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Full Length Research Paper

An evaluation of critical success factors in oil and gas project portfolio in Nigeria

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This study focuses on investigation of the critical success factors required for successful deepwater development in offshore Nigeria. Thirteen critical success factors were established along with project delivery schedule, project budget and portfolio management strategy as impacting on project success. A sample of 200 participants were identified and issued with a set of self developed items web based questionnaire, with the variable items drawn from the literature review. 85% of the target sample responded to the electronic mail web based questionnaire. The findings of this research show that, thirteen critical success factors are of high importance within the deepwater oil and gas project portfolio management. It also identified that some critical success factors in mega construction projects can be applied to deepwater oil and gas projects.

Key words: Critical success factors, project portfolio, deepwater, oil and gas, Nigeria.

INTRODUCTION

Nigerian offshore fields comprise of reservoirs containing commercial hydrocarbon volumes. Ideally, the reservoir will contain sufficient energy to cause hydrocarbons to flow freely to the surface. To optimize the recovery of the resource, a well is drilled into the hydrocarbon reservoir, requiring deep water subsea wells tied back by flowlines, with the aid of manifolds and subsea risers, to an FPSO, before final processing and transportation to energy markets. ISO 10006 defines project as a unique process, consists of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources. A Portfolio is a collection of projects or programs that are grouped together to facilitate effective management of that work to meet strategic business objectives (Project Management Institute, 2004).

During the period 1999 to 2005, the major oil companies in Nigeria and the Nigerian National Petroleum company (NNPC) embarked on huge capital expenditure investments in deep water project portfolios, under a production sharing contract agreement, amounting to over 6 billion dollars and equivalent to 80% of their total capital budgets. While these projects are the first of its kind offshore in Nigeria, most of the project portfolios experienced project management challenges with huge cost overruns and schedule delays.

This research is very important and of interest to exploration and production company executives, project managers, project engineers, business executives, regulatory stakeholders, production sharing contract (PSC) partners, and investors.

The aim of this research is to investigate critical success factors in deepwater oil and gas project portfolio's in offshore Nigeria. The specific objectives of this research are to:

1. Determine the prerequisite for successful project outcomes in exploration and production deepwater oil and gas project portfolios, in offshore Nigeria.
2. Identify the prevalence of critical success factors.
3. Identify what specific capabilities are required to enable organizations have consistent positive outcomes in deep water project portfolios.
4. Identify any relationship between the prevalence of critical success factors and the overall organisational/

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project portfolio strategy.

Significant contribution of research

This piece of research is useful for deepwater oil and gas project management practitioners in the petroleum industry who will encounter issues of cost and schedule overrun, strategy and resource allocation and therefore, can make use of the recommendations in this research study. The research would enable the exchange of knowledge in tackling current and future challenges and create pathways for deepwater oil and gas project management and enhance further success in locating, extracting, and transporting oil and gas to meet global demand.

Project management is indispensable for business results, the research will be able to create strategic dialogue on issues of project success, that reflect the realities of capital project management in the oil gas, and petrochemical sectors, to improve efficiency and further ensure a framework of good practices is consistently applied. It will also bridge existing knowledge gap and further aid in reducing project failures of major and complex national projects.

For this study, the research problem is to identify the critical success factors, required to address concerns on recurrent project cost escalation and schedule delays. This paper intends to answer the following research questions with regard to the study carry out in Oil and Gas Project Portfolio in Nigeria:

1. What specific Critical Success Factors is required for deepwater project success?
2. What Critical Success Factors are aligned to the overall organisation/portfolio management strategy?
3. Why do particular deepwater project portfolios run over budget?
4. Why do particular deepwater portfolios have schedule delivery overrun?

LITERATURE REVIEW

Petroleum industry

Petroleum and gas deposits occur naturally throughout the world in every continent and ocean. Most of the deposits are several thousand meters deep. The petroleum industry's mission is to find, develop, refine, and market these resources in a fashion that achieves the highest economic return to the owners or investors while adequately protecting the fixed investment in the operation (Van der Veer, 2007). The main facets of the oil and gas industry are exploration, production, refining, transportation, and marketing. According to Lyons and Plisga (2005) exploration for oil and gas reservoirs consist mainly of geological testing and drilling of exploratory “wildcat wells”. To find crude oil or gas reserves underground, geologists search for sedimentary basin in which shales, rich in organic material have been buried for a sufficiently long time span of ten to a hundred million years. Oil and gas from the drilled well is produced through primary separation facilities, into individual stream of gas, oil and water.

The produced liquids and gases are then transported to a gas plant or refinery by truck, railroad tank car, ship, or pipeline. The final facet involves marketing, bulk plants, distribution and marketing terminals store that distribute finished products from refineries and gas plants (Grace, 2007). Typically, these facilities handle gasoline, diesel, jet fuels, asphalts, and compressed propane or butane. The oil and gas industry is complex and requires expertise in various areas and technical disciplines, as well as technological capability and capital to fund these high-risk ventures (Memorial University Newfoundland, 2010; Brown, 2009). Gidado (1996) suggested possible causes of project uncertainty, namely: (1) Unfamiliarity with the inputs and/environment by management, (2) Lack of uniformity, such as when material to be worked varies with place and time or teams working together vary with place and time or the role of the teams keep varying with place and time, and (3) Unpredictability of the environment, such as the effect of weather and perception of the local community.

Project management

Project management includes the planning, organizing, monitoring and controlling of all aspects of the project in a continuous process to achieve its objectives (Alam, 2009; Chan et al., 2009). American National Standard defines project as a temporary endeavour undertaken to create a unique product or service or result. Project management is the art and science of managing all aspects of the projects to achieve the project mission objective, within the specified time, budgeted cost, and pre-defined quality specification working efficiently, effectively, and ethically in the changing project environments (Alam and Khalifa, 2009; Chan et al., 2009). Table 1 illustrates the process by which a project is brought to a successful conclusion and has three dimensions which are objective, management process and levels. Modern projects are inter-dependent and interrelated, that involve heavy investments.

It requires high level of technology and need effective management of voluminous resources. The deepwater industry is a very highly specialised, technology based, and small community (Leimkuhler, 2010). However, Acharya et al. (2006) insisted that when a new technology is applied, at the same time, it must be seen whether skilled people are available to convert the technology into the real work. Otherwise, improper application of the

Table 1. Dimensions for projects.

Dimensions	Details
Objective	Scope, organization, quality, cost, time
Management process	plan, organise, implement, control
Levels	integrative, strategic, tactical

Source: Turner (1999).

Figure 1. Critical success factor influence on strategic planning.

technology may lead to quality degradation or monetary losses.

Projects environment

Project exists in association with internal and external risk prone environment that cause frequent changes. The internal environment of a project includes corporate objectives, stakeholder's interests, resource problems, and people management. The external environments are associated with changes in social, political, legal, economic, financial, and climate factors. The success of a project depends on the management of these risk prone changing environments within the framework of project objects (Baccarini, 2005). Most project managers wish to minimize the uncertainty and consequent risk; however, in the process project managers either overestimate or underestimate risks.

Strat*egy management*

Strategies are broad action plan statements that guide and direct the use of organisation's resources to accomplish the mission and goals (White and Patton, 2002). Strategic management is geared towards achieving corporate objectives. It provides a guiding force that integrates the efforts of all levels of staff in an organisation. Rachman and Mescom (1978) identified strategic management as one approach to the 'big picture' problem; they believed, it stresses the importance of focusing on overall company goals, rather than on individual products or division within the company. Jauch and Gleuck (1988) defined it as "a stream of decisions and actions which leads to the development of an effective strategy or strategies to help achieve corporate objectives". According to Hill et al. (2007), the strategy management process is a combination of not only strategy formulation, strategy analysis, and strategy implementation, but also evaluation and control (monitoring performance using actual results learning and adjustments) and environment scanning by identifying what is important and addressing the strategic issues by gathering information and analysing both the external (opportunities and threats), and internal (strengths and weaknesses).

It is worthy to note that, each of these stages as outlined above, does not necessarily come detached and separable. They are all interrelated and overlapping (Ottih, 2002). The turbulence and unpredictability caused by technology, competition, and geopolitical forces has meant that strategy has become as much about managing uncertainty as a quest for profit (Grant, 2008). According to Mintzberg et al. (2003), a well-formulated strategy helps marshal and allocates an organisation resources into unique and viable posture based upon its relative internal competences and shortcomings, and also anticipated changes in the environment. The recent concept of strategy focuses less on detailed plans and more about mission, vision, principles, guidelines, and targets as shown in Figure 1. Strategy must embrace flexibility and responsiveness (Grant, 2008). A clear

sense of direction is essential to the pursuit of objectives. The setting of clear and unambiguous objectives is the key to success; hence, little progress can be made until this is done (Turner, 1999).

Strategic choices can be distilled into two basic questions (1) Where to compete? and (2) How to compete? The answer to these questions also defines a firm strategy into Corporate and Business strategy. Bourgeois (1980) referred to corporate strategy as the task of domain selection and business strategy as the task of domain navigation. Grant (2008) postulates that, corporate strategy defines the scope of the firm in terms of the industries and markets in which it competes. Corporate strategy decisions include investment in diversification, vertical integration acquisitions and new ventures, the allocation of resources between the different business of the firm, and divestments. Business strategy focuses upon how to better deal with competition, so the essence of business strategy, is to create competitive advantage which gives an organisation a sustainable lead over competitors for attracting customers and defending against competitive forces (Srivannaboon and Milosevic, 2004). If the firm is to prosper within an industry, it must establish a competitive advantage over its rivals. This area of strategy is also referred to as competitive strategy (Grant, 2008).

Portfolio and portfolio management

Project management is about the implementation of strategy (Baccarini, 2005). The solution of linking project management to strategy is often related to program management and project portfolio management (Artto et al., 2004). Strategic change in firms is largely delivered through multiple simultaneous projects (White and Patton, 2002).

Theoretical framework

Critical success factors (CSF)

Project success is a vague term (Lientz and Rea, 1995). McCoy (1996) points out that, “before attempting to categorise projects as a success or failure, it is necessary to determine the criteria upon which this evaluation will be made. A synonym for success is effectiveness, which is measured in terms of the degree of achievement of objectives (Belout, 1998). According to Barccarini (2005) cost performance is a key success criterion for project sponsors. Qiao et al. (2001) identified eight independent CSFs for project management that include, appropriate project identification, stable political and economic situation, attractive financial package, acceptable toll/tariff levels, reasonable risk allocation, selection of suitable subcontractors, management control, and technology transfer. Jefferies et al. (2002) identified five CSFs for project management which are solid consortium with a wealth of expertise, considerable experience, high profile and a good reputation, an efficient approval process that assisted the stakeholders in a very tight timeframe, and innovation in the financing methods of the consortium. Innovative technical solutions (Zantke and Mangels, 1999) and ‘Soft’ critical success factors also regarded as critical for portfolio project management. The ‘soft’ CSF are social support (Frilet, 1997), commitment (Stonehouse et al., 1996; Kanter, 1999), and mutual benefit (Grant, 1996). The importance of procurement transparency and competitive procurement process can also be considered as CSF, for some portfolio project management (Kopp, 1997; Gentry and Fernandez, 1997). Effective management of constraints of the stakeholders, leadership styles, and work environment are also revealed as factors behind the success of project efforts (Sawhney and Prandelli, 2000; Shim and Lee, 2001). Critical success factors will influence all the project management process/phase from formulation, planning, and execution, controlling, and closing process. In order to understand critical success factors needed in deepwater development projects, an understanding of why projects fail is important.

Portfolio management strategy (PMS)

A project cannot address every organisational strategic goal but it contributes to the organisation’s ability to perform some of its tasks in an improved way. Therefore, all business are built around objectives for success, achieving high productivity, improving quality, delivering at the appropriate time, decreasing cycle time, growth of market share, utilising resources effectively, and managing cost (Andersen et al., 1995; Stewart, 2001). The project goal is the overall strategic orientation to which the project will contribute and should be consistent and extracted directly from the strategic plans of the organisation. The strategic justification requires the objectives of the project to be consistent with government, and agency’s strategic objectives. The strategic justification criteria are critical to the process of defining a projects desired outcome by linking all projects to the strategic direction of the organisation. Projects are taken to fulfil the strategic plans of the initiator. All projects shall support the organisation’s strategic goals (Gray and Larson, 2002; Turner, 1999; Project Management Institute, 2004).

Project budget (PB)

The cost escalation is highly dependent on the length of the implementation phase (Flyvbjerg et al., 2003). The possible factors that might impact on construction time and cost overrun are due to delay as design changes, poor labour productivity, and inadequate planning (Kaming et al., 1997). Built capital cost is on average, 14% higher than estimates in the bankable feasibility

study. The capital cost estimation is intentional and driven by scarcity of project financing, and the need by the project sponsors to reduce the project economics to secure financing. In fact, cost overruns of 100% or more might happen in one out of thirteen projects (Bertisen and Davis, 2008). Large construction cost escalations in infrastructure projects are common and exists across different types, different continents, and different historical periods. Bower (2000) argued that indirect costs are more difficult to quantify. It was revealed that, the cost of rework caused by variation orders accounted for more than four-fifth of the total costs of rework (Love and Li, 2000). Flyvbjerg et al. (2003) concluded that an increase in project size translates into the need for improved planning processes and institutional set-ups for infrastructure development and management.

Project delivery schedule (PDS)

The concept of project duration is important in assessing the success or viability of a project. The estimation of time is still the main concern and interest to both researchers and contractors (Ogunsemi and Jagboro, 2006). Several authors agree that exceeding the original project delivery date will create variation orders and project time overruns (Chan and Yeong, 1995; Mohamed, 2001; Toor and Ogunlana, 2008). Construction delays resulted in cost overruns, poor quality, and greater disputes. Most companies find it difficult to deliver on time not because of lack of financial resources but mainly due to the fact that, they are facing enormous pressure of multiple jobs and parallel deadlines with less than adequate human resources. Focus on reducing the delays can also help to reduce resources spent on heavy litigation processes (Al-Khalil and Al-Ghafly, 1999; Phua and Rowlinson, 2003; Williams, 2003). Arain and Pheng (2006) stated that situations beyond the control of the contractual parties, which give rise to project schedule failures include weather conditions, certain health and safety consideration, government regulation change, changes in economic conditions, socio-cultural factors, and unforeseen problems. Deepwater portfolio developments are projects that involve extensive unforeseen condition. This makes understanding the local environment crucial for deepwater project success.

RESEARCH METHODOLOGY

Study design

For this research, the study design has been identified as cross-sectional, and non-experimental. Within this research, the cross sectional study has been selected as the number of contacts within the population as one. Some advantages of the cross-sectional study are, the low amount of time and cost needed to conduct the study, as well as its usefulness in generating an overall view of the study. This research focuses on known outcomes, which are referred to as a non-experimental type of study. Therefore, the researcher is not able to influence the data. However, it will lead to the problem that the comparability between data is limited (Kumar, 2005).

Instrument administration

The questionnaires are administered personally or through electronic mail with an accompanying letter to the top managers or their deputies by the researcher. Prior phone calls were made to explain the purpose of the questionnaire and to secure permission for questionnaire administration. Early appointment fixed to facilitate access to the companies. The entire process for all ten (10) companies consumed about two weeks.

Research ethics

To ensure the university's guiding ethical principles are upheld, ethics approval application form C and consent forms were filled out, indicating the title of the research project, the scale of human participation and method of data collection. With support of the project supervisor the ethics application was signed-off and submitted to the Research and Development office for processing. Ethical clearance number 2010-14-KS-BG was issued before commencement of data collection.

Hypothesis development

Table 2, indicates a summary of literature reviewed in the theoretical framework that links and relates to the hypothesis. A hypothesis is a hunch, assumption, suspicion, assertion, or idea about a phenomenon, relationship or situation, which one intends to investigate in order to find out how right she/he is. A hypothesis may either be rejected or not rejected. As a hypothesis is usually constructed on the basis of what is commonly believed to be right, disproving it might lead to something new, that has been ignored by previous researchers (Kumar, 2005).The empirical evidence presented in this research reflects the increased importance of critical success factors in deepwater oil and gas project portfolio management. Recognition of their importance provides avenue for deepwater project managers and engineers to focus on the underlined key variables. Figure 2 illustrates the relationship between the critical success factors with the hypotheses for this study.

One sample T-test

One-sample t-test determines whether a sample is representative of a population with specified mean. A one sample t-test is a hypothesis test for answering questions about the mean where the data are a random sample of independent observations from an underlying normal distribution N(μ, σ^2), where σ^2 is unknown. The null hypothesis for one sample t-test is:

H0: μ = μ0, where μ0 is known.

That is, the sample has been drawn from a population of given mean and unknown variance (which therefore has to be estimated from the sample).The null hypothesis, H0 is tested against one of the following alternative hypotheses, depending on the question posed:

H1: μ is not equal to μ
H1: μ > μ
H1: μ < μ

Table 2. Hypothesis links to literature.

Literature reviews	Hypothesis
Project management for 21st century (Lientz and Rea, 1995). Effects of human resource management on project effectiveness and success (Belout, 1998). The changing role of the information systems executive: a critical success factors perspective (Rockart, 1982). Framework for critical success factors of BOT projects in China (Qiao et al., 2001). Critical success factors of the BOOT procurement system (Jefferies et al., 2002). Some universal issues in BOT projects for public infrastructure (Frilet, 1997). The financial structure of private finance initiative projects (Akintoye et al., 2001).	H1: Critical success factors are criteria's for deepwater project success
Balanced scorecard for projects (Stewart, 2001). The handbook of projects-based management-improving the processes for strategic objectives (Turner, 1999). Goal directed project management (Andersen et al., 1995). Project management (Gray and Larson, 2002).	H2: Portfolio management strategy is dependent on the critical success factors.
What causes cost overruns in transport infrastructure projects (Flyvbjerg et al., 2003). Bias and error in mine project capital cost (Bertisen and Davis, 2008).	H3: Critical success factors positively influence deepwater project Budget.
Assessing extension of time delays on major projects (Williams, 2003) Problems causing delays in major construction projects in Thailand (Toor and Ogunlana, 2008) Important causes of delays in public utility projects in Saudi Arabia construction (Al-Khalil and Al-Ghafly,1999)	H4: Critical success factors positively influence deepwater project delivery schedule.

This section shows test of the null hypothesis where the population mean is equal to some hypothesised value. A two tailed test is used, to test the null hypothesis H01, H02, H03, and H04 against the alternative hypothesis:

H01: Critical success factors are not criteria for deepwater project success.
H02: Organization/Portfolio management strategy is not dependent on the critical success factors.
H03: Critical success factors do not positively influence deepwater project Budget.
H04: Critical success factors do not positively influence deepwater project delivery schedule.

Sampling

The sample size for quantitative research can be statistically calculated or easily determined through tables as shown in Table 3 (Sarantakos, 2005). The samples for this research are deepwater project management professional working in Nigeria and who are currently engage in development of deepwater project portfolios. They are project owners, project engineers, project senior engineers, project manager, and project directors. A total of 200 questionnaires were distributed using the convenience sampling method. The questionnaire targeted ten major oil companies Shell, Chevron, Exxon Mobil, NNPC, ADAX, Schlumberger, AGIP, and others to enhance an even spread of the instrument. It has been issued to other smaller deepwater companies in Nigeria as shown in Table 3. A time period of fourteen days were given for the data collection. The collection of data was carried out just before the end of the fourteen days. The study population of the research is 200 respondents. However, due to the fact that the time for this research is limited, the researcher able to secure about 170 respondent or 85% of the study population responded to the survey.

Questionnaires

The formulated questionnaires comprise of self developed items from the literature review, these were divided into sections of closed-ended (Part A) and open-ended (Part B) questions. All data were completely transferred and no problems were experienced within this process. While open-ended questions are the questions that seek to get the opinion of respondents. An open-ended question is a qualitative enquiry aiming at minimising the imposition of predetermined responses when Gathering data whereby people can respond in their own words. It provides a wealth of information and insights that allow respondents to feel comfortable in expressing their opinions. It provides the respondents an

Table 3. List of companies.

Company listed	Questionnaire e-mailed out
Shell Nigeria Exploration and Production Company	20
Nigerian National Petroleum Company	20
EXXON MOBIL	20
ADAX	20
CHEVRON	20
Nigerian AGIP Oil Company (NAOC)	20
Schlumberger	20
OANDO	20
PAN OCEAN	20
FAIRSHORES	20
Total	200

opportunity to express themselves freely that result in a greater variety of information, and virtually eliminate the possibility of the investigator's bias (Patton, 2002; Kumar, 2005).

Section A of the questionnaire collects data on respondents' demographic information such as age, gender, education level, annual household income, job position, organisation, and oil industry working experience. It further establishes the organizational characteristics. Section B of the questionnaire enquires about the prevalence of the listed thirteen critical success factors in deepwater project success and how the dependent variables of project management strategy, project budget, and project Schedule are dependent or impacted by these critical success factors. Each dependent variable (1) critical success factor, (2) project management strategy, (3) project budget, and (4) project schedule has 13 items; each consists of statements followed by a five point Likert scale. The scale ranged from 1 which represents 'strongly disagree' to 5 which represents 'strongly agree' and 3 which represents 'neutral'.

Validity and reliability

Validity is referred to as the correctness or credibility of a description, conclusion, explanation, interpretation, or other sort of account. In terms of measurement proce-dures, validity is the ability of an instrument to measure what it is designed to measure (Kumar, 2005; Maxwell, 1996). In fact, the research is concerned with investigating a hypothesised casual relationship between an independent variable and dependent variable. If such a relationship is found, inferences are drawn upon the population and perhaps, a variety of circumstances in which the relationship may apply beyond the studies (Fellows and Liu, 1997). Therefore, validity is premised on the assumption that what is being studied can be measured or captured, and seeks to confirm the truth and accuracy of this measured and captured data, as well as the truth and accuracy of findings or conclusions drawn from the data. Reliability is premised on the notion that, there is some sense of uniformity or standardisation in what is being measured, and that methods need to consistently capture what is being explored (O'Leary, 2004). An instrument is proven reliable, if it provides the same results on repeated trials. A research instrument is reliable, if it is consistent and stable, and hence, predic-table and accurate. Reliability will be analysed using SPSS by calculating the correlation of values of items for questions of which responses are predicted.

Reliability test

Reliability is concerned with how far one can rely on the consistency of a measure (Rose and Sullivan, 1996). Reliability testing for independent variables calculates the coefficient of reliability based on the average correlation of items within a scaled test considering the items are standardised. Cronbach's alpha coefficient is used to test the reliability which varies from 0 to 1 and the closer the coefficient is to 1, the more reliable the scale. Cronbach's coefficient is an accurate estimate of the reliability of measurement instruments. Satisfactory test results in a lower bound estimate providing a worse-case scenario of reliability. An alpha value of 0.7 or more, indicates a reliable measurement instrument for data that are used for fundamental research. This means that a test with a reliability of 0.7 has 30% of its variance as irrelevant. However, it is common to find low Cronbach's alpha coefficients, for example, 0.5 for scales with fewer than ten items. SPSS is used to calculate the correlation matrix of responses to the ordinal scale questions, which is used for calculating the level for each variable used in the questionnaire. The reliability of a scale varies, depending on the sample that is used. The lower the number of items, the more likely the reliability coefficient will be lower (Pallant, 2005).

An appropriate reliability test for a single occasion data collection is Cronbach's coefficient alpha which is an estimate of internal consistency of responses to different scale items (Tredoux and Durrheim, 2002). Any measure-ment instrument should meet the general standard of (1) validity and (2) reliability. Are the right questions being asked? Furthermore, internal inconsistency may arise in a set of scaled items. An assessment tool has validity, if it measures what it purports to measure. The reliability of a test refers to the consistency of the evaluation results. To be valid, assessment scores should also be reliable. A fair and valid assessment instrument must be reliable and differences between raters are a major source of error. Researchers have traditionally conceptualized rating inaccuracy as the unwitting result of rating errors. From a psychometric perspective, rating errors are understood to be the results of the rating stimuli that do not trigger reliable and valid responses (Nijhof and Jager, 1999). From a cognitive perspective, rating errors are conceptualised to be the result of the limitations of human cognition (DeNisi, 1996). Thus, departing from the traditional psychometric and cognitive perspectives, the goal-based approach to performance evaluation concep-tualises that a part of rating inaccuracy is indeed not related to rating error; rather, it is intentionally introduced by the rater to achieve specific goals in organisational contexts (Cleveland and Murphy, 1992; Murphy and Cleveland, 1991; Murphy et al., 2004; Wong and Kwong, 2007). Also, cultural implications arise in the definition and interpretation of meaning. Furthermore, deterministic probability skewness may occur in assessments where the assessor tool is skewed to a particular area of thought and not having a helicopter view on

Table 4. Cronbach alpha for variables.

Variables	No. of items	Items deleted	No. of items used	Cronbach Alpha
CSF	13	2	11	0.812
PMS	13	0	13	0.878
PB	13	4	9	0.779
PDS	13	0	13	0.839
All Variables	52	6	46	0.925

view on issues and thus being prone to interpretation errors. Russell (1994) indicates that invalid feedback results, when participants are not skilled in giving feedback. To ensure validity and reliability, (1) participants who understood the subject matter are selected; (2) information is given to the participant on how to go about the questionnaire process; (3) where required participants are further coached on termi-nology; and (4) participants are motivated to complete the assessment through written emails and phone calls. Most of these steps are taken to prevent invalid feedback.

Analysis of the validity and reliability of the study

For this study, it is established that the value of 0.7 and above is reliable for questions having between 5 and 13 items. The overall Cronbach's alpha coefficient for all scaled questions is 0.925 which satisfies the reliability test requirements. Table 4 shows the reliability test summary for questions relating to (1) critical success factors (CSF), (2) portfolio management strategy (PMO), (3) project budget (PB), and (4) project schedule (PS).

The reliability test assessed is analysed using Cronbach alpha reliability coefficient as depicted in Table 4. Generally, the reliability for prevalence of the listed critical success factor is high, with the Cronbach alpha value of 0.812. The reliability for portfolio management strategy influencing critical success factors for deepwater project success is also very high with the Cronbach alpha value of 0.878. The reliability for project budget is highly dependent on the listed critical success factor is strong with the Cronbach alpha value of 0.779. The reliability for total that critical success factors will influence project schedule for deepwater project success is relatively high with the Cronbach alpha value of 0.839.

Edit, code, and analyse the data collected

Data analysis encompasses the compilation and interpretation of the data collected. Since the data has been recorded using qualitative and quantitative approaches, the analysis will be done accordingly. Whether it is qualitative or quantitative data, the main rule of any form of analysis is to move from raw data to meaningful understanding (O'Leary, 2004).

Quantitative analysis

Quantitative analysis uses the syntax of mathematical operations to investigate the properties of data (Walliman, 2005). Quantitative data is analysed statistically. Statistical analysis can be, descriptive and inferential. Descriptive statistics are used to describe and summarise the basic features of the data in a study, and are used to provide quantitative descriptions in a manageable and intelligible form. Descriptive statistics measure the central tendency (mode, median, mean) and the dispersion (standard variation) will be adopted. Inferential statistics draw conclusions that extend beyond the immediate data (O'Leary, 2004). Raw data from the closed-ended questions will be captured using Statistical Package for Social Sciences (SPSS) and subsequent calculations are generated and interpreted. The data within this research are of

qualitative and descriptive nature. In order to extract the information that answers the main and sub-objectives, a content analysis is conducted (Kumar, 2005). The content analysis is executed in two major steps within this research.

The first step is to assign main themes. These are taken from the literature review and represent the critical success factor categories. The supervisor of the researcher reviewed the categorisation, in order to increase the level of accuracy of the classification process. The classification of the quotes under the main theme is done in the next step of the content analysis (Kumar, 2005). This step has been executed manually and been reviewed by the supervisor to ensure accuracy. This follows the analysis of the data, and an important process step as the collected information highlights meaning through investigation of relationships and patterns relevant to the main and sub-objectives (Sarantakos, 2005). Therefore, the prevalence and the demographical distribution of the individual themes and the critical success factor are manually determined within this step. The most prevalent themes out of the content analysis step 2 are described more in detail and are linked to the literature. The demographical distribution is also the basis for the investigation of the existence of a relationship between deepwater critical success factors, organisation/portfolio management strategy, project budget, and project schedule delivery times.

DATA ANALYSIS

The data collected are analysed by utilising the Statistical Package for Social Science (SPSS) version 17 software. For hypotheses testing, T test and correlation analysis were carried out to test the relationship between variables under research.

Respondents' demographic profile

A total of 200 E-mail questionnaires were distributed to Nigeria's deepwater oil and gas project population. The summary of the demographic profile is shown in Table 5. From the total of 200 questionnaires distributed, 170 were returned on time for the analysis process. This

represents an average response rate of 85%. The majority of the respondents between the age group of 43 to 47 which represent 40.6%, and 48 years and above represents 30%. Most of the respondents are senior engineers (41.8%), followed by project engineers (20.6%) and project managers (18.8%). Most of the respondents work in the major oil and gas companies (43.9%) and majority of them possess a degree mainly masters degree holder respondents are dominant with 52.9%, followed by bachelor degree holder respondents with 44.1%. The majority of the respondents have more than 10 years working experience (58.8%). While 24.7% have less than 5 years experience and 100% of the respondents are male.

Education profile

It is evident that 52.9% of the respondents have a master's degree educational level and this is also the median of the respondents. While 2.9% are PhD holders.

Job position profile

The position held by respondents in their deepwater oil and gas organisation is evident. These positions included project owners, project engineer, project senior engineer, project manager, project director, and others. With 71 of the respondents as project senior engineers and 32 are project managers while 35 are project engineers. This finding has implication for the expected reliability of responses.

Number of years working in the company

It is evident that the experience of respondents in Nigeria deepwater oil and gas project portfolios ranged from less than 5 to more than 20 years. The median length of experience working in the deepwater oil and gas industry is 11 to 15 years (41.8%), most of the respondents had been in their present companies for a period ranging from 4 to more than 20 years. This finding has implications for the expected reliability of responses.

Descriptive analysis company profile

80% of the respondents were from the major oil and gas industry such as Shell, Chevron, Exxon Mobil, NNPC, ADAX, Schlumberger, and AGI. 90% of these companies have been in operation in Nigeria for more than 20 years, with an estimated annual profit between three to nine billion USD. While other marginal oil and gas firms, such as Fairshores has been in operation in Nigeria for 6 to 10 years and most earning above 30 million US Dollars. Amongst the major oil firms, only NNPC is a solely owned Nigerian entity and others are joint venture partnerships (all the marginal firms are joint venture partnerships).

Correlation analysis

The correlation technique is used to describe the strength and direction of the linear relationship of one variable to another (Pallant, 2001). It generates correlation coefficients which highlights the co-variation or association between the measured variables. The correlation coefficients in Table 6, reveal a medium/large strength of linear association and positive direction (Pearson correlation r = 0.485) between the dependent variables of (1) critical success factors and portfolio management strategy while (2) project schedule has a medium linear association (Pearson correlation r =0.372) with critical success factors.

Furthermore, (3) project budget has a small linear association, Pearson correlation r =0.094 with critical success factors. The correlation analysis further reveals a large linear association between portfolio management strategy and project budget both having r =0.506 same also applies with project budget and project schedule, having r =0.704. While project schedule and portfolio management strategy have a large linear association of r =0.659. The amount of shared variance as highlighted by the coefficients of determination showed PB and PS with 43.4% variance, PMS and PB with 25.6% variance, while CSF and PMS has a shared variance of 23.5%, with CSF and PS having a shared variance of 13.84%, and the lowest being 0.088% shared variance between PB and CSF. The overall statistical significance among the dependent variables is high as listed sig. 2 tailed p=0.000.

Hypothesis test- one sample T-test

This section discusses the hypothesis, in total four hypotheses are tested against the findings from the research instrument. The T test is used to test the hypothesis, and determine, if there are any significant differences between the four variables namely CSF, portfolio management strategy, project budget, and project schedule. The results of the test suggest there is no significant difference between all of the groups. A review of Tables 7 and 8 indicated that, in all p=0.000. So, all hypotheses are accepted.

There is huge consensus of opinion with regards to the prevalence of CSF and the relationship between the prevalence of CSF and the overall organisational/project portfolio strategy. The results show compelling evidence of congruency with 95% confidence level, that the interval contains the population mean are significant, indicating that the null hypothesis H01, H02, H03 and H04 are not accepted.

Table 5. Respondents' demographic profile.

Age	Frequency	Percent	Cumulative percent
33 - 37 years old	21	12.4	
38 - 42 years old	29	17.1	12.4
43 - 47 years old	69	40.6	29.4
48 years old and above	51	30.0	70.0
Total	170	100.0	100.0
Education level			
Bachelor degree	75	44.1	
Master	90	52.9	44.1
Others	5	2.9	97.1
Total	170	100.0	100.0
Job position			
Project owner	9	5.3	
Project engineer	35	20.6	5.3
Project senior engineer	71	41.8	25.9
Project manager	32	18.8	67.6
Project director	11	6.5	86.5
Other	12	7.1	92.9
Total	170	100.0	100.0
Number of years working in company			
Less than 5 years	42	24.7	
6 - 10 years	28	16.5	24.7
11 - 15 years	71	41.8	41.2
16 - 20 years	23	13.5	82.9
More than 20 years	6	3.5	96.5
Total	170	100.0	100.0

Table 6. Pearson correlation.

	CSF	PMS	PB	PS
Pearson correlation	1	0.485**	0.094	0.372**
Sig. (2-tailed)		0.000	0.223	0.000
Pearson correlation	0.485**	1	0.506**	0.659**
Sig. (2-tailed)	0.000		0.000	0.000
Pearson correlation	0.094	0.506**	1	0.704**
Sig. (2-tailed)	0.223	0.000		0.000
Pearson correlation	0.372**	0.659**	0.704**	1
Sig. (2-tailed)	0.000	0.000	0.000	

Table 7. Mean, standard deviation, standard error of mean.

	Mean	Standard deviation	Standard error of mean	N
CSF	4.3406	0.46608	0.0357	170
PMS	3.8312	0.55396	0.0425	170
PB	3.9601	0.54682	0.0419	170
PS	4.0416	0.50943	0.0391	170

Table 8. One sample T-test.

					95% Confidence interval of the difference	
	t	df	Sig. 2-tailed	Mean difference	Lower	Upper
CSF	37.50	169	0.000	1.340	1.270	1.411
PMS	19.56	169	0.000	0.8312	0.7473	0.9151
PB	22.89	169	0.000	0.9601	0.8773	1.043
PS	26.66	169	0.000	1.042	0.9645	1.118

Table 9. Factors important to deepwater project strategy (opened ended question).

	N	%
Project related factors	113	66.7
Project procedures	104	61.12
Project management action	126	74.1
Human related factors	108	63.5
External environment	148	87.1

CSF is criteria's for deepwater project success

The study found that all the respondents perceived the listed 13 critical success factors as major criteria for deepwater project success. The statistical data analysed substantiates this position with a high significant 2 tail of p=0.000. This is further collaborated with 95% confidence of the population mean. Therefore, the hypotheses that critical success factors are criteria for deepwater project success cannot be rejected.

PMS is dependent on the CSF

The study found that majority of the respondents perceived that portfolio management strategy is dependent on the listed critical success factors. The statistical data analysed substantiates this position with a high significant 2 tailed of p=0.000. This is further collaborated with 95% confidence of the population mean, thus indicating that the initial hypotheses are valid and reliable. Therefore, the hypotheses that organisation/portfolio management strategy is dependent on the critical success factors cannot be rejected.

CSF positively influence deepwater PB

The study found that all the respondents perceived the listed CSF positively influence deepwater project Budget. The statistical data analysed substantiates this position with a high significant 2 tailed of p=0.000. This is further collaborated with 95% confidence of the population mean. Therefore the hypotheses that CSF positively influence deepwater project Budget cannot be rejected.

CSF positively influence deepwater PDS

By comparison, the results with the literature show that, of the prevalent thirteen CSF are of high prevalence and importance within deepwater oil and gas project portfolios. Interestingly, understanding local environment, and proper contract planning and management is of high prevalence and importance within the respondents. This perhaps reflects the complex uncertainty and risk environment of deepwater project portfolios. Another interesting finding is that, the prevalent CSF reflects the PMI Project Management Body of Knowledge.

Furthermore, the study identified that CSF in mega construction projects can be applied in deepwater oil and gas project. This research, through the open ended questions in the questionnaire has captured and identified the prevalent themes associated with these CSF. This offers a deeper understanding of the characteristics of each CSF. The study found that majority of the respondents perceived that, CSF positively influence deepwater project delivery schedule. The statistical data analysed substantiates this position with a high significant 2 tailed of p=0.000. This is further collaborated with 95% confidence of the population mean. Thus, indicating that the initial hypothesis is valid and reliable. Therefore the hypothesis that CSF positively influence deepwater project delivery schedule cannot be rejected. The survey questionnaire had asked the respondents to identify independent variable crucial to deepwater project strategy. Table 9 shows the original frequencies of the variables. It may be seen that external environment is important to 87.1% respondent, while project action accounts for 74.1%, human related factors was seen as important by 66.7% and project procedures by 61.12%.

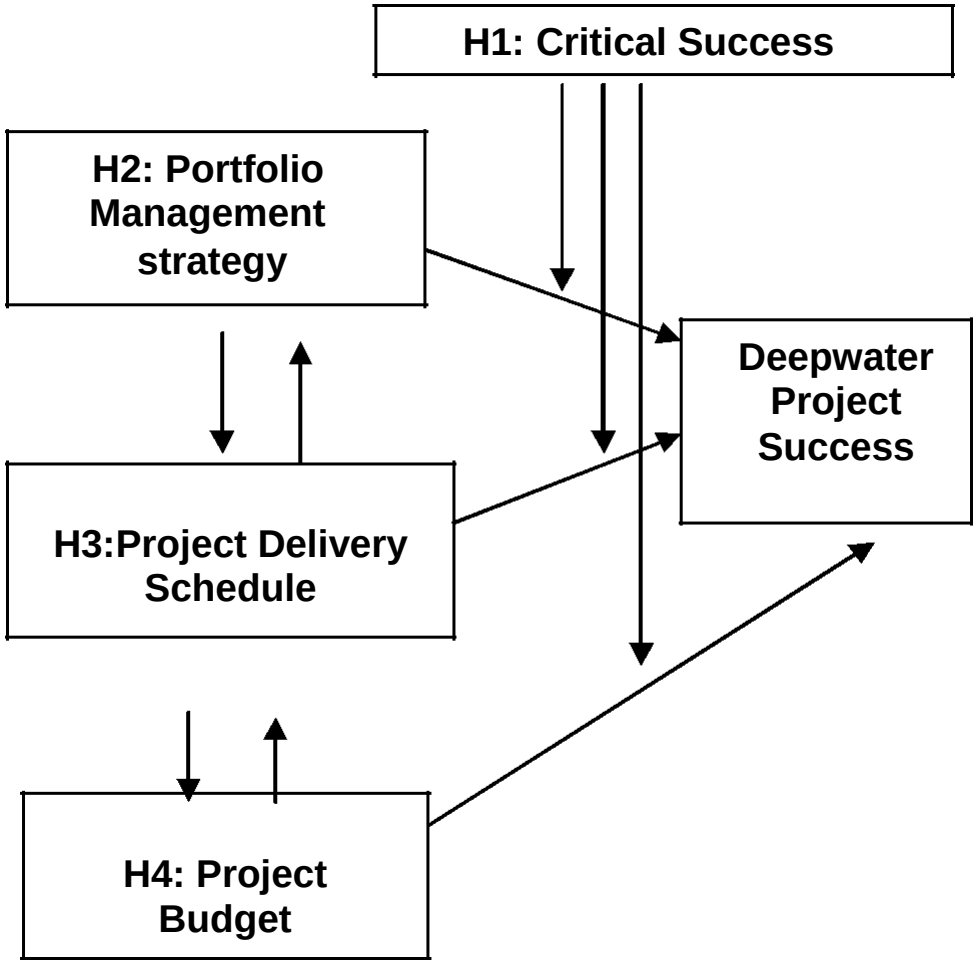

Figure 2. Factors in deep water project success.

On the flip side 12.94% did not see external environment as important while 38.82% felt that project management is not important.

Summary of the analysis

The mean value of the total CSF that greatly influences deepwater project success is 4.75 as shown in Figure 3. On the scale of 1 to 5, the mean value of prevalence of listed CSF is above agreeing point. Table 10, lists the details of the items tested under CSF, and it shows that all items are important for CSF.

The mean value of the total that portfolio management strategy will influence CSF for deepwater project success is 3.83 as shown in Figure 3. On the scale of 1 to 5, the mean value of portfolio management strategy, influencing critical success factors is at agreeing point. Table 11, lists details of the items, it shows that proper contract planning and management, good project formulation, resource availability, and effective risk allocation are top four CSF for portfolio management strategy.

The mean value of the total project budget is highly dependent on the listed CSF, and it is 3.96 as shown in Figure 3. On the scale of 1 to 5, the mean value of project budget has been highly dependent on the listed critical success factor at agreeing point. Table 12, lists the items tested for project budget. The most important items are proper estimation of capital cost, proper planning and management, project duration, and effective risk allocation are the top four CSF for project budget. The mean value of the total, that CSF will influence project schedule for deepwater project success is 3.76 (Figure 3). On the scale of 1 to 5, the mean value of critical success factors will influence project schedule for deepwater project success is above the agreeing point. Table 13 lists the items tested for project schedule. The most important items for PS are proper planning and management, good project formulation, realistic project duration, project management capability, understanding of local environment, resource availability, good project implementation and effective risk allocation.

The implication that can be drawn from this result is that, the researched dependent variables are criteria for

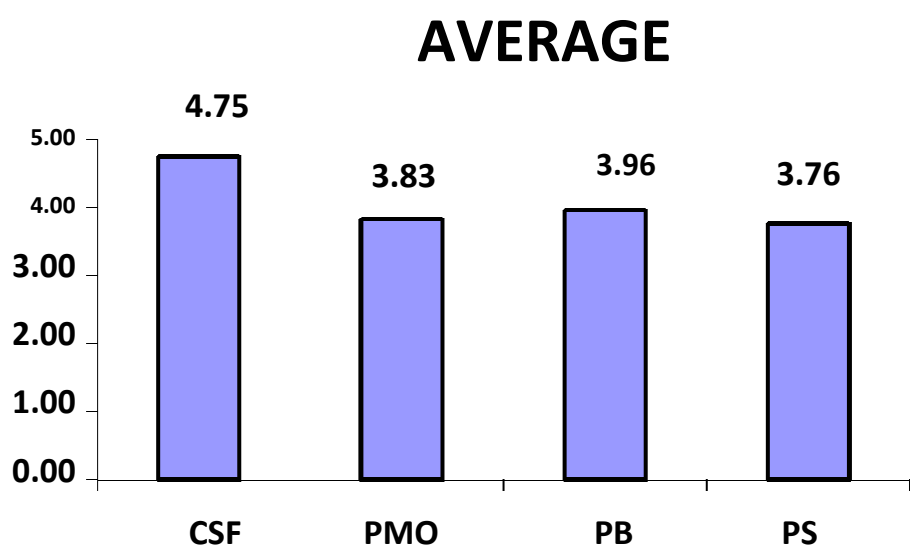

Figure 3. Average score of variables on the Likert scale.

Table 10. CSF items.

Items (N=170)	Mean	Standard deviation
Good project formulation	4.4353	0.55357
Project management capability	4.3353	0.72114
Good project implementation	4.4941	0.69014
Realistic project duration	4.1588	0.93173
Effective risk allocation	4.2471	0.87579
Resource availability	4.4471	0.91672
Access to secure finance	4.2765	0.79943
Communication	4.1118	0.87326
Innovative technology	4.0706	0.91391
Proper estimation of capital cost	4.4353	0.73697

deepwater project success and are impacted and dependent on the 13 listed CSF. The respondents were provided with a list of variables that are indicators of the prevalence of critical success factors in deep water oil and gas project portfolio and asked to rank them, to indicate how the items will influence or impact on project success. Descriptive statistics of the stratified groups, in particular frequency distributions, indicated high levels of consensus.

SUMMARY AND CONCLUSION

Meeting the aims and objectives of the study

The researcher considers the main aim of the study, to evaluate the CSF for deepwater oil and gas project portfolio's in Nigeria to be met, because all the proposed four sub-objectives have been met.

Prerequisite for successful project outcomes in deepwater projects

The results of the study clearly shows that, the key prerequisite for project success in deepwater oil and gas project portfolio's is the prevalence, and understanding of the required CSF, project management capability, fast project delivery, and proper budget implementation and control.

Identify the prevalence of CSF

The thirteen most prevalent CSF within deepwater oil and

Table 11. Portfolio management strategy items.

Items (N=170)	Mean	Standard deviation
Proper contract planning and management	4.235	0.8723
Good project formulation	4.147	0.7270
Project management capability	3.912	0.5842
Good project implementation	3.958	0.8381
Realistic project duration	3.717	0.9744
Effective risk allocation	4.006	0.8104
Understanding of local environment	3.329	0.8956
Resource availability	4.070	0.9457
Access to secure finance	3.947	0.9118
Fast project delivery	3.694	0.9548
Communication	3.447	0.8704
Innovative technology	3.400	1.034
Proper estimation of capital cost	3.941	0.9651

Table 12. Project budget items.

Items (N=170)	Mean	Standard deviation
Proper contract planning and management	4.258	0.944
Project management capability	3.965	0.915
Good project implementation	3.900	0.854
Project duration	4.123	0.904
Effective risk allocation	4.029	0.733
Fast project delivery	3.782	0.824
Communication	3.311	0.974
Innovative technology	3.717	0.955
Proper estimation of capital cost	4.553	0.806

gas project portfolios are identified, including their most prevalent themes from the open ended questions, which the researcher has attempted to categorise. Interestingly, understanding local environment and proper contract planning and management is of high prevalence and importance within the respondents. This perhaps reflects the complex uncertain and risk environment of deepwater project portfolios. Another interesting finding is that, the prevalent CSF, reflects the PMI Project Management Body of Knowledge. Furthermore, the study identified that, CSF in mega construction projects can be applied in deepwater oil and gas projects as well. Understanding local environment is identified, which has previously not been recognised as CSF. This research, through the open ended questions in the questionnaire have captured and identified the prevalent themes associated with these

Table 13. Project schedule.

Items (N=170)		
Proper contract planning and management	4.5235	0.7708
Good project formulation	4.3941	0.8990
Project management capability	4.3294	0.7115
Good project implementation	4.1941	0.8016
Realistic project duration	4.3824	0.7999
Effective risk allocation	4.0706	0.9008
Understanding of local environment	4.2765	1.020
Resource availability	4.2000	0.8184
Access to secure finance	3.8706	0.8182
Fast project delivery	3.5706	1.008
Pro communication	3.6176	0.8775
innovative technology	3.4235	0.8479
Proper estimation of capital cost	3.6882	1.050

CSF. This offers a deeper understanding of the characteristics of each CSF.

Identify what specific capabilities are required to enable organisations have consistent positive outcomes in deep water project portfolios

The research shows that most of the analysed critical success factors require specific competency and skill sets and what came out was the need for project management capability (Project management action) and increasing technological expertise. Understanding and coping with the external environment - stakeholder management came out as a core capability requirement for consistent positive outcomes in deepwater project portfolio's.

CSF and overall project PMS

The research identified a strong positive relational congruency between the prevalence of critical success factors and the overall organisational/project portfolio strategy. The statistical data analysed substantiates this position with a high significant 2 tailed of p= 0.000. Furthermore, the finding shows that, the mean value of the total portfolio management strategy will influence critical success factors for deepwater project success and is 3.83 while standard deviation is 0.554. On the scale of 1 to 5, the mean value of portfolio management strategy influencing CSF is at agreeing point.

Conclusions relating to the main aim

In undertaking this research, a number of issues did present themselves. There appears to be few studies undertaken in the evaluation of CSF for deepwater oil and gas project portfolios globally and in Nigeria. A review of the literature found no articles relating to deep-water oil and gas project, with critical success factors in the petroleum industry in Nigeria. Past studies conducted in Nigeria includes finance (Odularu and Okunrinboye, 2009; Fajana and Ige, 2009; Fodio, 2009; Ugoh and Ukpere, 2009), employee management (Gberevbie, 2010; Taiwo, 2010; Adekola, 2010; Shadare, 2010; Samuel et al., 2009), politics (Ugoh and Ukpere, 2010), government policy (Ugoh and Ukpere, 2009), companies performance (Aworemi and Ilori, 2008), e-payment (Ayo and Ukpere, 2010), and organisational development (Ukpata and Olukotun, 2008).

It was confirmed that, the project type as well as project size influences most CSF, and what is related to their underlying nature. Most of the major deepwater oil and gas facilities are designed fabricated and integrated at various locations outside the shores of Nigerian. This practice has brought about several deepwater project cost escalation and schedule overrun. The research shows that deepwater oil and gas projects industry has

gender bias, job positions are skewed more towards the male gender, there seems to be no gender diversity and inclusiveness. Of the 170 respondents none were women.

Limitation

The study makes relevance to the Nigerian context, but to make generalisation for the whole oil and gas deepwater project environment, further research has to be conducted in other regions to confirm that the findings can be universally applied.

Value of research

It is hoped that this research has contributed to the knowledge which relates to the application of critical success factors in the petroleum industry, project management and strategy implementation body of knowledge and that this research will:

1. Increase the awareness amongst senior management, project engineers and leaders in deepwater oil and gas organisations.
2. Increase the understanding of what CSF really are and how it can enhance project success.
3. Provide guidance with regards to issues and challenges which must be dealt with in strategy implementation and project actions, in order to successfully accomplish the corporate mission/vision and achieve required deepwater investment objectives.
4. Enhance the ability to deliver business value on time and on budget from projects.

The research has significantly increased the knowledge of the researcher in the area of project critical success factors. As an aspiring global project manager and consultant, the researcher finds this information invaluable.

Recommendations for further research

This research has focused specifically on the CSF for deepwater oil and gas development organisations in Nigeria. The validation of the existence of CSF for deepwater oil and gas project portfolio's by this research, calls for further clarification and more rigorous evaluation of the patent factors that are associated with each of these thirteen CSF and their relationship to deepwater project success. In this research, due to proximity and time, this study was not able to focus on the capability of Nigerian deepwater facility fabrication contractors. The researcher believes that, further research into capability and CSF requirement for deepwater facility fabrication contractors to be carried out. This is based on the research findings that, most of the major deepwater oil and gas facilities are designed, fabricated, and integrated at various locations outside the shores of Nigerian. This practice has brought about several deepwater project cost escalation and schedule over-run. Therefore, as a key component of deepwater oil and gas project success, the proposed study of the local content capability to support deepwater facilities fabrication projects in Nigerian should be contemplated. This will add value to the current drive for local content involvement in major oil and gas development projects and also support the about to be enacted Petroleum Industry Bill (PIB).

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