and dissatisfaction for the project stakeholders.

Some obstacles to achieving total quality management in the construction organisation as stressed by Yong and Wilkinson [19] and in APM [6] and PMI [5] are:

a) Lack of efficient leadership of the construction management team to create the right organisational climate, values, behaviour and culture for total quality management;
b) Lack of long term strategy or vision which often leads to confusion and incompatible projects that could take the organisation in the wrong direction or nowhere at all;
c) Lack of time for the organisation to pursue QM initiatives;
d) Lack of resources and infrastructure. Resource limitations are the most pervasive difficulty for quality programme implementation of many companies, while these resources constraints apply not only to physical and human resources, but also to managerial resources for total quality management; and

e) Lack of action and consistency despite the management team knowing that quality management is essential for business survival; this recognition has not been followed with visible actions, thus, total quality management is becoming a vision without action.

However, the project management objectives are to deliver the project on time, to cost and to specification, [2]: these are easier and more efficient if the organisation implements an effective and efficient quality policy [20]. Thus, in the project management process, there is a need to continuously balance time scales, cost and risk without undermining the performance and quality of the project. In addition, the overall objective of quality management within the construction sector is to adopt new business approaches, increase productivity and reduce costs whilst improving the overall quality of the finished product.

Since quality is the totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs [5, 15], the significance of quality management in the project context is the requirement to turn the implied needs into stated needs through proper management techniques and principles.

Risk management

Risk management is the process that helps organisations to understand, evaluate and take action on all activities containing risk [21], with a view to increasing the probability of success and reducing the likelihood of failure [5, 10]. Thus, effective risk management enhances comfort for project stakeholders and helps the organisation to confirm its compliance with governance requests. That is, it enhances accountability, performance measurement and reward and promotes efficiency at all stages of the production process.

Key success factors in determining efficient risk management within an organisation [5, 9, 10, 18] include the following:

a) Setting a policy and strategy for risk management;
b) Being the primary champion of risk management at strategic and operational levels;
c) Building a risk awareness culture within the organisation including appropriate education and training;
d) Establishing internal risk policy and structure for business units;
e) Developing a risk response process including contingency and business continuity programmes; and
f) Preparing reports for the board and the stakeholders.

Risk management requires a detailed knowledge and understanding of the organisation and the process involved in a business. Risk management includes maximising the results of positive events and minimising the consequences of adverse events, and these involve [5]:

a) Risk identification: To determine which risks are likely to affect the project and document the characteristics of each risk;
b) Risk quantification: To evaluate risks and risk interaction in order to assess the range of possible project outcomes;
c) Risk response development: To define the enhancement steps for opportunities and responses to threats; and
d) Risk response control: To articulate quick responses to changes in risk as it occurs over the course of the project.

Thus, for an organisation to strive, RM starts from the boardroom and to achieve success in the contemporary business world, companies need to redefine risk management since the current simple tactical measures are longer adequate. Thus, what are required are a more expansive strategic vision and a longer term integrated approach, one that embraces strategic control over customers, value drives, and operations [22, 23].

Management of risk in a project is complex, arises from a wide range of sources and has a broad scope of possible effects on any project [10, 24, 25]. Managing project work and project risk is a task that requires a detailed understanding of the organisation and the process involved in the business. The management includes maximising the results of positive events and minimising the consequences of adverse events. Also, an efficient risk management system requires effective risk identification, risk quantification and risk response development and control [5]. There is no reward without risk and therefore, the duty of good management is to take the right risks and the right level of risk at the right time. This implies that strategy and creative approaches to risk management are the key factors of success in any business environment.

Time management

Time management is about controlling the use of resources (encompassing planning, monitoring and regular reviewing of production) with minimal waste of effort to achieve a definite or desired result, [26].

This involves efficient use of time in achieving important goals; doing the right thing at the right time [27, 28]. The project time management process is to ensure timely completion of the project within the estimated time. Time management is a continuous ongoing process of analysing, planning, re-analysing and re-planning. Thus, an efficient use of time to save costs in the construction satisfies the client interest.

Satisfactory completion of projects in relation to cost, time, and quality could be (but is not absolutely) a yardstick for measuring a successful project. However, it is difficult to weigh the paramount factor. Many construction stakeholders are interested in executing a quality project at minimal cost. Conversely, every project has a purpose and the ability to achieve the expected purpose of the project significantly relies on the project delivery time.

Variables that could lead to construction project delay [21] include inclement weather; inaccuracy of materials estimates; inaccurate prediction of artisan production output; inaccurate prediction of equipment production ration; materials shortages; equipment shortages; inadequate planning; poor labour productivity; design changes and frequent alterations. However, effective time management induces personal fulfilment and self-regard for completing the project within the budget period without jeopardising the cost of construction and quality.

To achieve the best outcome through time management, the following aspects are essential, (10):

a) Plan to handle a group task logically;
b) Efficient and effective delegation of authority, that is, distribution of authority and power among sub-ordinates;
c) Provision of necessary facilities to undertake a task when due;
d) Good record systems via the adoption of a fast tracking record recovery system that suits each project plan and sequence; and
e) Provision of an effective communication system for both incoming communication and outgoing communication.

In PMI [5], it was affirmed that an effective project time management requires:

a) The inclusion of a tasks time frame in the project plan: to identify how long a task will realistically take in advance and to keep with the allotted time;
b) Deadline of a specific task: to concentrate on sticking to the time frame, if possible to finish earlier and the possible provision of incentives for using time productively;
c) Provision of time lag for time loss: to enable a task possible overruns time frame to be planned to make-up the time without delaying successive tasks; and
d) Provision of incentives: enabling the construction participants' awareness that there are incentives for effective use of time and completion of tasks within the specified period.

The benefits of effective time management in relation to construction project delivery are, [29]:

a) Increase in effectiveness and efficiency of use of construction resources;
b) Enhancement of productivity of building production;
c) Increase in leisure time while delivering the set target at less time, as expected;
d) Reduction of stress of repetition works aimlessly;
e) Creation of room for forward planning and for long term solution for the next stage of work to be done; and
f) Enhanced creativity while saving time gives room for thinking constructively.

"It is one thing to recognise the importance of time at the theoretical level, quite another to do so at the practical and emotional levels. And ... we are best able to appreciate the value time has in our lives" [29]. Thus, to manage time effectively, construction project participants need to have several significant qualities; such as: clarity of thinking, decisiveness, a good memory, punctuality, calmness, and objective rationality [30]. These factors are achievable through good leadership traits, self-assessment, avoidance of provocation, dynamism, effective delegation, setting goals, priority delegation, follow-up and effective communication of the action plan.

Procurement management

Procurement management in construction is the process of acquiring construction resources. Management of project resources procurement is to balance the construction project requirement towards financial accountability, to uphold equality, proximity, fairness and the project specific objective [26]. This process includes the modality of obtaining goods and services for the production process that is outside organisational performance.

Procurement management involves procurement planning, solicitation planning, source selection, contract administration and contract close up [5]. These processes interact with each other to determine what and when to procure, the documentation of products requirements and identifying the potential sources. Also, obtaining quotations from different contractors or sub-contractors and comparing different bids offered for the project. In addition, the procurement management process includes selection of tenders to undertake the production process or the supplier for goods and services and involves managing the relationship of the parties involved and resource supply for project production.

Traditionally, project success factors are measured with respect to cost and time. Tools such as cost/schedules control systems have been developed specifically to monitor project performance with respect to cost and time. However, project procurement is equally paramount in the success of any project. Efficient utilisation of construction resources depends on an efficient procurement planning system employed during the design and construction phases. Thus, procurement planning is a process of identifying which project requests could be best met timely by careful selection from various procurement systems for a particular product or service. It involves consideration of: whether to procure, what to procure, how much to procure, what quality to procure and when to procure? Thus, procurement managers need advance knowledge and awareness of the more rigorous management procedures: tried and proven experience in successfully balancing leverage and control techniques and a demonstrated ability to repeat the success.

Every project has certain unique characteristics; in respect, there is a significant need for the site managers to have adequate knowledge of construction skills that are required for a peculiar project. In addition, towards optimal resources utilisation, the construction site manager also requires various attributes and traits to be efficient in implementing the management principles and techniques adequately.

SUMMARY OF FINDINGS

It is evident from the literature reviewed that, during construction production process, site managers are required to be significantly proficient in three groups of abilities as manifested in this paper, the success factors of a site manager are related to (Figure 4): the ability to integrate all management techniques effectively [5, 6]; the ability to utilise all construction resources (materials, manpower, plant and equipment) economically [31]; and the ability to deliver the construction product(s) within the project scope, (the project cost, delivery time, quality and stakeholders' expectation), satisfactorily [2]. In addition, towards optimal resources utilisation, the site manager requires diverse attributes and traits to be efficient in implementing the management principles and techniques adequately. The relationships of these site managers' abilities, management, stakeholders' project objectives and resources utilisation are illustrated in Figure 4.

CONCLUSION

Efficient use of construction resources depends on efficient integration of several management principles and techniques by the site manager. These facts make the competency of the construction site manager on resources utilisation crucial for project success.

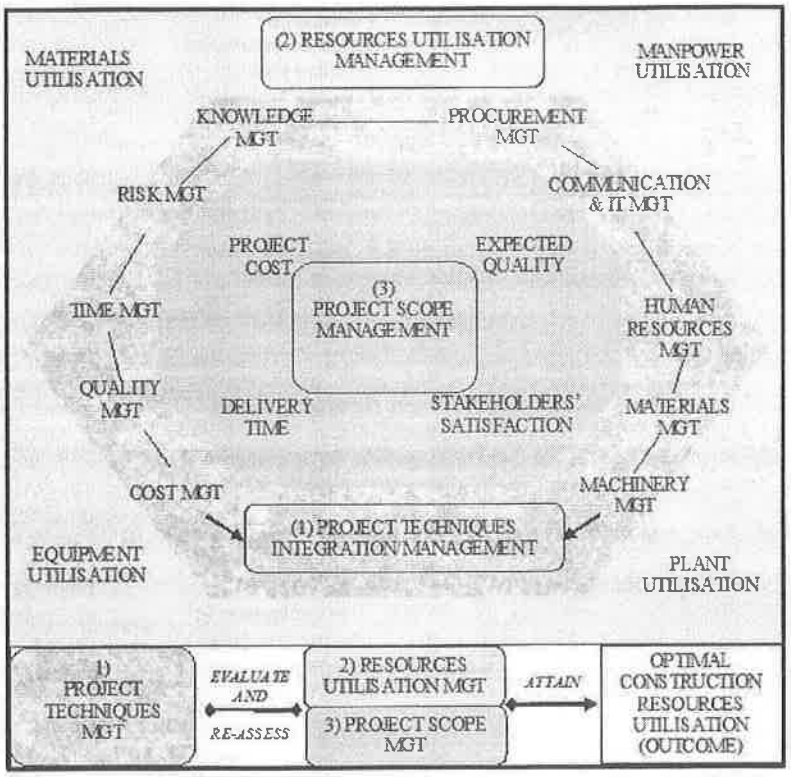

Figure 4: Achieving optimal resources utilisation through efficient integration of project management systems and techniques model.

Key: Management – MGT

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