QUESTIONAIRE

A research is being conducted on Construction 4.0 Application: Industry 4.0, Internet of Things (IoT) and Lean Construction Tools Application In Quality Management of Residential Building Projects on some construction site and project variables. This is being undertaken to increase sensitization about the Construction 4.0 and Industry 4.0. A set of questionnaire to assist you in completing this assignment is attached. Your sincere response to the questions is requested. It is intended that the information gathered to be used exclusively for scholarly reasons and that it would be kept completely confidential.

Thank you in advance for your anticipated assistance.

Yours faithfully,

Section A: General Information of Respondent and Organization

1. Name of Organization …….
2. Gender: Male [ ] Female [ ]
3. Age: a.21-30yrs [ ] b. 31-40yrs [ ] c. 41-50yrs [ ]
4. Type of Organization
   (a) Small scale [ ] (b) Medium scale [ ] (c) Large scale [ ] (d) others

   If others, please specify…….
5. Position in Organization: Project manager [ ] Design Specialist [ ]Project Coordinator [ ]
6. Company Status a. Developer[ ] b. Contractor [] c.Contractor [ ] d.Client [ ] e.Consultant [ ]. .
7. Education qualification of the respondent (tick as appropriate)
   (a) W.A.S.C.E [ ] (b) OND/NCE [ ] (c) B.Sc [ ] (d) M.Sc [ ] (e) others [ ]

   If others, please specify …….
8. Designation of the respondent
   (a) Architect [ ] (b) Builder [ ] (c) Quantity Surveyor [ ] (d) Engineer [ ] (e) others

   If others, please specify …….....
9. Years of working experience in the construction industry
   (a) 11-15 [ ] b.5-10 [ ] c. >5 [ ] d. 15 [ ]

10. What type of project are you involved in? (Please tick as many as you have been involved in)

(a) Residential [ ] (b) Office [ ] (c) Industrial [ ] (d) Civil [ ] (e) Institutional [ ]

Section B: Construction 4.0 Influence Parameters.

Instruction: Please tick as appropriate your level of agreement and support on Construction 4.0 Influence Parameters. Scale: **SA** (Strongly Agree-5), **A** (Agree-4), **UN** (Undecided-3), **DA** (Disagree-1), **SD** (Strongly Disagree-2]

Construction 4.0 Influence Parameters	SA[5]	A[4]	N[3]	SD[2]	D[1]
Intelligence Manufacturing					
Development of Digitalization Initiative in quality management					
Additive Manufacturing					
Artificial Intelligence in quality management					
Mobile Computing System for quality management					
Social media and Multimedia System					
Innovative Robotics in quality assurance					
Automation of Construction Systems quality management					
Big data application					
Cloud Computing and Applications					
Virtual Reality and Augmentation					
3D-Printing in quality output in documentation					
Expert system and Neural Networking					

Section C: Internet of Things (IoT) impacts on Quality Management Process of Construction Project

Instruction: Please tick as appropriate your level of agreement and support on Internet of Things (IoT) impacts on Quality Management Process of Construction Project. Scale: **SA** (Strongly Agree-5), **A** (Agree-4), **UN** (Undecided-3), **DA** (Disagree-1), **SD** (Strongly Disagree-2]

Construction 4.0 Influence Parameters	SA[5]	A[4]	N[3]	SD[2]	D[1]
Introduction of Robotics					
Automation in Construction					
Additive Product Manufacturing					
Development of Internet of Things for system development					
Mobile Computing					
Digitalization of Functions and Processes in Construction					

Big data application in construction process					
Simulation Models Development					
Invention of Social Media applications					
Advent of Cybernetics					
Synthesize of Augmented Reality and Virtual Reality					
Proliferation of Encoding System					
Advent of Building Information Modelling(BIM)					
Introduction of Human Computer Interaction					
Advent of Embedded System and Encryption					

Section D. Current Level of wastage threshold on construction site on account of process automation

Instruction: Please tick as appropriate your level of agreement and support on Current Level of wastage threshold on construction site on account of process automation. Scale: **SA** (Strongly Agree-5), **A** (Agree-4), **UN** (Undecided-3), **DA** (Disagree-1), **SD** (Strongly Disagree-2]

Indicator Parameters of wastage level on site	SA[5]	A[4]	N[3]	SD[2]	D[1]
Extremely low level of wastage					
Moderately low level of wastage					
Low level of wastage					
High level of wastage					
Moderately high level of wastage					
Extremely high level of wastage					

Section E: Critical Success Influencers of construction quality management using the lean construction concepts

Instruction: Please tick as appropriate your level of agreement and support on Critical Success Influencers of construction quality management using the lean construction concepts. Scale: **SA** (Strongly Agree-5), **A** (Agree-4), **UN** (Undecided-3), **DA** (Disagree-1), **SD** (Strongly Disagree-2]

Critical Success Influencers	SA[5]	A[4]	N[3]	SD[2]	D[1]
Leaving out non-value adding tasks focusing on value adding tasks					
Project cost reduction as a means of construction process improvement					

Defining sequencing and work inventory on sites					
Adopting work break down structure in site waste reduction and elimination					
Continuous flow of activities to avoid delay on site					
Adopting usable quality management systems in enhancing construction project characteristics					
Problem detection and design to improve construction projects operations					
Adapting the concept of Just-in-time applications in resources design and delivery on sites					
Proactive project success prediction taking value from design and client considerations					
Adopting and designing of systems for value mapping of human resources and material sourcing					

Section F: Framework Development Parameters

Instruction: Please tick as appropriate your level of agreement and support on Framework Development Parameters. Scale: **SA** (Strongly Agree-5), **A** (Agree-4), **UN** (Undecided-3), **DA** (Disagree-1), **SD** (Strongly Disagree-2]

Model Parameters **Lean Thinking Parameters**	SA[5]	A[4]	N[3]	SD[2]	D[1]
Quality Cost Objective Parameters					
Allowing contingencies for tools and incidental for internal and external failure					
Improving construction processes thereby reducing Project cost					
Benchmarking project expenditure on account of machine and plants maintenance					
Minimizing expenditure to maximize profit					
Parameters on Communication, Authority and Responsibility					
Setting up an effective communication strategies for work quality and improvement of quality of work and operational standard					
Delegation of responsibility is essential					
Periodic establishment of quality and maintenance Management meeting on sites					
Policy implementation committee need to be established					
Establishing line of command is essential					
Identify value from the client's perspective					

Benchmarking project expenditure on account of machine and plants maintenance					
Monitoring and controlling of quality in the Management of Construction process					
Conceptual Phase					
Demonstrating organization features					
Lean knowledge training					
Establish communication					
Review potential waste and lean practice					
Define assessment matrices					
Lean Thinking Quality Control parameters					
Pilot project implementation					
Lean implementation documentation					
Standardizing the lean practice					
Employees organizing and training					
Expanding lean practice					
Industry 4.0 [Internet of Things Parameters]					
Motion controlled lighting system should be installed to aid energy management system practices					
Implementation of car holder energy saving switches should be connected to lighting circuits and air conditioning systems					
Implementation of Building Automaton System should be used to provide data from HVAC operations					
The use of sensory nodes of lighting and HVAC should be incorporated into building design					
There should be a central monitoring controlling system of electrical energy					
There should be implementation of smart energy management					
Smart energy-saving air conditioning system should be installed in buildings					
Computer-based energy management system should be adopted in buildings					
Computer-based energy management system improve energy efficiency					
Computer-based energy management system reduces energy waste					
Introduction of Robotics					
Automation in Construction					
Additive Product Manufacturing					
Development of Internet of Things for system development					

Mobile Computing					
Digitalization of Functions and Processes in Construction					
Big data application in construction process					
Simulation Models Development					
Invention of Social Media applications					
Advent of Cybernetics					
Synthesization of Augmented Reality and Virtual Reality					
Proliferation of Encoding System					
Advent of Building Information Modelling(BIM)					
Introduction of Human Computer Interaction					
Advent of Embedded System and Encryption					

Section G: Challenges associated with Application of Lean thinking

Instruction: Please tick as appropriate your level of agreement and support on Challenges associated with Application of Lean thinking. Scale: **SA** (Strongly Agree-5), **A** (Agree-4), **UN** (Undecided-3), **DA** (Disagree-1), **SD** (Strongly Disagree-2]

Challenges associated with Application of Lean thinking	SA[5]	A[4]	N[3]	SD[2]	D[1]
Just-in-time deliveries causes congestion on the supply chain					
Non favourable disposition of workers to the application of the principles					
Application of lean principles gives little or no space for changes in the construction					
The process of management can be expensive and cost intensive					
Reduction in flexibility to react to new conditions during execution of project					