Global Scientific JOURNALS

GSJ: Volume 8, Issue 8, August 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

ASSESSMENT OF THE EFFECTIVENESS OF PROJECT MONITORING AND CONTROL MECHANISMS FOR SUSTAINABLE BUILDING PRODUCTION

By
Uchenna Ugochi Moneke
Department of Project Management Technology,
Federal University of Technology, Owerri- Nigeria
Email:ucmonk@yahoo.com

Abstract:
The concepts of Project Monitoring and Control Mechanisms (PMCM) and their effectiveness for sustainable building production are indispensible measures to contain building collapse and project failures. Only few studies have analysed integrated relationship between construction project and production systems with an in-built PMCM in their plans. The study carries out a quantitative field survey on a sample of 30 randomly selected building projects in three geopolitical zones of a state which recorded incessant building collapses and project failures.The study identified the following three PMCM; cybernetic, go/n-go and post-performance system and they were used for assessment on their respective levels of effectiveness for sustainable building production. The primary data generated for the study were elucidated from experts' opinions through the instrument of questionnaire and analysed through confirmatory computer-based analysis of variance tool. The results and findings indicate that for sustainable building production, go/no-go, cybernetic (in ranking order) are the most effective PMCM. However post-performance mechanism did not indicate significant result to justify its effectiveness in managing building production for sustainability. The findings suggest the need to focus attention on continuous monitoring and controlling of inputs and project performance parameters through the go/no-go and cybernetic control mechanisms.
Keywords: Building production, control mechanism, cybernetic, go/no-go, performance parameter, post-performance.

Introduction:

Building construction industries are facing challenges such as increase project complexity, scope requirements, shorter deadline, economic, uncertainty, rising competition and subsequent decrease in profit margin.

Periodic project monitoring and reporting provide the information for leverage in determining the time, cost and quality status of current individual activities and the entire project, based on the project plan. Control is an essential follow up to a plan; and should be able to signal out deviation between planned and actual progress of work. Discrepancies between planned action and reality are usually expected. The

ability to have access to reasonably correct and timely information on deviation of actual from planned progress is very important for project control in building production. Effective monitoring and control towards implementation or execution of building production when carried out correctly at the right time and place is one of the most important aspect of ensuring project success of many building projects. Unfortunately professional and developers at all levels of construction project do not use it holistically during projects execution rather they tend to give little attention to it in a bid to fulfilling requirements of most sponsors or clients. Project monitoring and control are veritable processes towards effective implementation of building production for sustainable development. An efficient control system generates information that can improve the productivity of men and materials, economize the employment of resources, enable understanding of time and cost behavior; provide early warning signal of ensuing dangers; assist in formulating bonus/incentive schemes for motivating people.

Many developing countries of the world especially Nigeria have numerous building projects in attempt to improve on infrastructures as well as meet the needs of housing in order to improve the standard of living of its citizens. A lot of resources is committed to these projects financially by both government and even private sectors. The building business serves mankind by providing shelter and service for its habitation, educational, recreational, social and commercial needs. The building works are mostly designed by architects/engineers. The building plan and design specify certain parameters that needs to be controlled. A well formulated plan would have inbuilt mechanism to ensure that all necessary guidelines are in place to enhance success based on the plan. Akpan and Chizea (2002) refer to these guidelines as control mechanisms.

Problems of building collapse have been adduced to many factors such as low quality inputs, poor quality of design etc. However,little or no emphatic discourse on the effectiveness of project monitoring and control in the course of implementation of building projects has been established.Building project planning precedes implementation, monitoring evaluation and control. A plan is likened to road map that identifies the route that one needs to take to get to his destination. Many stakeholders in the building industry believe that the mere fact that one has devoted great resources and time on the planning processes and had hopefully come up with what meets with the criteria of an effective plan, it does not necessarily guarantee that when the plan is put into action, it would automatically achieve the desired goal. Control provide management with the signals likened to be litmus paper to

immediately detect the moment the unexpected starts to show signs; usually as implementation progresses. It could be on those premises that Chitkara (2006) state that despite the well recognized importance of controlling projects, experience shows that the controlling systems are rarely effectively implemented at the project sites. Many cities in Nigeria have suffered several building collapsed and disasters especially Owerri, Lagos, Abuja and Ibadan. Reasons for these force majeures could be said to be incompletely ascertained and have not been exhausted. Poor quality of designs and inputs materials as well as faulty building plans may be some of the causes of building collapse, but ineffective monitoring and control are among the lethal plagues bedeviling building projects in Nigeria. Ubani (2012) avers that in spite of planning to the minutes details, yet always (most of the time) it is not possible to achieve 100 percent as per plan. Due to ineffective monitoring and control activities of original plans are usually compromiseddue to dearth or low quality of materials, malfunctioning or breakdown of equipment and machines, absenteeism of workers, shoddy workmanship, and lack of coordination and communication gap between various functional areas of the project team.Inability to properly monitor and control these factors has led to building collapse and project failure.

The major objective of the study is to assess the effectiveness of project monitoring and control mechanisms so as to contain the problems of building collapseby timely monitoring and regulation of the inputs, work-in-progress and performance parameters in building production and projects.The specific objectives include developing the concepts so as to; dictate and exercise influence on project progress status,benchmarking the success factors in the course of project implementation and to determine the effectiveness of each control mechanisms in building production for successful implementation based on the plan. A formulated null hypothesis on the effectiveness of the three basic types of control mechanisms; cybernetic, go/no-go and post performance techniques will be tested for valid conclusion.

Literature Review

Control mechanism ensures that actions intended to implement established plan of action are compactable with set objectives and capable of realizing the plan. A control system is normally put in place during the planning process so as to compare actual performance during plan implementation, with the established planned standards. The system provides signals on deviations from plan that require necessary corrective actions. In order to have value for the huge money (finance)

committed to the implementation of these structures, two aspects of project management techniques among others are required to achieve these feats. They are project monitoring and control.

The building production environment commonly known as the built environment simply refers to everything that depicts man's intervention and involvement in the natural environment which include pre-design, procurement, construction, management of effective operation of buildings as well as infrastructure (Dassah and Nimlyat 2010). A careful consideration of the technique of monitoring and control toward project implementation play a great role in contributing to effective building production for sustainable development (Bosswell and Walker 2004).

Unfortunately, professionals and managers at all levels of construction projects including owners or clients do not recognize the usefulness of these techniques. Therefore, this paper seeks explore the capabilities of control mechanisms for effective monitoring and control towards implementation of building production for sustainable development.Monitoring and control of project performance parameters should not be over emphasized by stakeholders in the building industry.

Monitoring and Implementation

Monitoring involves routine check carried out in order to track the key elements of project implementation performance activities through record keeping and regular report. It includes assessment of an on-going or completed project to determine its actual impact against the planned impacts in relations to its design, implementation and results (Wanjala 2017). From the definition above, monitoring is seen as a process that provides information and the application of such information helps the management professionals to effect the implementation of project and also assert their impacts; while control measures compares and effects corrective actions. It aims at determining whether the intended objectives have been met or not.On the other-hand, implementation is the process of putting a decision or plan into action or execution of a building process after all have been adequately figured out according to fact check and figures available in line with the objectives of the building production and projects.

Projects Design Concepts in Building Production

Project design is a plan with details for the structure and functions of a building or system. Project design is an early phase of the building construction where key features, structures, criteria for success and main deliverables are all planned out in other to achieve intended project goals. The point here is that, more than one design are developed to achieve project goals. This is done so that stakeholders

involved can then make a choice of the best design to be used for the actual implementation of the project. The project design provides the work breakdown structure, cost breakdown structure/project budget, bill of quantity for materials, inputs specifications, architectural, mechanical, electrical and structural drawings and performance parameters to be controlled.Control mechanism get data and clue for the management team for monitoring, evaluating and adjusting their decisions and operational objectives.Objectives can be set to get optimum coordination. It also evaluates the performance metrics of managers at each level. Monitoring and control of project parameters based on planned standard are indispensible to effective project delivery. There is also need for a quick test of the project design to ensure that the conceptualization of project inputs, outputs, effects and impacts are shared by everyone involved in the project. In view of this, project monitoring is the process of routinely gathering information to comparatively check out for the actual use of project inputs and completed outputs with planned use of inputs and the completed output for effective building production. This is such a veritable tool managers need in order to make informed decisions; in this case control actions come into play.

Roles of Monitoring Towards Building Implementation

Project monitoring refers to the process of keeping track of all project related matrics including team performance and task duration, identifying potential problems and taking corrective action necessary to ensure that the project is within scope, on budget, quality specification and meets the specified deadlines (KnowledgeHut 2017).Monitoring is a good management tool which should provide continuous feedback on building implementation if used properly as well as assist in the identification of potential successes and constraints to ensure timely intervention and decision. Monitoring also helps to assess stakeholders understanding of the project implementation, minimizes the risk of failure, assesses level of progress, lessons learnt etc.

Building Production System and Control Mechanism:

Building production system is the pattern that is formed by the structure, participants and the inputs of the production process (Kanoglu 2019)

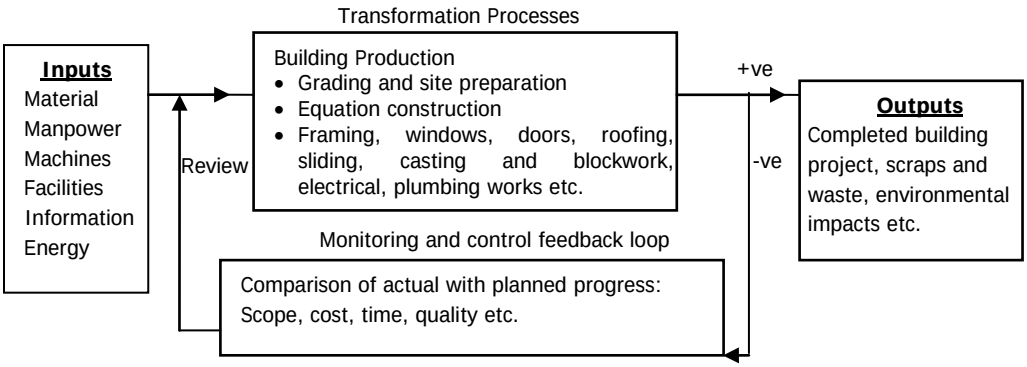

Figure 1: Schematic Conceptual Model of Building Production System

According to Antunes and Gonzales (2015) building construction sector relies on practices based on intuition and experience, overlooking the dynamics of its production system. Building production is the organization and management of the plans, equipment, materials and labour involved in the construction of a building, while at the same time complying with all codes, rules and contractual stipulations. The procedure should be designed to run efficiently to keep costs low and to allow returns on the investment to be realized as early as possible. Building production is usually in the context of building construction project management.Antunes and Gonzales (2015) in their study established a foundation for dynamic production systems management in construction projects. However, it could be opined that lack of effective control mechanism has the capacity to mar or resist the realization of building production objectives. Control mechanism is any mechanical or system used to keep one or more variable parameter constant, or within specified bounds and planned targets. The four functions of management are planning, leading organizing and controlling. Companies use various control mechanisms- such as business plan, need assessment, audits, communication, training, performance review and employee incentives to optimize performance in each of these areas (O' Connor 2015). Control mechanisms play an important role in any business organization, without which the role ofmanagers are constrained. Control is required for achieving goals in a predefined manner because it provides the instruments which influence the performance and decision making process of an organization. Control is in fact concerned with the regulation applied to the activities with an organization to attain expected results in establishing policies, plan and practices. Chand (2019) posits the basic types of control mechanism in project management as follow: cybernetic, no/no-go control and post- performance control. According to him, there have to be mechanisms to control the project and to ensure that the project is proceeding/progressing as planned. Chand (2019) avers that most control over project focuses on the following three elements; cost, time and performance. He

also opines that the three basic types of control mechanisms in project management are cybernetic (M_1), go/no-go (M_2) and post-performance (M_3)

Cybernetic control (M_1) is the most common kind of control mechanism. A project has inputs and outs. The output can be in the form of milestone. Cybernetic control focuses on the outputs. If these outputs or milestones do not measure up to the set standards, the situation is investigated to see if there is a sufficient cause to change pattern of activities. The focus of this kind of control is to reduce deviations from a standard. The more the deviation, more is the attention the situation warrants.

Go/no-go (M_2) control takes the form of testing to make sure that certain preconditions are made before a task is undertaken. This type of control can be used for a specific part of the project too. Go/no-go control are linked to the actual plan and are not independently set on a calendar.

Post-performance (M_3) control is applied after the completion of the project or the task. The focus here is not on altering what has already happened, but in making sure that good and bad practices are recorded for being of help in future projects. The post-performance controls include a set of recommendations on how to improve future projects.

The project control objectives are generally stated in terms of specified completion time, within predetermined cost and profitability (Chitkara 2006). The project plan shows that path for achieving these objectives. A project needs an effective control system to continuous monitor the deviation from the planned paths, and to apply corrective measures. According to Ubani (2012), if there is deviation between the actual and planned progress, control function comes into action through control mechanism so as to take corrective actions to match planned with actual targets. Akpan and Chizea (2002) postulate the following sequential actions of project control;

i. Tracking, reporting and documentations of project progress.
ii. Comparing of observed actual progress in terms of time, cost and quality.
iii. Managerial actions in form of control decision, taken to correct any deviation or variances from the above.
iv. Updating the remaining portion of the project in line with the realities of items above.

Similar steps in control process as stated by Chitkara (2006) that are used as follows:

- Define the parameters of measuring performance
- Establish baseline for measuring performance
- Account performance by measuring, recording performance and reporting deviation
- Monitor performance by consolidating reported performance data, analyzing performance variation and forecasting performance trends.
- Communication information: Feedback, management report and record keeping.

Ubani (2012) also avers that four essential elements of control could be of immense use during project monitoring and control. They are:

i. Measurement by accurate sensory device
ii. Feedback of information in a timely manner
iii. Comparison with standard such as cost and time standards, quality and profitability.
iv. Corrective action by one with authority and ability

Performance Parameters to be Controlled

Performance in simple words implies the degree of achieve. Parameters define the goals to be achieved. The performances of the assigned parameters are measured and feedback information transits the deviation between the actual and planned performance to the monitor for comparison and corrective actions. Control mechanisms can therefore keep track of the following parameters in building production when necessary and take corrective actions or re-plan. The parameter to be controlled include, time, cost, quality, profitability, resource mobilization, work done etc. Similarly, Dobre (2006) posits that in project management field, there are few things that can cause a project to require control. They include performance, cost or time etc.

Sustainable Building

Sustainable building is actually concerned with the final products-buildings, which is a subset of sustainable construction (Ladin et al 2008). Danssah and Nimlyat (2010) led credence to the fact that the sustainable building encourages buildings that are durable and environmentally friendly as well as “incorporate energy-efficient principles, the physical and psychological sense of wellbeing experienced by the building occupants.”More so, sustainable building as cited by Ladin et al (2008) is structured to provide required performance with minimum adverse environmental impact, while encouraging improvements in economic, social and cultural aspects at local, regional and global levels.” All these facts hinge on a good monitoring

practices which ensures proper projects implementation, and sustainable building production.

Research Methodology

A cluster sampling and field survey research designed was employed to evaluate theeffectiveness of Project Monitoring and Control Mechanisms (PMCM) on performance and sustainability of building production in Imo State Nigeria.A questionnaire was designed to assess the level of effectiveness of PMCM on the performance of building and projects in the state. The structured questionnaire for data collection was designed on a three point scale as follows: ineffective = 2, neither effective nor ineffective = 4, effective = 6 score points. The following PMCM based on literature review were considered. (i)cybernetic (M_1) (ii) go/no-go (M_2) and (iii) post-performance (M_3). The questionnaire was piloted by a survey of experts who are conversant with the region's built environment to determine whether the questions were unambiguous and substantially captured PMCM perceived to be effective for project performance and sustainability. The selected performance parameters for the study are time, cost, quality and productivity. The target respondents are experts and professional in thirty building projects and building production activities from three geographical zones of the state; Okigwe (OK), Owerri (OW) and Orlu (OR) with ten from each zone. The questionnaire was designed in such a way that captured the experts and target respondents opinions on the effectiveness of PMCM on; performance, cost, quality, time and productivity with their respective constructs. The target respondents are the builders, architects, quantity surveyors, project managers and engineers. The method of data analysis and test of research hypotheses is Analysis of Variance (ANOVA). The one-way ANOVA was used to determine whether there are any statistically significant difference between the means of the three independent geographical zones/groups on the effectiveness of PMCM on building project performance and sustainability. Each zone possesses a mixed-up of building production experts for consistency of responses and the resulting inferences. The different between the group means are statistically significant and the model was found to fit with the data collected. The model also meets the assumptions of the analysis of variance model. ANOVA uses F-test statistic and the test was conducted at 5% level of significance using SPSS computer software version 21. PMCM therefore tracks and regulates the following project performance parameters among other to check the problems of deviation of actual from planned targets:

i. **Performance:** unexpected technical problems arise, insufficient resources are available when needed, insurmountable technical difficulties are present,

quality or reliability problems occur, clients require changes in system specifications, inter-functional complications arise, technological breakthrough affect the project.

ii. **Productivity:** declining productivity of labour, materials, capital, energy and time.

iii. **Cost:** technical difficulties requires more resources, the scope of the work increases, initial bids or estimates were too low, reporting was poor and untimely, corrective control were not exercised in time, input price change occurs.

iv. **Quality:** poor quality of inputs supplied, faulty and malfunctioning machines and equipment, esthetics features deviating from standard specification, quality of design deviation, dimensional inaccuracy occurs. etc.

v. **Time:** technical difficulties took longer than plan to solve, initial time estimates were optimistic.

Table 1: Questionnaire Distributed and Returned by Building Production Experts

Target Respondent	Builders	Architects	Quantity Survey	Project Management	Engineers	Zonal total	Mean
Distribution:							
OK Zone	10	10	10	10	10	50	10
OW Zone	10	10	10	10	10	50	10
OR Zone	10	10	10	10	10	50	10
Total	**30**	**30**	**30**	**30**	**30**	**150**	**30**
Returned:							
OK Zone	6	5	4	3	6	24	4.8
OW Zone	10	7	6	5	8	36	7.2
OR Zone	8	5	5	5	7	30	6.0
Total	**24**	**17**	**15**	**13**	**21**	**90**	**18.0**
Percentage returned	80.00	56.67	50.00	43.33	70.00	60	

Table 2: One way ANOVA Results

		Sum of squares	Df	Mean square	F	Sig.
M_1	Between Groups	136.750	7	19.536	5.465	.000
	Within Groups	35.750	10	3.575		
	Total	172.500	17			
M_2	Between Groups	267.800	9	29.756	9.133	.000
	Within Groups	65.167	20	3.258		
	Total	332.967	29			
M_3	Between Groups	99.208	8	12.401	1.218	.353
	Within Groups	152.750	15	10.183		
	Total	251.958	23			

Hypothesis testing on the effectiveness of M_1, M_2 and M_3 on sustainable building production.

Null hypothesis Ho: $M_1 = M_2 = M_3$. There is no significant difference between the mean effectiveness of the three PMCM; M_1, M_2andM_3on sustainable building production.

Alternative hypothesis HA: $M_1 \neq M_2 \neq M_3$

From table 2: Ho_{M1} and Ho_{M2} are rejected in favour of alternative hypothesis. H_{AM1}, and H_{AM2}, while the H_{OM3} is accepted. The significant ordered ranking on the effectiveness of the three PMCM on sustainable building production is; M_1,M_2 andM_3 (M_3 not significant).

Discussion of Results and Findings

From the confirmatory ANOVA result, the work tested the effectiveness of three PMCM on the performance and sustainability of building projects and production. Not all the three PMCM are inferred to influence the effectiveness of building projects due to unique characteristics and built environment of the building production.

The ranking of PMCM on the building production and project performance parameters has been evaluated and inferred for aid in decision making processes. The results and findings indicate go/no-go PMCM as the most effective in monitoring and regulating the progress of building production. The null hypotheses of go/no-go PMCM was rejected as it indicated thep-value of 0.000 and F-ratio of 9.133. Go/no-go control takes the form of testing to make sure that certain preconditions are met before a task is undertaken. Though this type of control can be used for a specific part of the project too, project tasks are implemented, monitored and controlled based on the sequence in the work breakdown structure. Any failure to exercise tight control to make sure that certain precondition are met before the succeeding tasks are undertaken might lead to costly mistakes which might result to colossal waste of resources and time. For instance, Keenmon (2019) state that, that's why it is crucial to develop an effective Go/no-go process. According to him, consistently making the right Go/no-go decision will empower firm to focus on high probability, high-profit project. Hutt (2011) avers that rather than start from scratch, it's easier to use Go/no-go checklist to prompt other questions and checks that may be relevant to the project. Check list helps to identify serious gaps and deficiencies to be addressed before go-live.

Cybernetic PMCM ranked second in the effectiveness of project performance and sustainability of building production. Cybernetic control is evident in all aspect of technology. It occurs when a closed system regulate itself using a feedback loop. The system now shows that the programme manager is performing day-to-day control of the programme and is delegating work to project managers. Feedback control loop will provide information based on the measurement and comparison between the actual and planned project parameters.Cybernetic controls focus on the outputs and if these outputs or milestone do not measure up with the set standard, the situation is investigation to see if there is a sufficient cause to change pattern of activities (Chand 2019).Post-performance control are applied after the completion of the project or tasks. From table 2 it is not significant for decision making for effective implementation of building project and production. It does not alter, but records good and bad practices to help in future project.

Conclusion and Recommendation

By identifying and analyzingeffectiveness of project monitoring and control mechanisms for sustainable implementation of building production, this study contributes to literature on the imperative of project monitoring and control mechanisms needed for project success. The identified three PMCM are cybernetic, no/no-go and post-performance systems. The methods of cluster sampling and survey research design were used to subject the three PMCM to statistical test of hypothesis with their respective constructs on the three cluster groups. The analytical tool used for data analysis is computer-based ANOVA and the test was conducted at 5% level of significance using SPSS version 21. The PMCM of Go-no-go was found to be the most effective and significance in controlling the performance parameters of building production and projects. The next PMCM in ranking order and which is also significant is cybernetic method. However, post-performance PMCM was not significant and found ineffective for management of building projects and production. The results and findingsof this studycould predispose the unique characteristics of building production within a given built environment. It is therefore worthy to note that building project plan without inbuilt control mechanism is like a ship without a rudder and can therefore lead to cost and time overruns; suffer scope screep, environmental degradation and project failure. A system of control mechanism should be on ground, to actuate and sustain actions of control throughout the implementation phase of building production.

References

Akpan E.O.P and Chizea F.E (2002) *Production Management: Theory and Practice.* Owerri FUTO Press Limited.

Antunes R. and Gonzale V. (2015) A Production Model for Construction. A TheoreticalFramework. *Buildings 5(1) 209 – 228. http://www.researchgate.net*

Bosswell P. and Walker L. (2004) Procurement and Process Design: *FIDIC and Lorna Walker Consulting Limited.* Geneva/London Pp 1-18

Chand S. (2019) Project Control Mechanism. Three Types of Project Control Mechanisms. http://www.yourarticlelibrary.com

Chitkara K.K. (2006).*Construction Project Management: Planning, Scheduling and controlling.* Tata McGraw- Hill Publishing Company New Delhi

Dobre E. (2006) Control of Projects – A Cybernetic Control Projects and *Program Evaluation, Risks, Resources, Activities Portfolio and Project Management.*http://ca.linkedin.com.

Dossah E.T. and Nimlyat P.S. (2010) The Role and Responsibilities of Professionals in Built Environment in Contributing to Sustainable Development in Nigeria. *Journal of Science and Multidisciplinary Research.* Volume 2. Pp 40 – 47

Hutt J.W.J (2011) The Project Go/no-go checklist. Go/no-go Decision Strategy. http://projectsmart.co.uk

Kanoglu A. (2019) Building Production Systems: Basic Concepts and Production Patterns in Construction Industry web:itu.tr>Kanoglu>c

Keenmon K. (2019) Expert Advice: How to Make the Right Go/no-go Decision. Consential http://blogconsential.com

KnowledgeHut (2017) How Important is Project Monitoring and How do we Implement it Through A. I http://www.knowledgeHut.com

Landin A., Olander S. and Persson M (2008) Sustainable Construction Management at a Project Level: A modified Environmental Management System Structure. Conferencepaper. Doi 10.13140/2.13223.5840

O'Connor P. (2015) How Do Control Mechanisms Affect Management of Small Business/Managing Employees/Managers. http://www.smallbusiness.chron.com

Ubani E.C. (2012) Production and Operations Management Concepts, Strategy and Applications. Ultimate Press Ltd. Owerri.

Wanjala M.Y., Iravo M.A, Odhiambo R. and Shalle N.I. (2017) Effects of Monitoring Techniques on Project Performance of Kenyan State Corporation. European Scientific Journals. Vol. 13, No. 9 Pp. 1857-7881.