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The Impact of Project Environment Study on Sustainable Change Control: A Case Study of The Lancasters Hyde Park, London.

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Abstract - *It has been established that construction projects are inherently complex and synonymous with high rate of management failures as a result of change orders and inherent risks. This paper identified studying and tailoring to project environment as an effective change control and risk management process in building construction. This was achieved through a review of literature and a study of an active construction project which led to multiples data collection sources including observatory, survey, and semi-structured interviews. 60 completed questionnaires and 10 successfully conducted semi-structured interviews generated data that were analyzed. From practitioners' perception of construction project environment, this study defined project environment, established its influence on project change orders, and revealed high level of investment made to study the environment as well as efforts to tailoring of project to its environment as a sustainable change control process and its effectiveness. It further identified gap in communication between management and operational teams as the main cause of poor change control implementation. This study developed a sustainable change control model for engineers and all construction managers. This model requires a thorough study of project environment to identify potential change triggers, capturing and monitoring the triggers through the design and execution stages as well as documenting them for future references*

Key Words: Sustainability, Change Control, Project Environment, Lancasters Hyde Park, Risk Management

1.INTRODUCTION

Quantity and interdependency of components is the reason construction projects are complex. And all project management processes should strive to make these interdependencies explicit by increasing the level of integration among the project views (Froese 2010). Ansari (2019) admitted that these complexities are risks triggered by unexpected changes and reworks. Hence, this study examines change control and the role of project environment study plays in change control and risk management. Chaudhry et al. (2019) identified project environment as the main component and influencer of change and risk control. Although owner-generated change orders are most often inevitable, unforeseen or environment-generated change orders are usually avoidable and their risks which are very common, are the causes of uncertainty in construction projects (Riley et al. 2005). Malik et al. (2019) recounted those delays and poor performances of construction projects are caused by environmental concerns. While Ansah et al. (2017) identified poor monitoring, scheduling and planning, poor feedback, ineffective coordination, poor decision making, poor project management structure, ineffective communication, poor supervision, troubleshooting, inadequate experience, conventional project management tools as risks associated with project environment. Consequently, change in plan, change in quality, change in budget, change in estimation, change in schedule require control and management (Ansah et al. 2017). Nonetheless, there are internal and external causes of project change as pointed out by Hayes (2022). This study focused on internal causes of project change which Chaudhry et al. (2019) referred to as project environment generated change and their control process to effectively manage their risks. To elaborate, this study assessed the change control processes used in risk management of the Lancaster Hyde Park project. The review of literatures identified the main gap in the studies and actual practice.

Riley et al. (2005) discovered that while owner-generated change orders are most often inevitable, unforeseen or environment-generated change orders are usually avoidable. In the quest of some researchers to study mitigation of project environment generated change as a control strategy, environment-generated risks were identified as the main cause of construction change orders. These are risks found in project environment and their influence. This study focused on these risks and how to control the change.

1.1 Background of Case Study – The Lancasters, Hyde Park, London

The Lancasters is a £100m residential building overlooking the Kensington Gardens in Bayswater, London W2. This ambitious five-year revival scheme of the old Lancaster

Gate Thistle Hotel features a 130m long/30m high facade retention, the longest in Europe, and excavation of a three-storey underground car park. With 77 lateral and duplex apartments, landscaped gardens, 24-hour porterage and extensive leisure facilities, Northacre's unique ability to fuse traditional architecture with new design and construction is clear to see (Northacre, 2021). It was originally built as 15 houses prior to their later conversion to a hotel. It has been returned to residential use providing beautifully appointed homes with high ceilings and stunning park views. The address is: The Lancasters, 75–89 Lancaster Gate, London W2 3NH (Steele, 2014).

2. LITERATURE REVIEW

2.1 The Construction Project Change and Risk

Molly (2007) defined construction project change, according to the project contract, as extra or additional work, deficient or defective plans or specifications, delay or acceleration in schedule, unforeseen differing the site conditions, or any form of disruption to the work flow, progress and methodology. Referring to Buttrick (2005), change in context of construction project, is any alteration or modification to the project scope, time, cost or benefits that have been initially planned and approved. By these definitions, there can only be a project change if there is previously approved baseline or standard. This baseline and standard have to be provided by the initial project plan and fully documented business case. Project change is an inevitable part of the project life cycle of which if not effectively controlled will cause a deviation from the main objectives, scope, goals and thereafter a total loss in project control. Othman et al. (2004) confirmed that because construction projects are often planned, designed and executed in a very interactive manner as a result, project change occur at the course of every construction project. In construction projects, an opportunity or risk will turn out to be an issue if the event happens to occur as Buttrick (2005) illustrated in Figure 1 below. The issues may be resolved within the initial project scope as defined by the business case, or through project change. If an issue is to be resolved through project change, the impact should be assessed especially with respect to the project requirements.

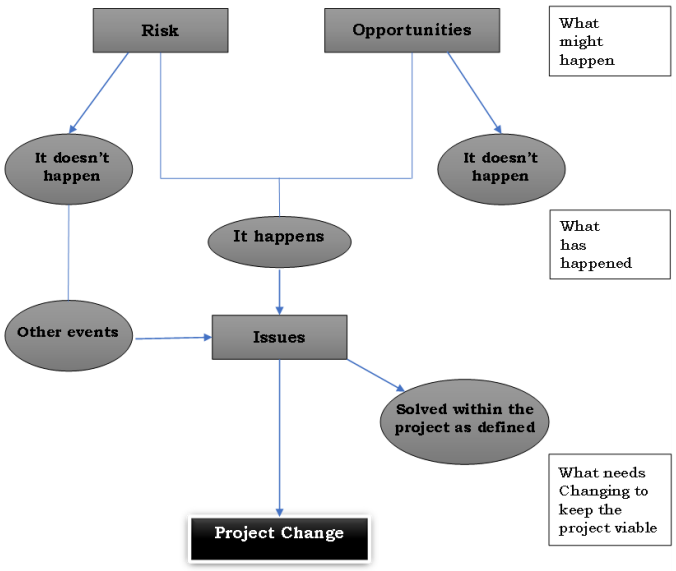

Fig.-1: Project Change (Buttrick, 2005)

2.2 Project Change and Project Environment

In many situations the construction project requirements have always continue to evolve all through the project life cycle (Othman et al. 2004; Isaac and Navon, 2006). The primary causes of construction project change are client-initiated changes or project environment influenced design omissions and errors (Isaac and Navon, 2006). Hanna and Swanson (2007) classified causes of project change and risk on the basis of their origins, they are either caused by external or internal pressures being applied to the project. Change in design, technological changes, change in competitor's activities, change in economy, change in government policies and societal demographic changes are classified as external changes.
While change in project management policies, project environment, change in organizational structure or objectives are categorized as internal (Sexton, et al 2010). Gilbeault (2007) identified three categories of project change, the components of Sexton et al. (2010)'s internal causes he termed unforeseen conditions but added causes like incompatible soil nature during excavation and unexpected adverse weather condition. These are similar to Rahman and Esa (2014) definition of environmental risk as hazard or impending risk to the ecology of whatsoever gradation and comprises all sorts of influences the environment has on the project. While Rahman and Esa (2014) and Gilbeault (2007) are concerned with project environment in context of ecological and nature, Malik el al. (2019) has a broader view of all activities both natural and non-natural that occur and influence a project environment. And this study is focusing on the entire environmental activities and evaluating their contribution to project change and risk.

2.3 Project Change Order

A construction project change order is a written and documented agreement that binds between two parties (Al-Rubaiei el al. 2018). Project change order alter work package originally set out in the project contract. With exception to rare case of project change orders that tends to reduce the scope of work package originally proposed. Ordinarily, project change orders generally cause an increment in the scope of work to be executed (Rita et al. 2016). Project change order constitutes rework which instantaneously impact work scope (Love et al. 2019). The inherent cost of change order is often expensive with the option of competitive bidding or comparison indirectly denied the project sponsor (Rita et al. 2016). The uncompetitive nature of project change orders, may encourage contractors to quote excessive price for rework and execution of the change order. For this reason, McGuiness and Bauld (2009) emphasized the importance of developing proxy mechanism to cross-examine proposed change order for effective cost control. In the quest for effective management of change order, Molly (2007) proposed six steps; evaluate the contract; identify the change; notify parties of change; document the change; prepare the change request; and resolve the change request. These orders for project change are extremely common in most modern construction projects (Ahmed and Arocho 2021), repeatedly resulting increase by 10 - 15% in budgeted cost and time (Serag et al. 2010). Exactly why project change control is a sensitive and complex aspect of construction management (Zou and Lee 2008).

2.4 Construction Project Change Control Process

Based on recent case studies and detailed review of existing researches, a generic construction project change control process model consists of these specific stages.

2.4.1 Plan and Start

As recorded by Al-Rubaiei et al. (2018), The change control and scope management plan is generated at this stage, all the proactive project requirements that are necessary for effective project change control are obtained. These requirements aid the project management team to respond readily to project change, in order to control the change effectively and to enable for contingence plan to be facilitated for any anticipated project change (Sexton et al. 2010).

2.4.2 Identify, Capture and Evaluate

All stakeholder's requirements and specifications are identified, captured, evaluated and documented in this phase with just one goal, which is achieving project objectives (PMI, 2013). The list of project requirements is generated through an in-depth investigation process with clear objectives ensuring no surprises especially from project environment (Monnapa 2017). Generally, this step will provide the foundation for defining and managing the project change and scope (PMI, 2013). This is achievable through a consideration and determination of whether any of the potential project change triggers are present at the course of the project execution (Sexton et al. 2010). OGC's (2009) change control methodology considers this as the first step in the procedure, these step captures the project issue that has been raised which is the cause of the change. As soon as a possibility is identified, change evaluation is carried out to assist the decision-making process with a streamlined project change information (Sexton et al. 2010). The change evaluation procedures will include change implications assessment, and optimum selection of available change options (PMI, 2013). OGC (2009) recommends that at project change approach must be confirmed and the change initiation planned. All contract clauses that entitle all parties to additional fund and time must be examined and clearly understood (Molly, 2007). Of course, You et al. (2018) warn that contract must govern the relationship between uncertainty and opportunistic behaviour within a project environment.

2.4.3 Propose

After a full understanding of the change impact has been gained, OGC (2009) proffered that the next step will be to consider other alternative options of response to the change impact and as well proposing a worthy course of action that will be best taken. A detailed consideration should be given on the effect of each option on the project in reference to time, quality, cost, benefit, scope and risk performance targets (Malik et al. 2019). This is necessary as there ought to be a balance struck between the advantage of implementing the available option and the project cost, time and risk associated with the implementation. (Sexton et al. 2010).

2.4.4 Decision and Approval

As soon as the evaluation process has been completed, the evaluated options carried out will be decided and approved by the appropriate member of the project management team (Al-Rubaiei et al. 2018), which is usually the project manager or in cases of extreme, the project board which is led by the project executive or may be the client, it depends on the nature of the change and the project (Sexton et al. 2010). But unlike Sexton et al. (2010), the British Office of Government Commerce (OGC) according to Kerzner (2017) stated that project change approval is the project board's responsibility. In a case where multiple changes are envisaged, the project board have to delegate this authority to a person or group known as the project change authority. This person may be the project manager and in the case of group may be the project manager and the project assurance officer (Kerzner 2017).

OGC's (2009) methodology further proposed that in cases of anticipated high level of project change tendencies, a budget should be set up to fund this project changes. This can help in addressing cost related conflicts that would arise during construction for a project with frequent high

change request forecast (Rita et al. 2016). Project change budget provides for a more realistic expectation for the overall project change cost/time frame (Ahmed and Arocho 2021). The project change control procedure would have to be defined in a way to control the access to the project change budget. After which the project change control budget is to be documented into the relevant plan (Kerzner 2017). But in order to approve the project change, it is necessary for the team in charge to evaluate the change impact on the project (Al-Rubaiei et al. 2018). There are bound to be several iterations during the change approval process.

2.4.5 Implementation and Review

As soon as the project change is approved, there is need for it to be effectively communicated to all project team members, more especially those whose role is affected by the change made (Malik et al. 2019). Where necessary, adjustment to schedule of work needs to be agreed by the all the project teams involved. The project management team should afterwards review and learn all lessons produced by the process of the whole change event (Sexton et al 2010). British OGC's (2009) Prince 2 methodology referred to this as updating and documentation of the lesson log book which is a product of the issue register and issue report. LeFevre (2019) insisted on integration, specialization, automation, research, organization, value for effective project control implementation.

2.5 Construction Project Change Feedback Process

Years ago, Lee et al. (2005) observed that the traditional network-based tools such as the Graphical Evaluation and Review Technique GERT that have been extensively used in the construction industry, lack the capability to effectively manage dynamic project change feedback due to iterative cycles, which are very common in construction. Lee et al (2005) explained that GERT captures rework iterations via loop relationships amid probability. After a decade, Mubarak (2015) resolved that GERT doesn't provide effective way to deal with dynamic derivative or supplemental activities, which of course are very common in today's construction projects. Although feedback in construction change process may be dynamic and insubstantial, but it affects the construction system (Mubarak 2015).

However, Ghaffar (2020) affirms that naturally, there are organised feedback processes in construction which he presented with the aid of the diagram below. In a gleam of hope, Moonseo (2010) stated that when change task and resources become available, and the change task completely reviewed, then resources for the task can then be commissioned. This task review helps in most cases to identify some hidden changes that can give rise to some more requests which in turn result to change tasks (A) and time delay (B).

As soon as change task is completed, the project performance on the change task is intermittently inspected or monitored to record whether or not the project target quality is met and the cause of the project change task was satisfied. Through this quality management and assessment process, decision to release the completed change task will be reached.

Low quality outcome can trigger (1) changes (C), (2) rework (D), or (3) hidden project changes (E) it depends on the project managers' willingness and readiness to adopt the next change option. And the more delay, the more option that will be adopted (F), for rework to be avoided, which is perceived to of course have costly impact on the project performance.

Because of this construction feedback nature, changes (F,G,H,I,J) can trigger further rework as well as schedule delays. Furthermore, these delays can also make project quality management less thorough (K), this will result to more changes (L). In addition, these changes are likely to cause more change correction requests (M), this is capable of delaying the entire construction progress as cause by subsequent feedback processes (N,I,J).

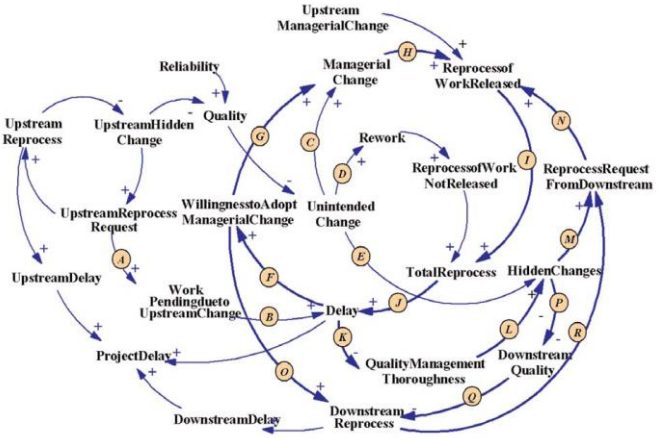

Fig.-2 The construction change feedback process (Moonseo, 2010)

2.6 Change Control as A Risk Management Approach

These orders for project change are extremely common in roughly all recent construction projects, repeatedly resulting to 10-15% increase in budgeted cost and time. (Serag et al. 2010) Zou and Lee (2008) earlier explained that project change control is a very sensitive aspect of construction management and not just that, it is also the most complex to manage.

Generally, the risks associated with project include ineffective coordination, joint ownership conflicts, change in orders, approval delays, financial problems, technical

skills gap, labour unavailability, supervision and communication, frequent disputes, design omissions and errors (Ansah et al. 2019). Professional bodies like Association of Project Management (APM) and Project Management Institute (PMI) have proffered that risk management must be applied to effectively control and monitor to ensure the smooth implementation of project change. Theses bodies also produce professional manuals to guild project managers in daily handling of such risk of project change, through to completion of the project.

Within the context of construction management, it is worthy to note that Ibrahim and Esa (2018) classified risk as not just a negative event, but one with a potential for either positive and negative outcome depending on the control and management adopted. Hence, risk is simply a project opportunity for positive or negative outcome depending on performance. There are two main approaches to managing risk associated with project change: The evaluation and the management approach. Risk evaluation is vital as it confirms on time whether or not a project change is worth initiating. Information about the risk is identified, analysed, for a proper understanding of the risk before onward management. Secondly, there are well-articulated procedures for management of risk as an ongoing process all through the project change control process (Maylor 2010).

For example, Kenna (2008)'s study with objective to the rate of flooding in British construction environment revealed that climate change which is caused by global warming is continuously causing more recurrent and intense rainfall and hence this rainfall increase the risk of flooding. The study concluded that increase in greenhouse gas emission will no doubt enhance the climate change and further unveiled that poor control approach are amplifying this risk. Berardi and Jafarpur (2020) added that construction building design codes and operational processes are reliable on weather data therefore project will be adversely exposed to significantly diverse climatic strains. Lisø (2006) warn that "we are venturing into the unknown with climate, and its associated impact could be quite disruptive". Lisø (2006) identified measures to halt global climate change influence on construction change order through early greenhouse gas mitigation options. Riley et al. (2005) believe that since adjustments and changes are unavoidable, and for more of these adjustments to be accommodated during design phase, design-build process should be adopted since unforeseen change orders are not caused by errors but environmental factors, that design-build project delivery methods have the potentials to decrease the rate of occurrence of construction project change orders.

3. METHODOLOGY

For contextual understanding of an actual project environment, this study adopted a case study - the Lancasters Hyde Park Project discussed under section 1.2. The project was observed and its' stakeholders were surveyed and interviewed. This mixed method study was conducted with fifty completed questionnaires for sampling and ten semi-structured interviews. The participants were drawn from professionals who operated and managed the reconstruction of the Lancasters Hyde Park project. Participants were selected based on their leading role in their respective contracting or subcontracting organisations within the project, with most of them occupying portfolios like Project Secretary, Site manager, Project Manager, Project Director, supervisors and tasks and team leaders etc. Seven of the ten interviews were traditional (physical) meeting which offered a better human connection, lengthy discussion, first-hand assessment of some document relevant to this study, and an assessment of project management organisational structures with an average meeting time of 60 minutes per meeting. The other three participants who were out of London at the time of this study were interviewed virtually via Zoom. These three virtual interviews lasted 27 minutes per meeting on average.

The Lancasters Hyde Park Project highlighted the factors that trigger unforeseen change orders and the control and risk management processes adopted by the project management team, and how successful they were. The survey and interview focused on the project management leadership of the case study project who were randomly selected based on Prince 2 certification of the Association for Project Management, UK. This ensured knowledge of how project change control process can sustainably be improved.

4. RESULTS AND DISCUSSIONS

Prior to the data analysis, the confirmation of data normality was carried out using the Shapiro-wilk test ($p<0.05$), it was then followed by an examination of the QQ plots. This was also followed by a test of the reliability of the data. This was conducted using the Cronbach's Alpha approach, which is a widely used method for determining the reliability of data (Onyia et al. 2021). With a Cronbach Alpha score of 0.72, the reliability analysis revealed an adequate level of internal consistency of the survey instrument.

4.1. Tailoring Construction to Project Environment

As examined in Chapter two, were most of the literatures reviewed stated that project environment is a factor that causes change. Most of the project management methodologies applicable in the construction industry

recommended that projects should be tailored to their individual environments (Chaudhry et al. 2019). This was tested in this study through a survey.

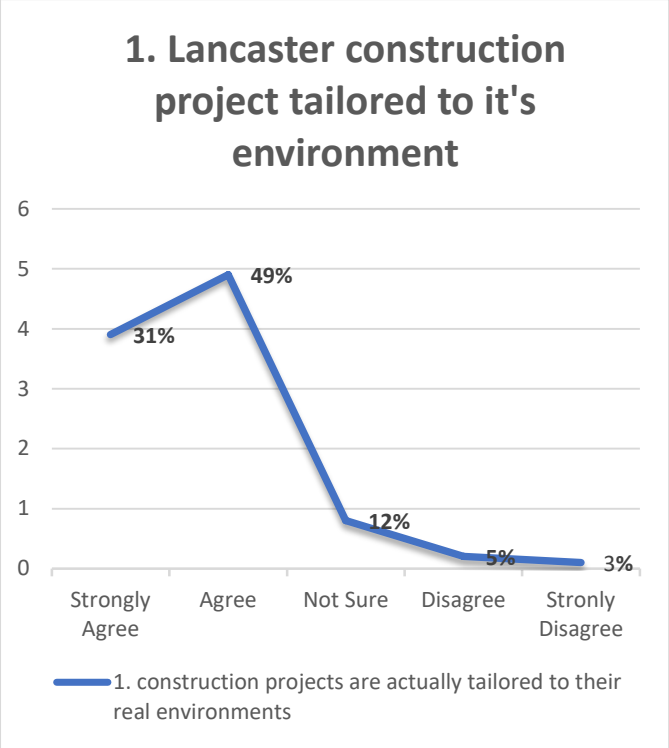

Chart -1: Lancaster construction project is tailored to its environment

Survey results presented in Chart 1 establishes the fact that the tailoring to project environment is a popular project management practice in the UK. Respondents believe that neglect to this principle could breed severe risks and project failure. From this descriptive statistic, 49% and 31% of practitioners agree and strong agree respectively that construction of Lancaster project was tailored to its environment.

The Minerva and Northacre developers both understood the importance of tailoring a project to its environment, these they demonstrated through the preplanning studies they carried out to understand the possible factors that could trigger change during execution. To understand The Lancasters Project Environment, they hired the services of an expert in project preplanning and technical studies URS Scott Wilson Group, a global civil engineering consultancy company with headquarters in London who planned the project. The company also collaborated with Nilson Architect during the design phase. The essence was to identify possible change indicators, proffer possible responds and inculcate approved decision to the final design before initiating the project. Evidences revealed that environmental issues like soil contamination, underground pipe leakages, wind direction, noise and traffic were among the risk identified. The change management framework adopted was OGC (the Office of Government Commerce, UK) Prince 2.

Furthermore, change control processes and lesson from previous related projects like BBC Broadcasting House London, Athletic Village London Olympics, The St Botolph Building London, Portsmouth Spinnaker Tower, The Walbrook London were all reviewed by the main project managers and owners, Woolf Construction, Minerva and Northacre Developers. During the preplanning stage, the brainstorming meetings between Northacre, Minerva, (developers/joint client) Woolf Construction (Project management team), Nelson Architect (Project designer), URS Scott Wilson Group (structural engineering expert/Project assurance team), Ruddy Joinery, CCP, Lorne Stewart, and other major suppliers highlighted the followings with regard to the project environment: Budget and contract, lesson from related projects, initial issues and pro change identification and assessment, risk, health and safety, control and management processes. The evidence revealed that recently, most large construction projects in the UK have been successfully tailored to their actual project environment.

4.2. Project Environment Change Order

The interviews and questionnaires responses helped to identify the level of possibility of project environment causing change order during project management progress. The Lancasters project involves a lot of change orders which were triggered by its environment. The control approach adopted by client and project management team was a mitigation approach which identified potential change triggers, they were captured in the design and effective control process adopted in the project plan. As shown in figure 4. Practitioners believe that project environment will affect the rate of change that will be ordered during work progress. Most of the change orders in the Lancasters project were triggered by environment factors like noise, soil texture, strength of structure, client's constant innovation to beat the luxury of other existing neighbouring luxury flats.

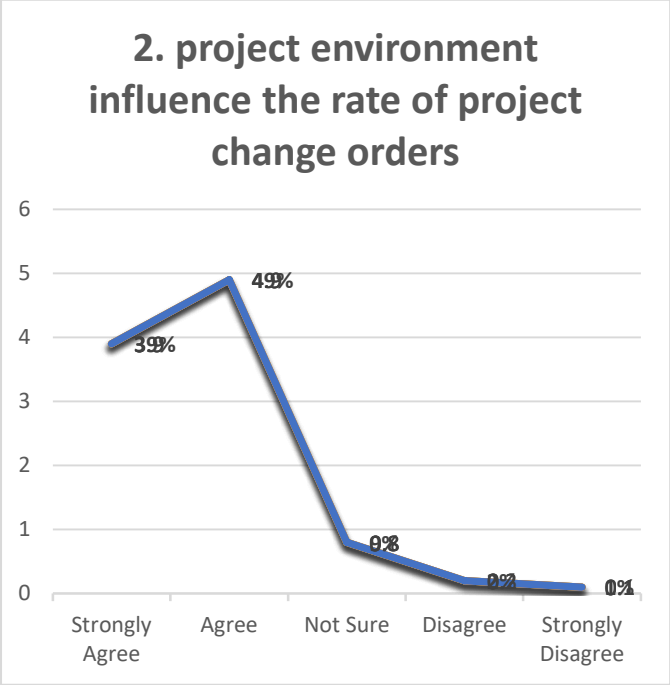

Chart -2: project environment influences project change order

Chart 2 shows that majority of the respondents share the view that projects are generally tailored to their environment. Their perceptions of project environment are that all the factors found within a project environment are capable of influencing, diverting or altering the initial project plans during execution. These factors are geographical location, natural, economic and political, manmade like communication, technology, which cause a high risk of change (Malik et al. 2019). These have the capability of triggering change therefore it is arguable that they influence the rate of change orders recorded in a given project.

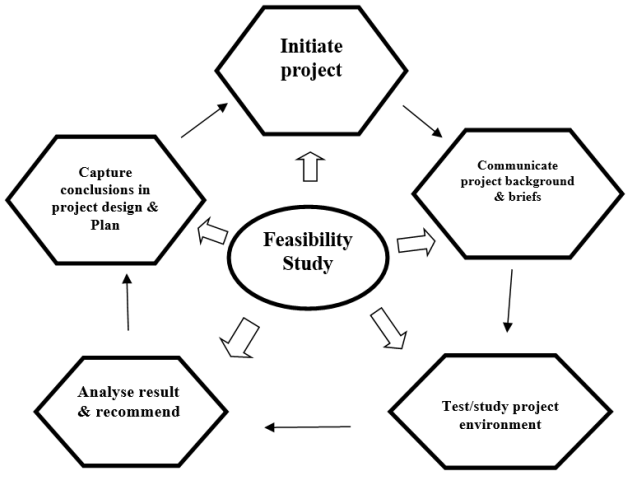

Fig.-3 studying Lancaster Hyde Park project environment as conceived by URS Scott Will Plc

Assistant director Alex Gouldes of URS Scott Will Plc while responding in an interview said "Yes project environment has a great influence on project change order but our job is to limit it". Since the environment is best defined as having to do with all activities around the project (Malik et al. 2019), therefore the environment has much influence on the change order and the entire project outcome as a result of which the level of project environment study required is limitless.

4.3 Project Environment Study

To understand the change risk appetite, this research inquired into investment appetite of practitioners' organisations. The questionnaire responses produce the result in figure 6. The client and the management team of Lancasters invested all that was necessary to understand the project environment. Services of expert in preplanning processes and structural analysis URS Scott Will Plc was hired to carryout series of researches to determine the level of soil contamination. This was done through the deployment of their team of geotechnical engineers and other professionals to collect soil samples which were tested in their laboratory. URS also mechanically studied the wind direction to determine the direction of noise in the Hyde Park, project neighbourhood as it is on the busy route of London business hub, with hundreds of commercial and private vehicles fleeting the project main view every five minutes. Underground drainage, water and gas pipelines and the building foundation were all inspected, recommendations were made by URS and all necessary issues were captured at the design stage as URS was made to work with Nelson Architect as design assurance team.

Economically, most of the senior project executives and managers within and around the Lancasters project believe that the impact of the recession affects the industry tremendously as less money from clients infer less projects and less income to construction companies imply fewer professional staff trainings and that invariably means less performance as the industry cannot keep up with the challenges of their ever-changing project environments.

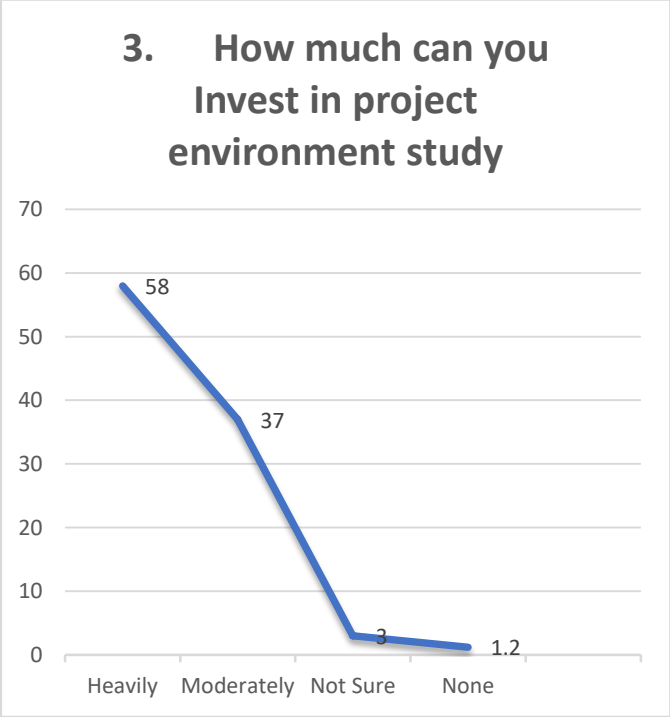

Chart – 3 Investment in project environment study

The survey conducted as shown in figure 6 indicates that 58% of practitioners are highly willing to invest as much as required by the project to get accurate results, while 37% of respondents will invest moderately towards studying a project environment. Both categories emphasized that investing in the project environment study enables them to identify some avoidable potential change triggers and to either capture them at the design stage or to plan extensively for their manifestation and impact as well as the risk it breeds.

The project owner of the Lancasters exhausted their entire project study budget which was 70% of the entire starting up phase budget. Through this study, it was determined that the concrete structure of the Lancasters needs complete reinforcement to strengthen the building to withstand the stress from the new loads. instead of the proposed renovation, this led to a complete reconstruction programme. Instead of the owner's royal metallic free view fence, a firm hollow wall was designed and approved to ebb the direct impact of noise from the main street on the ground level flats. The spending cuts by the Conservative British Government affected the project budget and delayed funding as the clients are major contractors to the British government as developers of government properties. Previous and recent projects were studied to understand logistics, change causes.

The implication is that clients developing mega projects should be willing to invest as much as necessary as fit-for-purpose should be the ultimate target of all clients as it satisfies the project business case and mitigates risk of failure. The investment is a change control process. With relevant investment appetite, the contractors may need to update their staff training and be equipped for effective change control as risk of with the demands of project environment, global warming and economy fluctuate over time and location.

The two types of trainings embarked upon by organisations that worked on the Lancasters projects are;

1. In-house training and knowledge sharing which was widely used as it is less expensive, as these organisations response to government budget cuts by cutting their expenses to stay on business.
2. Outdoor training which is more professional and awarded by special environmental and economic institution.

4.4 Efficiency of Change Control Mechanism

Data from the survey and interviews in Chart 4, show that 23 % and 58% of practitioners stated that project environment study as change control mechanism has been highly and averagely effective over the project time and cost. During the interview, it was revealed that the OGC Prince2 change management recommendations which emphasized project environment study and tailoring of project to its environment was adopted in the Lancasters project. The outcome confirms that to a great extent, this method was effective in monitoring and controlling project change and risk in the Lancaster project and other similar projects in the UK. However, it would be interesting to test the effectiveness of this method in developing economies like Nigeria where according to Nissi et al. (2021) access to reliable data in built environment is still a challenge to project environment study. In addition, the practitioners also believed that risk register should be kept in order to capture all lessons learnt.

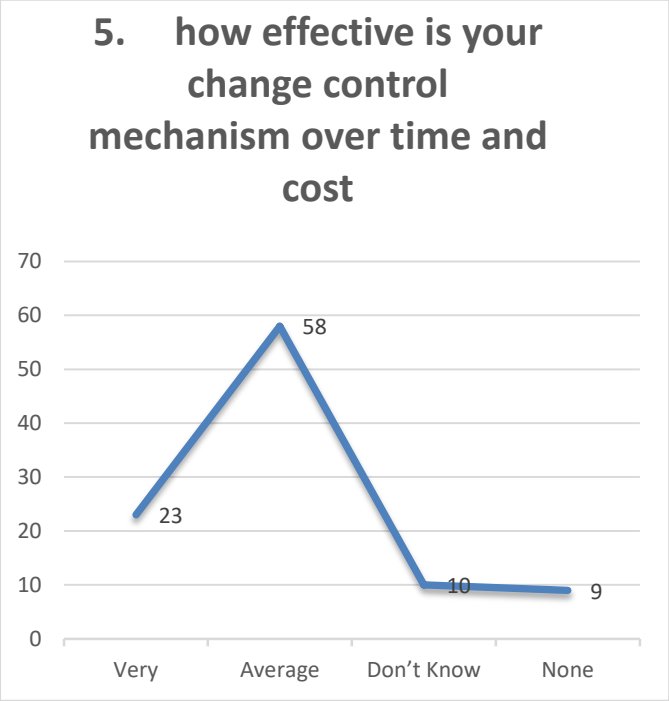

Chart – 4 Effectiveness of Sustainable Change Control

4.5 Communication

Communication at every stage of the project is important as it informs decisions making. Conor Banningan is sixteen years practicing project manager at Ruddy's Joinery insisted that for him, communication is very important to his job for every minute or stage. He emphasized that man-management strategy to communication is the best as he argued that human being and project environments are different on person to person and on project-to-project basis. His view is that it is best to access and manage humans as an individual while in teams. The same applies to a project, while similar, every project environment is unique. Communicating individually enhances his understanding of both project environment and humans. "I relate with the main contractor, clients, colleagues and other stakeholders aiming to get the actual and detailed information out of them to understand both the project objectives and intended benefits in order to reconcile them with the environment and calculate the feasibility of success on my own". This reveals the importance of communication at every stage and level of construction project management as it builds the required bridge across doubts, assumptions and actual. Secondly, in contrast with Nigeria as reported by Nissi et al. (2021), the built environment related agencies in the UK provided reliable information that enhanced the project environment study for robust decisions at the Lancasters project.

Fig.-4 Lancasters communication circle (Source: Woolf Limited)

According to the project secretary at Woolf Limited, Colleen Slater's response to the reason for email been most widely used communication system at the Lancasters project; "it is more evidential than phone call and in event of confusion it can always be review for clarity in addition to been less expensive".

The Lancasters project outlined an excellent communication management strategy, although it experienced a communication gap between task teams and management teams. The weekly project progress reports were sent to relevant quarters and issues were been escalated accordingly to the management level where they are communicated and discussed. The major communication features were:

- Change readiness assessment, control and management
- Weekly progress report
- Leadership alignment
- Risk communication, and
- Stakeholder's engagement

Nonetheless, ineffective communication was still experienced among operational or task teams, as approved change orders were not timely communicated to team members. This was recorded as human error and poor monitoring. In these scenarios, the project secretary revealed that upgraded design drawings were not communicated to team members by either their team leaders or task managers. In these scenarios, trade contractors are responsible for the cost of the risk as it is their omission. Unfortunately, communications of at this level were mostly verbal and exchange of design drawings. Monitoring and communicating updated design help to check human errors which has potentials to trigger more changes. This also provides primary feedback on the effect

of the change implementation on the project progress and outcome. To address this challenge, Lee et al. (2021) recommended traceable data transactions when sharing information in construction and this entails digitalization of all forms of communication amongst all project stakeholders. The Lancasters communication strategies are: media plan, communication plan, branding, training, knowledge sharing, definite roles and responsibilities, risks identification and mitigation, response actions from meetings, milestone status, status summary, progress reporting, evaluation and feedbacks.

4.6 The Sustainable Change Control.

To understand the effectiveness of studying and tailoring to project environment adopted in the management of Lancasters project and its contribution to the project success, the project practitioners scored this change control process high as presented in figure 7. According to the EWSA project manager, "the change control mechanism identifies possible risk of change triggers, and enables their capturing in the project design and plan. When you plan for a change, it is not a change anymore it is now part of the project plan. That way you have an effective schedule and budget for it".

Fig.-5 Sustainable Change Control Model

As demonstrated in Figure 5, all the organisations that participated in this case study responded that to the change control model adopted by most of them run a risk register, where all the identified possible change triggers and events are recorder with planned response for risk mitigation. They keep a lesson register to capture all previous lessons for robust decision-making, especially for future projects. It was also discovered that at the closure of every URS Scott Will project, lessons learnt session is organised with all participating contractors identifying what was well-done and what would have been done better and all the responses are documented for future review and studies. These help them in forecasting and productive decision-making process. The importance of this is that change control starts from the inception and start-up stage of the project. This enables the studying of project environment to understand the project scope, identify possible change triggers and events and then capture them all into the project plan as illustrated in figure 9. Key stakeholders are identified and actual information effectively communicated, as information distribution within the work teams is essential.

To reduce the uncertainty of change, clients developing complex projects invest much as necessary to study the project environment. while organizations on the project are responsible for training their personnel to equip them for risks associated with change triggering factors.

This sustainable change control process for risk management was scored high by practitioners, in terms of its application but the eventual outcome did not completely mitigate the risk and uncertainty of change in Lancaster project. Substantial gap existing in the following area;

1 Communication between operational teams and management team in effectively conveying approved change event.

2 Implementation of reports/findings of project environmental studies already captured in project design and plan.

3 Irrational government policies.

5. CONCLUSIONS

Main causes of project change are unforeseen and yet avoidable factors within project environment and organisations invest in project environment study in order to effectively control these factors as risk. Change control is an established and effective risk management approach in construction management. Hence, this study contributes to change control from many fronts. Firstly, it explained and rated the influence and effectiveness of project environment study in change control process. Secondly, it explored the influence and effectiveness of communication in project change control.

This study further established and validates the followings; project environment influences the rate of project change, organisations are interested in studying and tailoring projects to its environment for sustainability, ineffective communication is risky in change control process, sustainable change control is effective on schedule and budget management. Importantly, this study

developed a sustainable change control model as risk management tool for construction managers and engineers.

Unfortunately, as a result of some limiting factors, the findings of this study and this model need to be cautiously adopted until they are domesticated and validated. As a case study, the findings of this study are limited to the Lancaster Hyde Park project environment and context, hence data were generated and analysed within the limits of this context. Thus, for a more holistic perception, there may be need for validation of the sustainable change control model developed from this stud y by a large sample size of construction managers and engineers across geographic locations to improve the value of this model.

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