THEORETICAL RISK IDENTIFICATION WITHIN THE NIGERIA EAST- WEST COASTAL HIGHWAY PROJECT

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ABSTRACT

This study examined principal risks affecting performance in the Nigeria's east-west coastal highway project. The objective was to identify critical risks and their allocation preference. The study involved a two tier descriptive research processes. The first stage involved 10 high profile engineering design consultants and 6 projects managers, and the second stage was a survey of 66 construction/projects managers in Akwa Ibom and Rivers states, Nigeria. During the first stage, respondents were presented with a risk register containing 245 risk factors relating to the pre-construction stages to determine their applicability in the project. In the second phase, critical risks were ranked for degree of impact and likelihood of occurrence. Risk matrix was used to map risk impact and probability. Among the high impact/probability risk factors are government lack of political will; change in government, and corruption. 66% of the risks are allocated to contractor while the client bears only 34%. To ensure smooth delivery of the project, the study advocates the allocation of all policy; economic, financial, social, environmental, and technological risks to the client based on their shifting nature and existing contractual practice. The study provides an in-depth risk analysis and a comprehensive risk register for managing risks apparent in the project.

KEYWORDS

Coastal engineering, large construction project, Nigeria's coastal highway, risk, and risk management

1.INTRODUCTION

Coastal engineering projects involve a broad range of forms which are influenced by the action of water, tide and currents, wave actions and highest level of risks [17]. Construction in marine environment imposes diverse risk, the hazard involved, the antecedent cost, and environment consequences originate from three main perspectives. First, is the variability and uncertainties of storm, wave, swell, current and tidal and surge events;second, the need to work over, and supply material via water rather than land, and finally, the lack of adaptation of land-based clients, contractors, designers and insurers, procedures and contracts to these special circumstances. Improper consideration of the risk in coastal engineering like every other project endeavour could deter performance objectives' realisation.

The Nigeria East-West Coastal road project is unique and the very first in the region. The Nigerian coastal highway span 731Km with over 206Km straddling over barrier Island forest, fresh water swamps, mangrove swamps and inland water ways. Engineering design of the project shows an alignment that crosses almost 60 water bodies requiring 180 bridges. The world fifth longest cable stay bridge is to be constructed in this project. These unique features have placed significant impetus on the need to study the risk attributes of the project in order to improve the delivery process. Road transportation accounts for over 90% of the movement of people in Nigeria [12] including goods and services. The traveling distance between two ends Calabar and Lagos in the project takes 10 to 12 hours via road; and on completion, this travelling time will be half. The road is also intended to facilitate regional integration and linkage of coastal economies to the national economy in Nigeria.

Over the years, risk management has become the main stay of critical infrastructure projects decision making process. The objective behind risk management has shifted from enhancing an understanding of all stakeholders, to also facilitating possible agreement on what the threats to the project objectives really are and how they will be managed [2]. To generate appropriate value in today's unstable environment, analysis of possible risk has become the cultural ethics towards delivering success. Risk assessmentis also critical for establishing an efficient cost estimating improvement system that can be used to benchmark areas of potential problems thereby checkmating cost overrun [9]. It enhances continuous improvement in decision making and increases the probability of completing the project on time, budget and on other performance objectives. Based on the need to improve performance and ensure successful delivery of the proposed project, this study is conducted to provide useful empirical insight into imminent threats to performance realisation. The objective is to carry-out an assessment of imminent risks in the project, proffer mitigation strategies and assess the allocation preference within the context of the Nigerian construction industry's practice.

2.Theories of Risk Management in Coastal Engineering

Conventionally, risk management has been used instinctively while risks yet remain 'implicit' and controlled by judgement based on experiential knowledge [18].[17] argue that risk management should make risk explicit, formally describing and making them it easy to manage. Traditional risks assessment is based on expert opinion of perceived risks factors and this is widely used [6]. The utility theory is another widely adopted technique based on the ability to generate both qualitative and quantitative data (e.g. [5]). In this approach, respondents mainly professionals in the construction industry are required to assess the probability of occurrence and the degree of impact of a particular risk factor using numerical scales. Other tools AHP (analytical hierarchical process) and fussy theory [10] are also widely used.

The methodology for evaluating coastal engineering construction risks has undergone fundamental improvement, navigating from conventional 'deterministic' approaches to probabilistic techniques[8]. The improvement has impacted significantlyon the planning and the engineering processes of project development. The modification in risk analysis approaches is necessitated by a number of factors. First, the understanding of the probabilistic coastal processes has improved due to advances in field quantification, physical and numerical modelling [7].Second, standards of computing capabilities are growing significantly thereby promoting lengthened probabilistic calculations which were impracticable in the past.Third, the drives to implement better approaches that clearly illustrate improved analysis by practitioners have also emerged.

Two approaches are prominently used in coastal engineering construction risk assessment (16; 7], the frequency theory or frequency based approach and the life cycle approach. The frequency-based approach deals with the frequency of occurrence and its relationship with other key variables. The frequency approach combines forcing parameters with numerous occurrence frequencies to develop frequency of occurrence of key project response. The life cycle approach on the other hand,considers several possible development of the project with time during its life cycle. The life cycle approach is most suited to most coastal engineering projects [22]. This is because variation is essential in most coastal projects and it is directly co-opted into life cycle method. Other considerations such as functional performance variation, construction variation season and other economic and social environmental factorsare equally incorporated in the life cycle approach (ob. cit). The approach therefore leads to a unified analysis of technical performance and numerous economic factors that are determinants of project success. Consequently, it is widely acknowledged to be easily understood by non- technical stakeholders. However, [18] suggested the use of generic risk management methods on coastal engineering projects. This method, according to these authors, ensures proper identification and allocation of risks to the party best able to manage them. Their assessment strictly canvasses the use of software which however may not be available to project managers and other stakeholders in developing countries.Consequent upon the established impediments, the study utilises life cycle risk management approach in assessing the perceived risks in the Nigeria’s east- west coastal project.

2.1 Literature on Risk Management in Large Construction Projects

Studies in risk management in the Nigerian construction industry focused mainly on contractor’s risk management practices and performance [20]. Very few have studied risks in large construction projects (1;4). [23] studied risk in offshore engineering projects but failed to identify specific risks affecting off-shore projects. [18] studied risks in coastal engineering projects but focused mainly on river averment and shoreline protection works. [12] developed tools for flood risk and strategies for adaptation to climate change as an integral part of risk management in coastal engineering. From extant literatures, it becomes apparent that there is research dearth which attempts a life cycle understanding of imminent risk in coastal engineering projects. According to [17],existing literature tend to consider ‘small details’ which concentrate on the environment alone. There is need therefore for an empirical study with a ‘global discussion’perspective to identify principal risk in coastal engineering projects in all aspect of social, legal, political, environmental, economic and technological fronts.

With emphasis on the pre-construction stage, the present study attempts a holistic analysis of risk factors in coastal engineering in the Nigeria’s east-west coastal highway project. The need for the study stems from the strategic important, this project portrays to the Nigeria’s economic development. More so, given the shifting social, political and economic variables in developing countries amidst significant infrastructure gap to be filled [19]; the study will contribute significantly to project management knowledge in emphasising the need to address front-end issues as determinants of project success [15]. The objective is to determine perceived risk factors in the pre-construction stages of the project and to determine risk allocation preference practices among construction stakeholders in Nigeria. An understanding of stakeholders’ risk perception is essential to developing strategies for risk assessment and management. The effectiveness of risk assessment approach also depends on the diversity of stakeholders’ perception as it will engender opportunities for collaboration [15].

3. Research Methodology

To achieve the objectives of the study, a three tier research design was adopted. First, an in-depth literature search was carried-out to identify risk factors associated with coastal engineering projects. The aim of the literature search was to generate a comprehensive list of imminent risk factors associated with the project and to produce a 'prime version' of the risk register. The risk factors generated individually and collectively from practice and literature formed the basis for the second phase of the research.During the Second phase, the risk register containing 245 risk factors was presented to relevant stakeholders in engineering project delivery to identify critical risks that may affect the Nigerian east-west coastal highway project. To enhance quantitative risk assessment, respondents were asked to identify the likelihood of occurrence and degree of impact. The sample in this phase was determine using convenient sampling with 16 respondents comprising ten high profile engineering consultants and six project managers. Third, the critical risk factors which formed the risk matrix were presented as a survey questionnaire to a purposive sample of 66 project and construction managers selected from 32 construction organisations in Akwa Ibom and Rivers States, Nigeria. Purposive sampling was adopted due to the inability to aggregate and stratify firms into categories with capability to successfully undertake the scope of project envisaged in the study. The targeted population were project and construction managers in large and medium sized firm categories which are both national and international contractors with tendency to internalised and tap expertise abroad in executing similar projects. Self-administration was used to administer and retrieval was also done personally. The method was largely successful due to extreme personal contact involved hence, the significant response rate of 35.5% recorded. The respondents were required to identify and rank the likelihood of occurrence and degree of impact of 44 risk factors validated from stage two using a 3-point Likert scale and their allocation preference, and to also suggest mitigation strategies. Allocation preference was to identify who in the opinion of the respondents can conveniently or will likely bear each risk in order to ascertain the risk preference. Mean item score was used to determine the hierarchy of each risk factor. Risk factors with degree of impact and likelihood (3) are designated 'H', high; 2, 'M', medium; and 1, L, low.

4. Results

A total of 145 risk factors were assessed in 17 categories. Risks in the register and matrix below are identified as: political P1-7; Financial F1-11; Technical- Project Accommodation Tp1- 6; Technical Demolition TDe1-TDe10; Technical Early Works TE1- TE6; Technical Ground Condition TGc1- 5; and Technical Design TD1- 25. Others are: Economic E1-3; Technological TL1; Technical Logistics T1-2; Technical Archaeological TA1-3; Legal L1-3; Environmental Ev1-16; Social S1 -10; Project Management PM1-5; Cost Management CM1-5; and construction Risks C1-27.

Risk in Box 3 (Risk Matrix- Figure 1) cannot be tolerated if the project must succeed. The risk in this category includes policy risks; finance, design risk, environmental and social risks. The risks in box 5- yellow colour can be tolerated if it is economically and technically unreasonable to reduce them. The green region contains acceptable risks. The implication is that the presence of these risks in the project cannot deter the attainment of key project objectives.

4.1 High Impact High Probability Risks

These risks are those whose likelihood (probability) of occurrence is between 70 to 100%. They are P1, P2, P5, F1, F8, TP2, TP3, TP4, TP5, TD1, TD3, TD11, TD12, E1, E2, E7, E8,E14, S4, CM1, CM4, C3, C6, C10, C12, C21, and C27.

P1 (Government lack of Political will):- The project was first identified in 1991 as part of the UNDP/Federal Government of Nigeria Action to develop the oil rich Niger Delta among others. 20years after, the project design was concluded in 2012. Successive governments (2 military administration and 3 past civilian rules) did not prioritised the project. Following this trend therefore, tendency of non-implementing this project is significantly high. More so, committing such a huge budget to fund a single project in a region in five years is not feasible based on political grounds.

P2 (Change in government):- Nigeria is ruled on ethnic divides with very little nationalistic objectives. Successive governments had been the majority; the project is prioritised now because, a minority from the region is in power. The polity is tensed because the major wants back power. The incumbent's tenure ends in 2015 and the implication is that, the project might be abandon. This is why the study recommends legislative backing for the project.

F8 (Corruption and Financial Fraud):- Following 23years of military rules, the macro environment is characterised by corruption, wealth amassment and embezzlement. The tendency that, the project will be budgeted for,and fund diverted is very high due to weak institutional frameworks. The consequence is delayed payment to contractors, delay and cost increases. Delay and cost increases in federal government projects in Nigeria are very high.

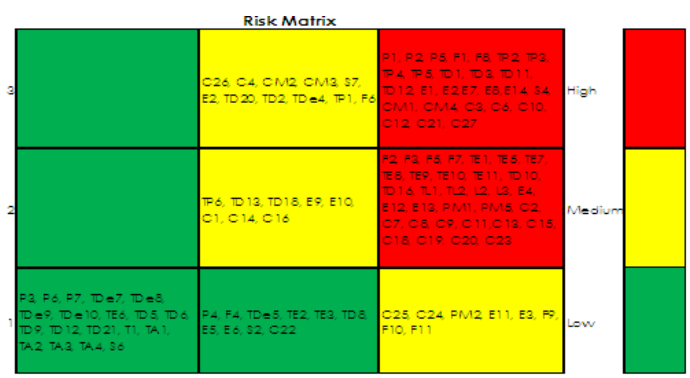

Figure 1: Risk Matrix

TD1 (Insufficient Design Details):- Due to the use of traditional procurement system which does not allow early involvement of the contractor, the tendency of insufficient production details is high. Several studies in this regard have proven the approach susceptible to related problems. The implication at the production stage might result in redundant time to get details and the adequacy of such details can also be questioned. Programmed delay is inevitable and this can be significant based on the scope of the project.

TD3 (Incompetent Design Team):- The design organisations are mainly indigenous consultants in partnership with foreign firms, the certainty of their collaborations my not be reliable or realistic. Like earlier mention, the skill requirement in the construction sector is inadequate like every other developing country. The greatest challenge is in the cable stay bridge. The tendency of engaging firms not on merit and competency is also very high. The chances of very high incompetent design team producing faulty design solution are 50:50.

TD11 (Ground Condition):- Over 80% of the total landmass of the Niger Delta region is either swamp, marshy or river. Site investigation cannot be conducted on the whole stretch of the project; the tendency of encountering an unsuitable ground condition is high. The chances of encountering unstable ground arealso very high. The consequence could mean complete inability to implement project at some point including associated delays, redesign cost and rework costs.

E1 (Market Condition):- The macro economic variables in Nigeria are very unstable and unpredictable. The inflation and exchange rates are equally very unstable and since true cost is in the market place (obtained in tenders), the chances of significant variation from what is budgeted for is very high. Where this occurs, the implication is that, the project cannot be awarded against budget and this may necessitate suspendingthe project.

EV1 (Flood/Coastal Surge Risks):- Flood risk disaster is on the increase in Nigeria, the shorelines are largely unprotected and the possible insurgence of flood risks from heavy down pour, sea and beaches fluctuation are significantly very high. The outbreak can significantly disrupt construction leading to redesigning, delay, rework and their associated costs.

EV2 (Exceptional Inclement Weather):- The true raining season in the thick rainforest region of the Niger Delta is nine against 7 months largely predicated from experts. This again depends heavily on sea wave from the nearby coast. This is a very significant threat to the timely delivery of the project. Extension in time is inevitable.

S4 (Militant Insurgence):- Arm taking and militancy is a black swan event in the area. In the past so many multinational coy have abandoned many on-going contract due to hostage taking, killing and disruption of work. The causes are often wide ranging; it could be a revenge or protest against government policy in other areas, excessive demands than the contractor can meet or other criminal tendencies. At the moment, there is a warning of possible attack on government and multinationals and locals as a result of Boko Haram insurgency up north.

4.2 Medium Impact Medium Probability

These risks are those whose likelihood (probability) of occurrence is between 50 to 70%. They are TP6, TD13, TD18, E9, E10, C1, C14 and C16.

TD7 (Inaccurate Survey Data):- Survey data are significant design and construction requirement in every infrastructure. The tendency of survey data being marred with flaws is very high. Incompetency is the leading responsible factor while long stretch and difficulty of generating these data are equally very high. Deep sea diving and the use of advance technology is involve but the first is a high risk endeavour while the latter is associated with high cost. As a result, concern parties might want to use intuitions which may not be accurate positively. Faulty data means ineffective design and project performance objective is not being met.

TD13 (Condition of Existing Structures):- Most section of this project are not entirely virgin, therefore the tendency of incorporating existing structure such as bridges is high. These bridges were built some 60years ago and require replacement. The risks of retaining these structures for cost saving or due to faulty condition analysis is feasible.

4.3 Low Impact Low Probability

These risks are those whose likelihood (probability) of occurrence is between 50 to 70%. They are P3, P6, P7, TDe7, TDe8, TDe9, TDe10, TE6, TD5, TD6, TD9, TD12, TD21, T1, TA1, TA2, TA3, TA4, and S6.

P3 (Inadequate Government Consultation):- Roads project construction in Nigeria is governed by fiscal federalism. This is a federal road project coordinated by the central government with different jurisdiction and authority. Therefore consultation with states and local government is irrelevant. The existing institutional framework is not strengthened to allocate appropriate commensurate rights to states and local government on this matter.

TP2 - Failure to Vacate Property Accommodation by Occupants):- Once properties are paid for and sufficient time is given in notice, such occupiers are expected to vacate although some might be adamant. The risk is in this category because where proper settlement is done compulsory demolition is imminent.

TDe8 - Additional Security to Demolished Properties):- Inability and unwillingness of owners to protect their properties during construction can result in litigation. However, owners of demolished properties are to provide relevant security to their properties after demolition e.g. fence.

TDe10 - Insufficient Working Space for Demolition: - Demolition harbours significant safety hazards. The probability of this risk is very low because the region is largely undeveloped with traditional settlements made in crude materials.

TD9 - Multiple Approval Problem: - It was earlier mentioned that roads are govern by jurisdiction vested on the three tiers of government. The project is coordinated at the centre hence; there is very little need to seek approval from state and local government. State and local government are mere beneficiaries.

5. Discussion

One critical attribute about the study respondents' perception of the risk factors is the homogeneity with which all respondents agree and rank every risk factor. Risk perception in the construction industry is widely agreed to be heterogeneous; with individual risks having different likelihood of occurrence and consequences [15]. Policy risks received very little mention in research literature notable where public sector finance projects are examined. Although, thereare numerous literaturesexamining joint venture projects in the construction sector. Policy risks are known as political risks in the general domain. They are unexpected variation in value as a result of unexpected discrepancy in public authority's action [14]. Many high impact and high probability risks in this study are consistent with study by[4]. [4] studied risk factors impacting highway construction in Nigeria; and identified contaminated soil, design changes and inaccurate design details. [14]also analysed policy risk as the key constraint to business investment globally.

Table 1: Principal Risk Factors in Nigeria's East-West Coastal Highway

Ref	Category	Heading	Mitigation Strategies	PR	IM	PF
P1	Political	Government lack of Political will	Government to show adequate commitment to project	H	H	CL
P2		Change in government	Backed project with legislation	H	H	CL
P5		Political indecision	Adhere to implementation milestone	H	H	CL
F1	Financial	Low budgeting	Prioritized funding & seek joint funding other tiers of government	H	H	CL
F8		Corruption & fraud	Engage reputable private fund manager	H	H	CL
Tp1	Technical-Project	Funding shortfall to acquire right-of-way	Prioritize key acquisition to enable expedient demolition	H	H	CL
TD1	Technical-design	Insufficient design details	Design consultants to submit full and detailed as applicable	H	H	CL
TD3		Incompetent design team	Engage best in class consultant	H	H	CL
TD10		Ground condition	Site investigation should be thorough	H	H	CL
TD22		Design error	Peer review design	H	H	CL
E1	Economic	Market condition	Improve estimate to allow for varying market condition	H	H	CL
Ev1	Environmental	Flood/coastal surge	Design for sea revetment and sea wall as appropriate	H	H	CL
Ev2		Surface run-off	Provide mitigation measures	H	H	CL
Ev7		Exceptionally adverse weather	Program to fit float where possible	H	H	CL
Ev8		Coastal erosion	EIA should address this problem	H	H	CL
Ev14		Beaches fluctuations	Adopt wait-and-see method with contingency for mitigation	H	H	CL
S3	Social	Stakeholder management	Prioritize and engage extensively before construction	H	H	CL
S4		Militant insurgence	Monitor and provide for security	H	H	CL
CM1	Cost Management	Inaccurate cost plan	Benchmark base estimates	H	H	CL
CM4		Uncertainty of project budget	Investigate and current tools for cost estimates	H	H	CL
C3	Construction Risk	Poor labourers training	Provide adequate training for employees	H	H	CR
C5		Lack of professionals	Contractor to explore local content	H	H	CR
C6		Force majeure	Appropriate remedies in contract	H	H	CL
C10		Political instability	Study closely to understand political climate	H	H	CR
C12		Construction tolerance	Design consultant to recognize what is achievable rather than what is desirous	H	H	CL
C21		Accessibility	Extensive pre-construction surveys	H	H	CLR
C27		Dredging & disposal	EIA should identify mitigation measure	H	H	CLR
TP6	Technical Project	Difficulty in serving vesting notices	Undertake advance consultation	M	M	CL
TE4	Technical Early works	Miscellaneous delay issues	Improve identification of miscellaneous causes	M	M	CR
TD7	Technical Design	Inaccurate design data	Engage competent consultant and modern equipment	M	M	CL
TD13		Existing structures	Preliminary survey should be thorough	M	M	CL
TD18		Dilapidation to existing infrastructures	Detour traffic as much as possible	M	M	CR
C1	Construction Risk	Delay in supply of offshore components	Fund should be release in advance of construction	M	M	CL
P3	political	Inadequate government consultation	Ensure all tiers of government are well consulted	L	L	CL
P6		Political opposition	Seek opposition support based on economic benefit	L	L	CL
TP6	Technical Project	Failure to vacate right of way	Pre-construction planning should be done in advance	L	L	CL
TDe8	Technical demolition	Additional security for demolition	Property owners should be mandated to vacate after payment	L	L	CL
TDe		Difficulty in demolition	Review schedule of property to be demolish	L	L	CL

9						
TDe 10		Insufficient working space for demolition	Contractor to consider careful phased approach	L	L	CR
TD5	Technical Design	Changes in design standards	Prioritization of the project is work as planned	L	L	CL
TD9		Multiple approval problem	Approval body should be harmonized	L	L	CL
Td11		Unexpected utility crossing	Site investigation should be thorough	L	L	CL
T1	Technological	Technology obsolesce	Prioritized the project as planned	L	L	CL
S6	Social	Public objection	Ensure sufficient engagement	L	L	CL

H = high; M= medium; L =low; CL =client; CR = contractor; CLR = client/contractor, PR =probability, IM = impact; and PF = preference

Although Irvin's assertion is in respect to privately financed projects, the shifting political, economic and social variables pattern in Nigeria significantly substantiate his position. [4]; [22]; and [23] also identified political risks and market condition among the critical risks factors in offshore projects. [15] identified land acquisition issues as a factor in road construction in India. 66% of the identified risks are transferrable to the contractor (Table 1). The proportion of risk retained by the client is 34%. Respondents from public client organisations disagree significantly on the governance of risk considered client's risks. They believe the contractor is paid premium to take up the responsibilities. But the underlying denominator, which needs an insight, is the trend in risk avoidance by the public sector client. The guiding principle governing risk allocation in the management of risk remains, the party which is best able to manage risk are allocated significant risks. In the present study, the chunk of the risks are better retained and managed by the client or jointly managed with the contractor for optimal result. [14] argues that policy risk for instance should be allocated to the public sector client.Allocation of risk should be tailored in accordance with an understanding of the project objectives. These must be clearly communicated to all parties at the inception of the project.Risk allocation principle shown in this study is therefore 'a one-size-fit all processes designed to ridicule project objectives [17].

While there is need to promote risk sharing in line with the emerging trend globally; to implement this project based on the existing contractual form, all policy, economic, financial, technical, social, environmental, technological risk should be retained by the client. Contractors are better disposed to manage construction risks.

6. Conclusion

Coastal engineering projects present unique characteristics different from conventional construction projects. This study, using the Nigeria's east-west coastal highway project determined the critical risk factors in coastal engineering projects and their allocation preference. The study focused on the pre-construction stages of the project based on the increasing emphasis on the need to pay attention to front end issues as determinants of project success.A risk register containing 245 risks factor was presented to relevant stakeholders- design consultants and project managers selected from consultant and contractor's organisations to identify perceived risks which may influence project performance. 44 risk factors were validated significant. 27 are high impact/probability factors; 6 are medium impact/probability factors while 11 are low impact/probability factors. Among the high impact-high probability factors are: government lack of political will; change in government; political indecision; low budget; and corruption. 66% of the risks were allocated to the contractor while 34% are retained by the public sector client. The study suggests risk allocation should be tailored according to an understanding of the project objectives, which must be clearly communicated to all parties at the inception of the project. To improve the delivery of the project, all policy, economic, financial, technical, environmental, and technological risks should be retained and managed by the client. The contractor should be allowed to focus on the management of construction risks. The study provides an in-depth risk assessment and analysis towards the management of risk in Nigeria's east-west costal highway project.

This study implements mainly survey research design which adopts and tested risks from the literature. The tendency subsists that the designed survey instrument may not enlist all salient risks that can affect project performance. A mixed approach study is therefore recommended notably semi-structured interviewing with a selected group from the survey's sample to be able to tap from their repository of experiential knowledge to enrich the risks tested in this study.

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