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Chapter 2

Theoretical frameworks and literature review on project efficiency and delays

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2 Literature Review

Projects have played a big role in helping organisations/ countries achieve desired results (SMRP BOK, 2020). It can therefore be considered as a means to an end, the end being – benefit realisation (Zwikael & Smyrk, 2019). These makes project crucial to organisational growth in meeting consumer needs, increasing throughput and improving safety of operations e.g. an upgrade of an oil production facility rate from 300kilo barrels per day to 600kbd will require projects to achieve such feat. The figure below illustrates the shift that projects could add to operations. Like every other endeavour, projects come with constraints that impedes free flow of tasks towards completion. One of such constraints is time "project duration" (Abdul, et al., 2013). Project delays being a function of time, could basically mean "schedule overrun" and this is said to occur when a project is delivered at a date after the agreed end date by the stakeholders (Kikwasi, 2012). These stakeholders are usually affected by projects – positively or otherwise (PMI, 2017) and have their agreements set at this predetermined date.

When delays occur in projects, other unwanted conditions might play out such as over spending – to bring the project back on the time track e.g. crashing schedules (gantt chart) could mean spending more for faster services, hiring a number of equipment concurrently at costs beyond baseline values.

In addition, timely delivered projects mean that client companies can attain desired capacity, leading to improved income, but before then, the facility/ plant reliability is greatly improved, particularly when reliability is embedded into the asset design phase (SMRP BOK, 2020). For example, having another line of asset improves overall efficiency of the client especially if the lines are arranged in parallel, such that failure on one string does not lead to a total collapse of the plant (Ramesh, 2013) thus, an improved

availability and high ROI potentials. In addition, timely delivered projects mean that client companies can attain desired capacity, leading to improved income, but before then, the facility/ plant reliability is greatly improved, particularly when reliability is embedded into the asset design phase (SMRP BOK, 2020). For example, having another line of asset improves overall efficiency of the client especially if the lines are arranged in parallel, such that failure on one string does not lead to a total collapse of the plant (Ramesh, 2013) thus, an improved availability and high ROI potentials.

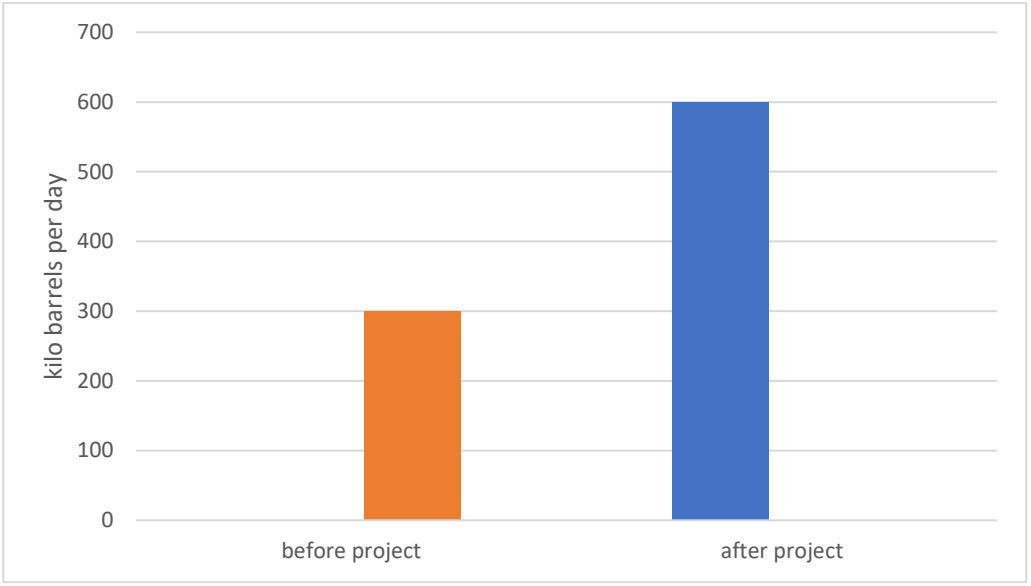

Figure 1: Sample Production Rate Improvement, Adapted from PMI (2017)

The question of how reduced projects delays can improve efficiency in the Nigeria oil and gas industry has not really been addressed as most researchers have not focused and the impact of delays in project delivery to efficiency in terms of operations and maintenance KPIs such as Overall Equipment Effectiveness (OEE), Mean Time Between Failures (MTBF), Mean Time To Repair (MTTR), maintainability, availability, reliability, plant down time etc.

2.1 Delay (Schedule) Measurement

According to Peter Drucker, "You cannot manage what you cannot measure", thus underscoring the importance of schedule measurement and performance tracking for improvement actions. Key performance indicators such as schedule performance index and cost performance index can form the basis to evaluate project health, achieving this

through appropriate earned value management approaches (Zwikael & Smyrk, 2019). All hands must be on deck to ensure that every moment counts through a robust schedule management plan.

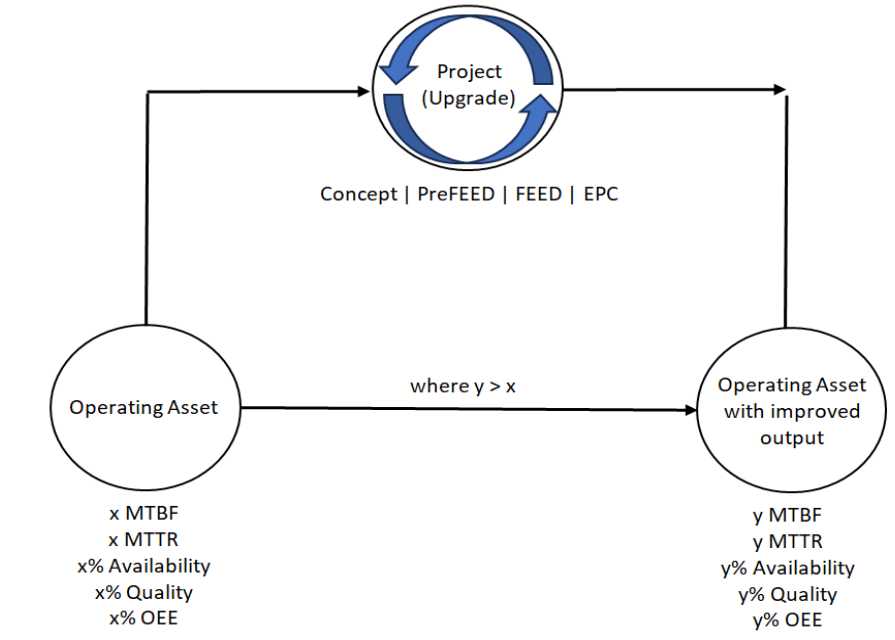

Figure 2 : Project improvement on Facility Reliability, by Author

The PMBOK PMI, (2017) views schedule management as being critical to project success, with key enablers and techniques such as the critical path method, dependence determination, and existing organisational processes, while monitoring progress during the lifecycle to determine appropriate corrective actions. The critical path, which determines the project earliest completion date, have been highlighted by Khan & Mir, (2021) being even more effective when used alongside PERT, considering the optimistic, pessimistic, likely estimate. One key question is if these approaches have yielded the expected results in delivering projects on time. How are project schedule determined? It can therefore be established that project delays have a largely negative effect on company asset efficiency, operability and turnover at the strategic level, but to what extent?

2.2 Oil and Gas Environment

Whether in the upstream, midstream or downstream sector of the oil and gas industry, projects have shown to be important in oil and gas environment (Eshenake, 2016). The

stream map shown below is a typical illustration of the supply chain of the industry's products, right from the underground well bore to the final consumer, as refined petroleum product. The environment is largely bureaucratic, with rising conflicts, owing to the size of stakeholders, incremental risk when processes go wrong, government direct or indirect involvement, licensing bodies and regulators, operational safety commitment and matrix organisational structure complexities (Goś, 2015). These could make projects suffer due to lengthy wait time, duplicated efforts and unclear lines of reporting.

The typical functions present in the industry include procurement, warehousing, logistics, security, projects, marine operations, production operations, maintenance, safety health environment, venture relations etc. These large number of functional units further adds to the complexity of doing projects as detailed by (Dye & Dye, 2002), where the drawback of matrix organisation were highlighted as lack of effective communication particularly when embarking on multiple projects.

2.3 Projects in Nigeria

Delays in projects are not exactly a new phenomenon in the Nigerian space, given that research conducted by Dlakwa & Culpin, (1990) more than 30 years ago, highlighted contractual breaches and unpredictability of resources pricing as major concerns leading to overruns even in the country's public sector.

Another study by Aibinu & Jagboro, (2002) in the construction industry examined the effect of project delays, where addition costs well over the 5-10% contingency is spent to re-align projects back on track. This shows that despite the twelve-year gap between both researches, the subject matter is still a major concern.

According to a 2018 study by Rui, et al., (2018) on Nigerian projects, oil and gas project delays data showed that 37% of them were not delivered at the agreed timeline, meaning that not much has improved in the space, over the years and if compared with developed nations, e.g. the US, UK, projects in the African country have been below par.

2.4 Importance of Oil and Gas to Nigeria

Oil and gas assets in Nigeria are consider value adding as it is responsible for 315000 jobs (Fajana, 2005). With a 6% impact on GDP, the nation's annual budget is pegged against global oil price (Osigwe, 2015).

Nigeria has proved to be a desired destination for crude oil buyers, owing to the low sulphur content and high yield of the crude variant being exported – Bonny Light and Qua Iboe Crude, as compared to its Brent counterpart (S&P Global, 2020).

Save for the Dangote Refinery, commissioned in 2023, Nigeria had relied solely on importation of refined (finished) petroleum products to meet energy needs (Siddig, et al., 2014). The project which delayed for more than a year, can be linked to Nigerians suffering the direct consequences of fuel subsidy removal in May 2023 that tripled the pump price of petrol (Bala, 2023). Although BMI, (2023) raised doubts in the refineries ability to end importation of finished petroleum products especially if the other government-owned refineries do not recommence full operation. The data (figure below) also forecasts crude oil prices to steady around $80 per barrel in 2027 and averaging $81.50 within 2024 – 2027, thus putting the country in a firm position to attract investors and projects alike.

HEADLINE FORECASTS (NIGERIA 2021-2027)							
Indicator	2021e	2022e	2023f	2024f	2025f	2026f	2027f
Crude, NGPL & other liquids prod, 000b/d	1,726.6	1,495.6	1,510.3	1,546.0	1,575.5	1,523.4	1,517.4
Refined products production, 000b/d	3.1	6.2	18.5	351.5	492.1	565.9	594.2
Refined products consumption & ethanol, 000b/d	522.5	533.8	453.7	458.2	467.4	476.7	491.0
Dry natural gas production, bcm	44.4	41.3	39.2	40.4	42.0	44.5	46.8
Dry natural gas consumption, bcm	22.0	19.6	18.6	19.4	19.9	20.3	20.5
Brent, USD/bbl	70.95	99.04	80.00	83.00	83.00	80.00	80.00

Figure 3: Petroleum Product Forecast, Source BMI, (2023)

The nation achieved an increase in oil output from 1.2mbpd to 1.3mbpd in 2023 and looking to surpass that in the coming years (OPEC, 2024), a number of projects have been lined up to achieve this according to the BMI forecast, with Uge Field OPL 214 of Shell and ExxonMobil billed to be completed in 2024 suffering a setback due to previous global oil price decline. These project along with the others forecasted could raise the oil production by more than 20%.

2.5 Causes and Consequences of Project Delays in the Nigerian Oil and Gas Industry

Project delays have become popular among projects of big sizes, for example, Australia's £2.6bn power project suffering a two-year setback due to resource and supply chain shortcomings (E&T, 2023). Particular attention has also been drawn to the oil and energy sector primarily due to their large cost implications and partly the world's reliance on energy sources, where projects in this industry have witnessed significant schedule and cost overrun, occasioned by bureaucracy and lengthy approval processes (Sweis, et al., 2020). For instance, joint venture (JV) projects which are quite prominent in Nigeria tend to experience this such delays. JV projects are usually agreed between international/ national oil companies (IOCs/NOCs) and the federal government, represented by the Nigerian National Petroleum Corporation Ltd (NNPC Ltd), with equity ranging from 60/40, 55/45 to 40/60. The major IOCs in-country being TotalEnergies, ExxonMobil, Chevron, Shell and Agip. The Niger-Delta region, south-south Nigeria - Figure 4 below – plays host to the major oil production companies because most hydrocarbons are extracted, processed, and shipped from the region. In 2009, the region's master plan regarding infrastructural development was introduced (Sunjka & Jacob, 2013), however, despite increasing technology, project management awareness and techniques, delays have continued to plague project delivery timelines (Aibinu & Odeyinka, 2006).

Figure 4 : Map of Nigeria, showing the South-South Region. Google Maps 2023.

Oil and gas projects, like construction are generally divided into three phases – Conceptual Phase, Front End Engineering Design Phase, and the Engineering Procurement Construction Phase, EPC (Salama, et al., 2008).

Unlike the Agile project management methodology where the cost and difficulty of changes are low, oil and gas construction projects do not enjoy such flexibility due to their traditional nature, especially in the execution phase (Fernandez & Fernandez, 2008).

Timeliness has been defined as a key performance indicator for projects. Referencing the project management triple constraints, projects could be determined as successful if they are completed within an agreed time frame, at the pre-determined budget, with proper attention to the scope and the delivered with the right quality (Abdul, et al., 2013).

The Iron Triangle as it is called, shows the balance between the key project success parameters. It is believed that for projects to thrive, trade-off have to be made (Van Wyngaard, et al., 2012). Although, this is typically a client-input, project managers are expected to re-validate these inputs to ensure a clearer picture. For example, the three triangles in the figure below shows the impacts of such trade-offs. Clients may pay more attention to cost and time; however, the scope of the project may need to be reviewed (reduced) to balance the triangle in the face of limited resources.

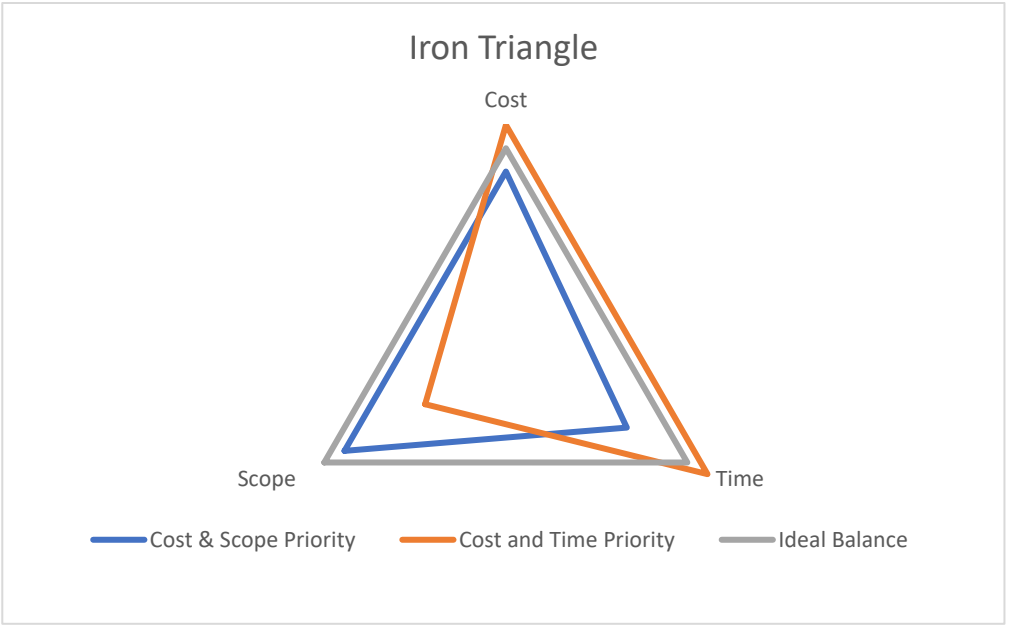

Figure 5 : Iron Triangle, Adapted from Van Wyngaard, et al., (2012)

Delay being a function of time is said to occur when a project slips beyond the agreed timeline by all parties (Kikwasi, 2012). It is essential to prevent these delays because there is always the need to increase spendings or revise scope, to bring the project back on track (Fakunle & Fashina, 2020).

For projects to stand any chance of success, the planning stage is quite vital and with project phases and sequence highlighted in the introduction chapter, Sabri, et al., (2017) implied that the conceptual stage serves as the project's initial phase where the ideas are developed. These would also include the scope identification, objective definitions, and business case analysis. These typically moves to the FEED phase where engineering designs, simulations and cost estimates for the projects are developed (Gibson, et al., 2023). These then progresses into the EPC phase which is usually handled by having an EPC Contract in place (Ban & Hadikusumo, 2017) as illustrated in **Error! Reference source not found.** below.

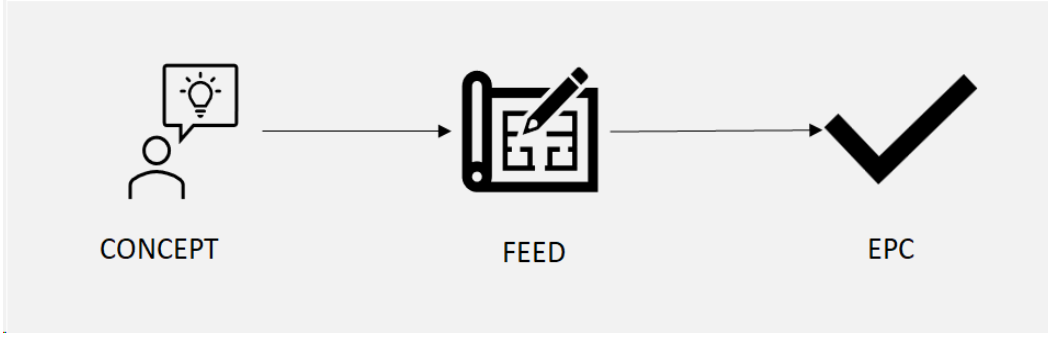

Figure 6: Construction Project Phases (Adapted from Salama, et al., 2008)

Scope identification which forms part of the conceptual stage is critical in project planning because all parties should be able to tell, without ambiguity, if a project has met the required criteria. The PMI, (2021) has placed particular importance on planning scopes and defining them as these forms the foundational work for the project, with the idea of reducing reworks and improving chances of timely completion. However, according to a survey by Assaf & Al-Hejji, (2006) on construction project delays, "change orders" were the principal cause and the respondents were contractors, consultants, and clients, adding that, if the triggers and causes of this change orders are effectively examined, it could significantly reduce project delays likelihood. This is indicative of poor project planning on the part of the key stakeholders who might usually consider proper planning as a waste of time and resources.

Perhaps a MoSCoW priority framework, if agreed beforehand by stakeholders, can help define mission-critical items within the project scope. Thus, reducing ambiguity and

project delays. The typical MSCW framework can clearly define project scopes by highlighting the must-haves, the should-haves, the could-haves and would haves, in a bid to manage stakeholders' expectations through detailed communication approach (Eskerod & Lund, 2013). Looking at existing researches on this priority tools, can the effectiveness be confirmed in the industry?

The conceptual phase, forming part of the initiation process would normally involve business case appraisal of the project. The business case will often consider the payback period, net present value of investment, initial rate of return as well as other cost-benefit analysis approaches to determine the profitability, feasibility and rank multiple projects in line with making the final investment decision - FID (Duan & Onuoha, 2020).

Alshibani, et al., (2023) having classified delays into client-based and contractor based, carried out a root cause ranking of project delays in Saudi Arabia's oil industry where late material delivery ranked highest among the top five from the client stand point. Models that could address material delivery issues such as the kraljic matrix, material categorization may play a role in reducing these logistic constraints, but by how much? And are these tools being used the right way? These also places emphasis on the need for inventory planning prior to project commencement, even as research by Egwim, et al., (2021) revealed that late supply of key materials, poor leadership decisions and inclement weather condition are three main causes of project delays, particularly in the construction industry. Sweis, et al., (2020) hinted that lack of overall planning and scheduling have resulted to significant project downtime, adding that most oil and gas dependent countries have experienced this first hand, and the need to effectively deep-dive and manage these factors cannot be over-emphasized.

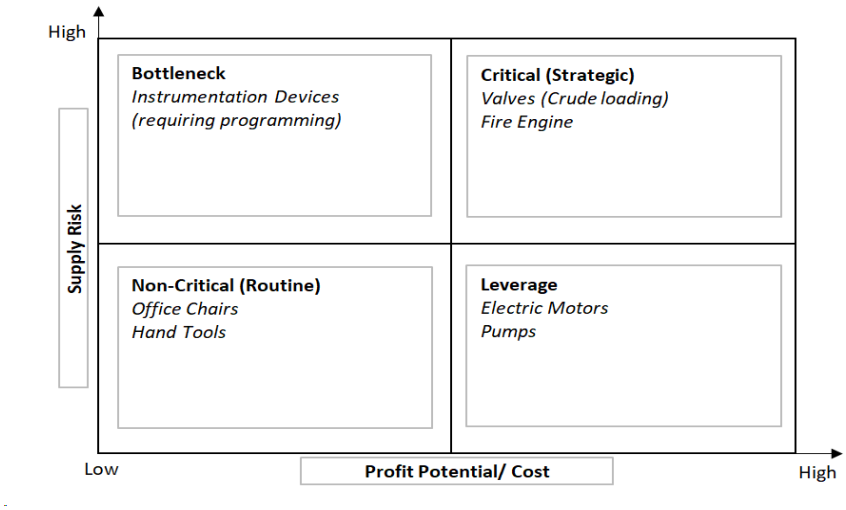

Figure 7 : Kraljic Matrix, Adapted from Baily, et al., (2005)

The matrix above assists in evaluating the criticality of project equipment and materials. The kraljic matrix examines the supply risk of a material on one axis and the potential cost on the other (Baily, et al., 2005). The supplier risk could represent the degree of uncertainties in terms of supplier availability, while the cost implications can be represented in form of extended delays. Materials on the critical quadrant will represent those that have direct link with the critical path which greatly influences project completion time.

Another aspect to consider is the increasing cost effect due to project delays, for example, the Nigerian Naira had suffered inflation and devaluation against the United States Dollars. The local currency was floated by the Central Bank of Nigeria (CBN) in 2023 leading to about 150% devaluation and that in itself would have impacted projects which were delayed beyond the point were this economic decision was taken by the apex bank further deepening finanacial burden on key project stakeholder – clients, contractors (PwC Nigeria, 2021). Could EPC contracts with economic price adjustment clauses effectively tackle these uncertainties? Are there other government policies capable of foiling project efforts? How effective are triggers and forecasts in avoiding these concerns?

These further links project delays to increasing cost as Denni-Fiberesima & Rani, (2011) are opined that project delays which eventually cascades into increased costs and quality mismatch were not due to limited financial capacity of the contractor company but mainly because they accept project deliveries beyond their handling capacity at a given time despite challenging human resources. Project quality can be said to be acceptable if the set-out deliverables are met at the completion of the project – no more, no less (APM,

2019). While sourcing for suitable contractors, some of the steps will include pre-qualification, invitation to tender and other bidding processes (CIPS, 2024). This forms part of the EPC process alongside a well-developed business case (Ban & Hadikusumo, 2017). The expectation is that capable contractors be selected to execute project work, however, (Denni-Fiberesima & Rani, 2011) research has proved otherwise indicating that there is need to examine the effectiveness of the contractor selection process. Are these occurring because client companies award contracts to "lowest bidders"?

Earned value management, a concept that has been in existence for decades now is still being neglected by a vast majority of project professionals who might prefer to measure project by schedule and adherence to the critical path, even though EVM can be considered a more appropriate measurement model (Webb, 2003). Poor or ineffective performance measurement in the energy industry has led to delays in schedule and increase cost of project outcome deliveries (Zhan, et al., 2019), underscoring the importance of EVM for clarity of performance for the project manager, project sponsor, and other key stakeholders (Richardson, 2014).

Traditional projects are typically broken down into activities using the work breakdown structure (WBS), forming the basis for cost estimation when the bottom-up budgeting technique is employed (Richardson, 2014). These could also be beneficial in developing the schedule baselines in the EVM. Under the EV method, a superimposed graph of Earned Value (EV), Planned Value (PV) and Actual Cost (AC) parameters are represented, making it easier to track performance and evaluate variances in cost and schedule (PMI, 2017). This is a lagging KPI because it is output oriented (results) and can also be accepted as a leading KPI as it serves as input in determining the direction of the project for the required corrective measures (Ramesh, 2013).

The role that clear leadership vision can provide was highlighted by Ramesh, (2013) as understanding the mission that projects are set out to achieve and translate them into clear acheivable goals following the SMART model of being Specific, Measurable, Achievable, Realistic and Time-bound. To test the effectiveness of this model, it might be beneficial to reexamining the effectiveness of leadership in a top-bottom approach, considering that another research by Pittayaporn & Jakrapong, (2018) on construction projects delays in Thailand's oil and gas industry from the standpoint of the project company (contractor) and the suppliers. The research outcome revealed that poor site supervision was principally the issue from the contractor end, while unqualified labour stagnated project progress on the supplier end. Therefore, a closer look at the factors and triggers could be instrumental in reducing schedule overruns significantly.

The BMI, (2023) report on a sample of Nigerian oil and gas projects in A number of factors have been identified in the literature as to project delays, but is it possible to narrow this to the actual phases that these delays occur? Would these be considered beneficial to project stakeholders? Will the expected outcome be achievable? Narrowing the main causes of schedule overrun (per phases) in the country's oil and gas project may be a step in reducing resource wastages, improving value for stakeholders, gaining investors' confidence and improving public perception.

Oil and gas projects could be of the following form, rig installation, gas lift projects, pipeline projects, power distribution upgrades, gas turbines installations, overhauls, turn-around maintenance and are usually located on shallow water offshore production platforms, deep-water floating production storage and offloading (FPSO) vessels and onshore facilities, with Nigeria projected to account for 24% of its continent's oil and gas projects in the next two years . These are projects which would usually cost more than $1billion will significantly impact the country and oil and gas operators if not managed correctly.

According to data from the Nigerian Upstream Petroleum Regulatory Commission (NUPRC), the industry has not attracted investments and this has led to a reduced crude production output to 1250 kilo-barrels per day (kbd) in November, 2023. To curb this concern, the regulators have proposed a reduction of cost of oil production from the current $25-$40 to below $20. These further pressures the industry to deliver projects with limited resources CAPEX, OPEX and increases the chances of schedule overruns, even when the country has failed to meet OPEC production quota amid rise in oil theft .

MAJOR UPSTREAM PROJECTS					
Name	Field Name	Companies	Completion Date	Status Notes	Est. Peak Oil/Liquids Range (b/d)
OML 130	Egina	Petrobras (16%), South Atlantic Petroleum (5%), NNPC (10%), Total (24%), China National Offshore Oil Corporation (45%)	2018	On stream in late 2018	200,000
OML 130	Preowei	Petrobras (16%), South Atlantic Petroleum (5%), NNPC (10%), TotalEnergies (24%), China National Offshore Oil Corporation (45%)	2027	Appraisal under way, expected to be tied back to Egina once capacity becomes available	70,000
OML 133	Bosi	Shell (43.75%), ExxonMobil (56.25%)	2025	March 2015: The project had suffered final investment decision delays due to low oil prices	135,000
OPL 214	Uge	Shell (43.75%), ExxonMobil (56.25%)	2024	March 2015: The project has suffered FID delays due to low oil prices	110,000
OML 83, OML 85	Anyala & Madu	First E&P (40%)	2020	FID in 2018, first oil in 2020	50,000
OML 23	Soku	Shell/NNPC	2024	na	50,000
OML 53, OML 21	Assa North/ Ohaji South (ANOH)	Seplat (40%)/NNPC/Shell JV	2022	FID made in February 2019	20,000
OML 118, OML 132, OML 140	Bonga South West/ Aparo	Total S.A. (10%), Chevron (19.6%), Sasol (0.3%), Shell (44%), ExxonMobil (16%), Eni (10%)	2028	FID moved to 2020, though likely due in 2024	150,000
OPL 245	Zabazaba	Shell (50%), Eni (50%)	na	Indefinitely delayed	120,000
OPL 245	Etan	Shell (50%), Eni (50%)	na	The field will be developed as a tie-back to Zabazaba field, which is also located in the same block	na
OML 99	Ikike	TotalEnergies (40%)	2022	FID in 2019, 5-well tieback to Amenam field	45,000
OML 145	Uge, Uge North, Orso, Nza	Sasol (5%), NNPC (15%), Svenska Petroleum Exploration (20%), Oando Exploration and Production Limited (20%), Chevron (20%), ExxonMobil (20%)	2025	To be developed via a leased floating production storage and offloading vessel, with first production expected in 2025	110,000
OML	Owowo	Exxon (27%), Chevron (27%),	2027	Appraisal under way	150,000

showed that three out of thirteen projects had final investment decision (FID) delay due to low global crude oil prices that followed the COVID-19 pandemic.

The FID stands as a major milestone just after completion of the FEED, where parties review the budgets, permit/ approvals requirements, environmental impact assessment before awarding the EPC contract or taking down the project entirely (Kurowski & Sussman, 2011). Since this involves extensive planning beforehand, then errors at this point in terms of estimation, omitting key stakeholders may lead to avoidable delays during project execution. There are also a number of external factors that can influence

the FID, for example, the crude oil prices highlighted earlier. What happens if the oil prices decline in the midway into the project? How can companies stay resilient in the face of oil price uncertainties?

Given that no two projects are the same (PMI, 2021), Fakunle & Fashina, (2020) also highlighted that the causes of schedule overruns in projects vary from one country to another and from one type of project to the other. For this reason, it is beneficial to critically examine the causes as it relates to the Nigerian oil and gas sector, given that, most researches so far have not focused mainly on the country's energy sector.

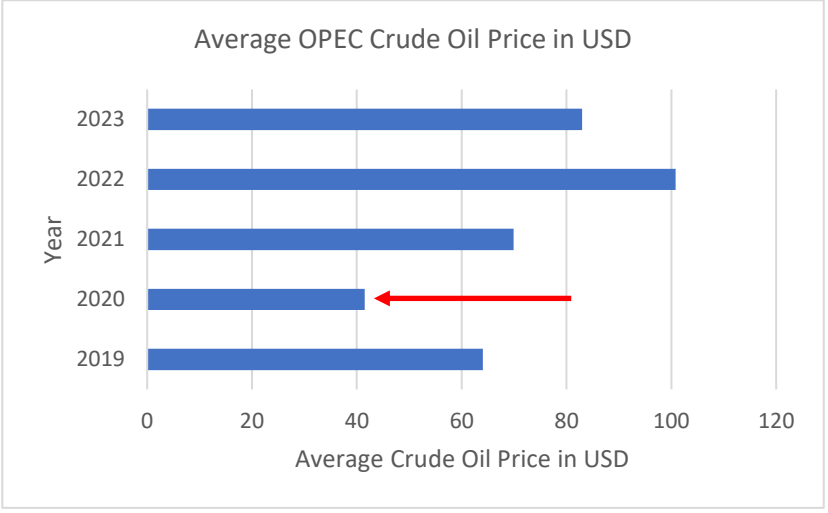

Figure 8 : OPEC Crude Oil Price 2019 - 2023, Adapted from Statista, (2024)

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Figure 9 : Upstream Oil and Gas Projects Forecast, BMI (2023)

(KPMG, 2022) IOCs in Nigeria have announced plans to divest parts of their assets particularly the shallow water and onshore facilities adding that their operations have been impacted by indigenes of host communities. The move to divest may be play a big role in extending the timelines of ongoing projects or lead to outright cancellation, with attendant contractual consequences.

PwC Nigeria, (2021) attributed delays of projects in this industry in Nigeria, to the pending passage of the Petroleum Industry Act - PIA which was not signed until 2021 adding that the uncertainties arising from not having the bill passed may have affected decision making by key industry players, leading to $15b loss annually and a depleting oil reserve of 36900 kilo-barrels in 2020 – see figure below.

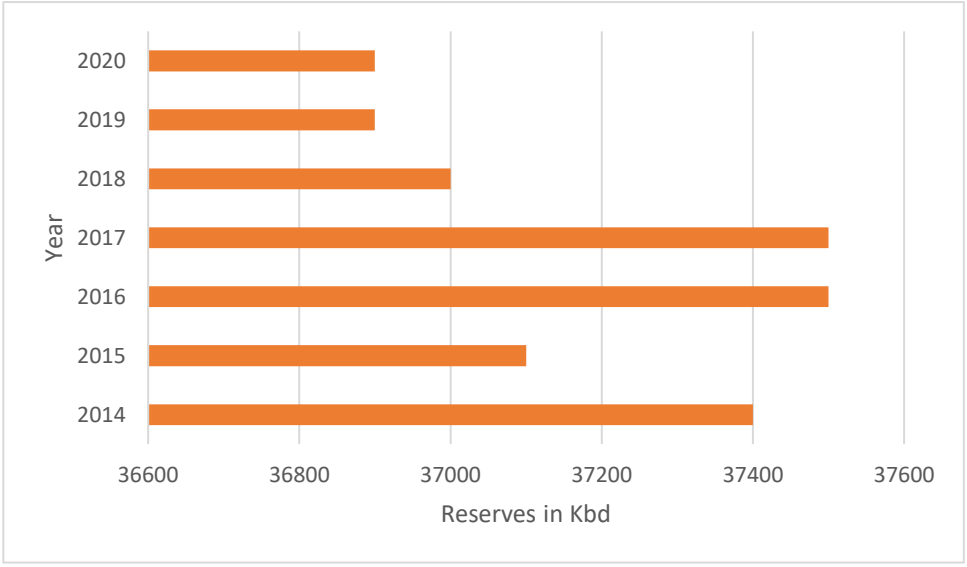

Figure 10 : Oil Reserves Nigeria - 2014 to 2020 - adapted from PwC 2021

2.6 Summary

The causes identified in the literature indicates significant need for proper project planning. From business case concerns, to late delivery of materials, poor leadership, inadequate stakeholder engagement, poor performance measurement, delayed petroleum industry bill passage and lengthy bureaucratic process, these can be greatly improved if effective planning and monitoring are carried out.

The figure below shows the key stakeholders and their corresponding delay factors per existing literature. These can help narrow the causes to the key players for example, poor leadership decision tends to be an issue for client and contractor, tying back to the BMI forecast for O&G projects and how FID has impacted on official commencement of project work. The main players are identified as government (representatives), client companies, contractor companies, and host communities; and there is great need to get

them involved for a relatively smooth flowing process, devoid of disruptions, especially in the execution phase. The main players are identified as government (representatives), client companies, contractor companies, and host communities; and there is great need to get them involved for a relatively smooth flowing process, devoid of disruptions, especially in the execution phase.

KEY STAKEHOLDERS			
CLIENT	CONTRACTOR	GOVERNMENT	HOST COMMUNITIES
Change Orders	Lack of Supply of Key Materials	Bureaucracy and Lenghty Approvals	General Project Disruption
Poor Leadership Decisions	Accepting Beyond Capacity	Reduced Investor Appetite	
Poor Planning and Scheduling	Inclement Weather Condition	Delayed Passage of PIA	
Poor Performance Measurement	Poor Leadership Decisions		
	Poor Planning and Scheduling		

Figure 11: Project Stakeholders - Delay Causal Factors

The importance of completing projects on time can be deduced from the effects they have on nations, companies and assets as these parties continue to develop measures to reduce the economic price effect on multi-year projects. One questions if it is feasible to adopt a proactive approach through cause-and-effect methods or bowtie risk matrix, which are predominantly utilized in the safety management terrain. Much of this will be discussed in the Methodology section. The next chapter will apply methods to further narrow the causes of construction project delays in the Nigerian Oil and Gas sector.

This approach is expected to focus on the causes that have the likelihood of delay projects beyond one year, then develop both preventive and mitigative countermeasures; while linking them with oil and gas projects deliverables, KPIs, asset operations and reliability improvements.