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The Moderating Impact of Risk Management on the Relationship between the Project Management Approach and Project Performance of the Oil & Gas Projects in GCC Countries

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Abstract: **The extensive application of formal project management styles still exposes GCC oil and gas projects to schedule delays, cost overruns and quality deficiencies. The paper is an investigation on the existence of moderation between the Project Management Approach (PMA) and the Project Performance (PP) by Risk Management (RM) in oil and gas projects in the GCC. The study provides the interaction testing (regression-based and supported by the group comparisons when needed) to determine whether RM reinforces or preconditions the relationship between PMA and PP using the survey data on the project delivery professionals. The results offer evidence of the purpose of RM as a performance enabling capability within an asset intensive and high consequence project setting providing implications on how to enhance delivery reliability and governance within GCC portfolios**.

Keywords: **O&G Projects, GCC O&G Projects, Agile Project Management, Hybrid Agile Project Management, O&G Project's Performance, O&G Risk Management, Risk Management Moderating Effect.**

I. INTRODUCTION

The oil and gas (O&G) economies of GCC countries rely on national oil companies (NOCs) to provide national development agendas, mainly in the form of major capital projects, but the stable performance of projects is challenging (Bromley, 1991; Alyatama, 2021; Abdullah Aliasser and Adesta, 2021). A disciplined application of tools, skills, and methods to achieve the project objectives (PMI, 2017) has been suggested as the definition of project management, however, it has been shown that performance can be better achieved when approachable and context-specific than when prescriptive approach methodologies are strictly followed (Wells, 2012; Joslin and Muller, 2015; PMI, 2010, 2022).

O&G projects are long-cycle, interface-intensive and strictly regulated, and delivery is susceptible to early definition mistakes and disruptions downstream (Postali and Picchetti, 2022). Two milestones are particularly vital: Long Lead Items (LLIs) that frequently feature in the critical path and the delays that result in the Shutdown/Turnaround (TAR) windows, during which execution is squeezed on slender intervals of outages and latencies can cause significant cost, schedule, and HSE impact. Such realities increase the significance of Risk Management (RM) as a life-cycle ability of detecting, treating, and tracking threats and chances, especially in the context of procurement and outage implementation (PMI, 2017; Amir Samimi, 2020).

Problem Statement: Although there are widespread project management practices, globalization, change in regulations, complexity in contracting chains, and uncertainty in supply chains aggravate the problem of delays in schedule, cost-overruns, and performance variability in GCC O&G projects (Wan Ahmad, 2016; Alshahrani et al., 2023). It is also observed that the literature has never reconciled the definition and measurement of project success, such as the mixing up of criteria of project success and project success factors, which can undermine the efforts to evaluate and improve project success (De Wit, 2008; Cooke-Davies, 2012).

Since the sector is experiencing a high consequence environment setting, the pragmatic technique is not to spot the project management approach used, but whether RM has reached a level of maturity and integration to stabilize delivery, particularly around LLIs and TAR windows. Nonetheless, empirical data on GCC O&G settings have scant information on RM as a moderator, which conditions the relationship between project management strategy and project performance.

II. PREVIOUS STUDIES REVIEW

II.i Search Strategy & Sources

The literature review was based on a systematic search of Emerald, EBSCOhost, ScienceDirect, Scopus, and Google Scholar of peer-reviewed articles (20082025) on GCC oil and gas project performance, project characteristics, Risk Management. Best practices were considered as routines that have proven to perform better than the alternatives depending on their context (e.g., cross-functional teamwork, iterative planning, continuous feedback). Validity criteria developed by Farrington (2003) (utilized by Al-Sobai, 2020) were used to screen the studies, and more than 135 articles were selected to support the review.

II.ii GCC Oil & Gas Project Context and Characteristics

Oil and gas Projects are normally characterized by the following interdependent features:

- Intensive capital and long exposure. Such projects often require a multi-billion-dollar investment, long implementation periods, and a high sensitivity of schedule slippage because any delay can push production generating revenue and limit the national supply planning (IEA, 2024).
- Hurrying technology and digitalization. Greater levels of digitalization, such as data platforms, industrial analytics, AI-ready reliability tools, and automation, have become more central to project design, planning, and commissioning strategies in order to enhance predictability and be ready to operate at handover (PwC Middle East, 2025).
- Strict regulatory, assurance, and HSE control. Stiff process-safety expectations, permissive regimes and auditable assurance practices, which originate at the concept selection stage all the way up to the construction stage, pre-commissioning and start-up, usually impose rigorous risk management and contractor management requirements over the lifecycle.
- The increasing sustainability and decarbonization demands. Emissions monitoring, efficiency upgrades, electrification interfaces, and carbon management pathways are progressively being incorporated in environmental performance scope and investment logic, and result in the creation of more stakeholder scrutiny and verification requirements in addition to established cost/schedule targets (Natural Resource Governance Institute [NRGI], 2024; DNV, 2025).
- Operating environment execution constraints. Huge percentage of GCC portfolios are carried out in or close to live facilities functioning all 24/7. Hence, work should frequently be provided either (a) with severe simultaneous-operations (SIMOPS) constraints, or (b) within brief shutdown/turnaround (TAR) windows, with downtime now having direct economic impacts and the complexity of coordination at its highest level. These limitations increase the cost of delay and render integrated planning and interface control very important to safeguard the critical path.
- Procurement constraints and Long Lead Items (LLIs). The GCC project schedules are often led by the LLIs and vendor packages (e.g., turbomachinery, specific process equipment, control systems). LLIs need to be early specified, aligned to design-freeze discipline and proactively managed by supplier engineering interfaces, expediting, inspection planning and logistics readiness as late delivery can be the direct cause of commissioning and start-up milestones directly put at risk. The recent industry analysis is being focused on that volatility in supply-chains, and limited capacity of materials/labor resources can significantly interfere with the project delivery unless resilience practices are enhanced (McKinsey & Company, 2023).

The oil and gas projects are generally categorised:

- ❖ According to activity/lifecycle purpose: Exploration and Evaluation, Development, Production optimization (brownfield capital), and Decommissioning.
- ❖ Depending on the circumstances of the implementation: Greenfield (new assets that need a long permitting and infrastructure) and Brownfield (modification of live plants that are limited due to the integration risk, stringent HSE requirements and constrained TAR windows).

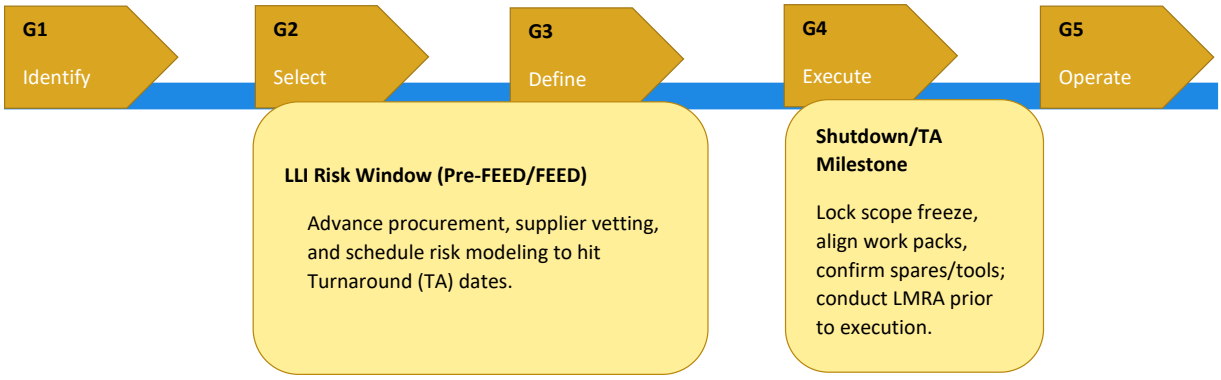


Figure 1: Project Time Line with LLI and Shutdown Windows - Adopted From (Aris 2018)

II.iii Project Management in the Oil & Gas Sector (Independent Variable)

It is common knowledge that project management (PM) has become a key skill within oil and gas due to the fact that projects tend to be extensive, capital intensive, and highly technical and have to be performed under strict governance and operating in high hazards operating environments. It is possible to define PM as the disciplined management of people, resources, and decisions to produce mutual results within time, cost, scope, and quality limits and ensure that it complies with the governance, HSE, and regulatory conditions (Kerzner, 2017; PMI, 2021).

Past research and practice-based evidence in the GCC oil and gas programs has pointed out that the performance of delivery is commonly influenced by two milestone-based restrictions that often dictate the critical path and the cost of delay (economic) element:

Long-Lead Items (LLIs). LLIs packages of equipment and vendors have long engineering, manufacturing and logistical cycles. Schedule overrun, rework and cost increase can be prompted by late specifications, lax design-freeze discipline, vendor lateness and logistics slippage, hence early discovery ofLLIs, design maturity discipline, expedition, and unceasing supplier-interface controls are usually stressed. Empirical studies in the oil and gas pipeline construction in Saudi Arabia indicate that material and equipment delivery delays rank as one of the leading causes of schedule delay, and procurement is one of the prevailing risks during execution in the area (Alshibani et al., 2023).

Shutdown and Turnaround Windows: Large percentage of brownfield tie-ins and upgrades should be performed during definite outages. Uncoordinated readiness activities (permits, isolations, work packs, materials staging, scaffolding, specialized resources) and interfaces may allow downtime to be increased, production loss to be incurred, and process-safety exposure to be enhanced. Based on the new turn around preparedness recommendations, integrated planning, materials preparedness, location access and permitting, logistics, and safety preparedness are typical precursors of success (Renoir Consulting, 2024).The stages of the oil and gas projects lifecycle are often defined as concept/feasibility, development planning, governance set-up, execution, and commissioning/start-up, which helps systematically regulate complicated work and investment decision-making (Field, 2015; Kerzner, 2017). Agile and hybrid-agile methods are not out of place with this lifecycle since planning and control are inherently iterative at the level of stages; teams can run short planning/review cycles whilst blocking governance points that cannot be bargained in oil and gas (e.g. LLI commitments and SD/TAR readiness). Related to this direction, oil and gas-specific work has suggested the application of agile thinking in the front-end loading (FEL) to enhance the quality of selection and decrease the amount of late rework without losing decision gates and assurance discipline (Nesan, 2022).

II.iv Project Management Models

Engineering and software-intensive programs since the 1970s have been based on a variety of models of delivery. One of the widely used models is the linear sequential (waterfall) model, which is then followed by variants of the model, including modified waterfall models, sashimi-like models that overlap the stages, and the V-Model where development and verification are synchronized (McConnell, 1996; Matkovic and Tumbas, 2010; Andrei, 2019). These models are frequently used in oil and gas as they can be predicted in phases, documented, and have control baselines, but could have disproportionate cost and schedule effects when change is introduced late and in areas where brownfield integration constraints and outage windows are limited (Dima & Maassen, 2018).

PMBOK and PRINCE2 are two governance-oriented PM approaches that are often mentioned in practice. PMBOK offers principle-driven advice and performance areas that facilitate the standard planning, integration, and control throughout the lifecycle, generally placing the project manager at the middle of the delivery choices (PMI, 2021). PRINCE2 is based on executive control by project board and management by exception, where the project manager is executing on the delegated authority and controlling the daily delivery (AXELOS, 2019; Jamali and Oveisi, 2016). The existing criticism is that PRINCE2 provides fewer clear prescriptions on non-technical (soft) skills compared to its dramatic governance focus, whereas its configurability enables it to adapt to new project environments (Matos & Lopes, 2013; AXELOS, 2019).

A. Conventional Project Management Methodologies

Waterfall model. Waterfall is a sequential method which is suitable in projects where requirements are stable and the extent of expected change is minimal. It is often expressed as the task that advances in requirements/specification, design, implementation, testing, deployment, and operations/maintenance (Balaji, 2012; Andrei, 2019). They have been reported to have proper phase boundaries, good documentation to support traceability and handovers and easier coordination when the scope is fixed. Limitations reported are low change, opposite rework and the danger of defects found in the later stage as a result of downstream validation (Dima & Maassen, 2018; Larman, 2004).

Stage-gate (gate) processes. The stage-gate structures are structured to deliver in stages that are separated by formal review gates. Gates in oil and gas are applied to enhance governance and investment decision-making, minimize an execution risk by staged assurance and offer explicit go/no-go approvals on the basis of maturity of scope, cost, schedule, and risk. Although stage-gate enhances decision discipline and independent assurance, it can result in overhead and decrease flexibility where work needs quick exploration, re-prioritization or re-planning (Cooper and Sommer, 2018).

The management of change in conventional systems. Capital projects can be described by the fact that the cost of change is growing rapidly as the project matures; hence such governance systems tend to be based on strong Management of Change (MoC) controls, accruing confidence packages of project estimates, and high baseline discipline, especially in brownfield settings (where interfaces and operational constraints steepen) (PMI, 2021).

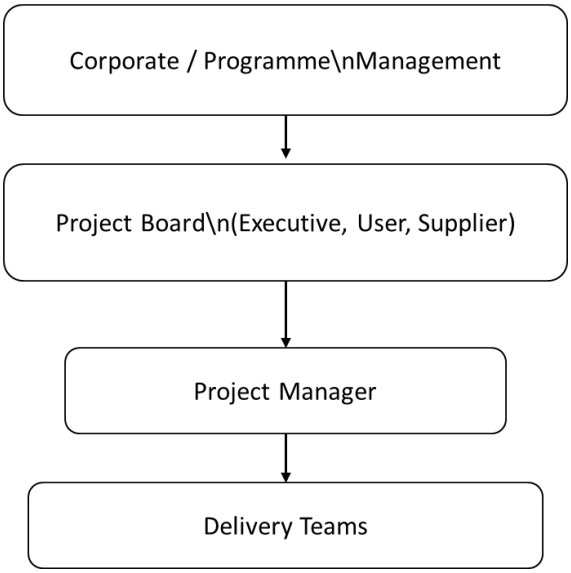


Figure 2. Simplified PRINCE2 governance model

B. Agile and Hybrid Agile Model and Project Performance in Oil and Gas

Context and rationale. Understanding Schedule underperformance is not uncommon in capital programs even where traditional delivery still prevails, which is why more responsive modes of working are still of interest. Oil and gas agility is usually desired to augment cross-functional consistency, quick choice making and diminish late in the cycle surprises, but compliance, HSE assurance and investment controls are obligatory. An interview-led narrative of agile transformation at a complex of energy explains the usefulness of agile tools to enhance speed and performance of cross-functional processes that are complex, and cultural and scaling issues (McKinsey & Company, 2023).

Agile project management (APM). APM concentrates on the delivery in small steps, a process of regular inspection-adaptation, and continuous feedback among the stakeholders. In work that is asset intensive, working outputs are often characterized as verifiable packages, sub systems or deliverables that can be reviewed early. Benefits such as flexibility due to short iterations, enhanced stakeholder alignment due to frequent reviewing and earlier interface and procurement risks visibility and quicker team-level coordination are reported. FEL research deduced in oil and gas also indicates that the earlier the agile principles are introduced, the better the evaluation of options will be, and the minimization of late changes that will cause the implementation to become disrupted (Nesan, 2022).

Hybrid agile (agile and traditional governance). Hybrid agile combines agile (e.g. sprint planning, retrospectives, daily coordination, visual management) and more traditional governance controls (e.g. stage approvals, assurance checks and regulatory documentation baselines). This model is frequently introduced as the one that would be especially effective in oil and gas, as it can maintain the decision rights and compliance levels but allow the stages of learning to be repeated (Cooper and Sommer, 2018; Sommer et al., 2015). Recent review-based literature on agile and hybrid scaling in oil and gas goes on to state further that hybrid solutions often make more sense in large projects, where regulatory limitations and highly hierarchical decision-making organizations prevent pure agile implementation (Bello, 2025).

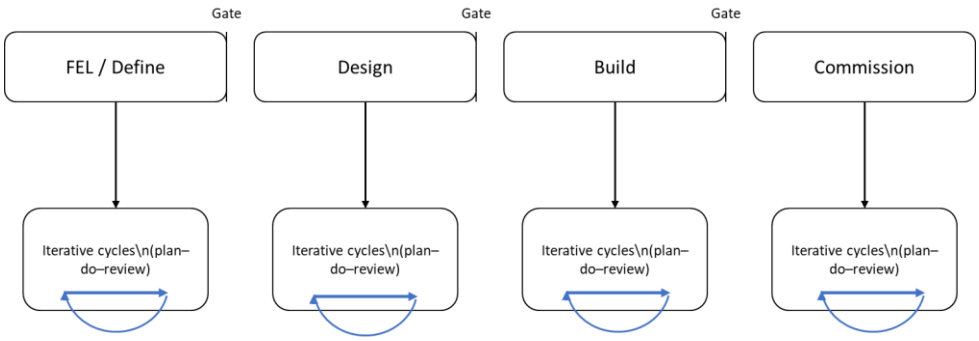


Figure 3. Typical Hybrid Agile–Stage-Gate model with iterative cycles within stages

II.v Project Performance (Dependent Variable)

The reasons behind the challenge of project performance. Regardless of significant progress in performance management and project controls, the performance of large petrochemical and facility projects still has a lack of cost and schedule shortfalls. Recent studies describe these outcomes to be due to closely interrelated technical interdependency, multi-party contracting interface, procurement and supply limits, and uncertainty in executions that has been fomented by market volatility and complicated stakeholder environments (Merrow, 2012; McKinsey and Company, 2024). The performance evaluation is also debatable due to the fact that the definition of success is relative across the owners, contractors, regulators and end users, and that the measurement base and time frame used (e.g., mechanical completion, start-up, or steady-state operations) has a material effect on conclusions (Turner and Zolin, 2012; Muller and Jugdev, 2018).

Success factors vs. success criteria. The literature tends to draw the difference between (a) the success criteria-criteria that are applied to determine whether a project is successful and (b) the success factors-levers, managerial and contextual conditions, which heighten the possibility of achieving the criteria (Lim and Mohamed, 1999; Cooke-Davies, 2002). In oil and gas, the criteria are composed of time, cost, quality/technical performance, stakeholder satisfaction, and sustainability or ESG-related outcomes more often than it is in the iron triangle; the sector is safety-critical and also under scrutiny regarding environmental concerns (Muller and Jugdev, 2018; Santos et al., 2022; Alotaibi and Alotaibi, 2024).

Time horizons of success evaluation. The use of success criteria is also performed at many levels: instant outputs by the end of the completion (delivery and acceptance), medium terms effects (capability, reliability, operability, and

maintainability of the produced asset), and extended-term effects (strategic and business value obtained via production, efficiency, safety performance, or emissions decreasing). This multi-horizon perspective is especially applicable to oil and gas whereby the value is achieved during ramp-up and stable operations and not just at handover (Turner and Zolin, 2012; Zakari Tsiga et al., 2017).

Oil and gas project success factors areas. Empirical investigations into sectors and integrative reviews consistently point to such critical areas as uncertainty in the external environment; client capacity and decision quality; top-management sponsorship; institutional compliance; project attributes (type, size, complexity, technology); project manager and team competence; organizational design and interface management; contracting and procurement strategy (including long-lead items); risk management; and requirements/scope control (Zakari Tsiga et al., 2017; Johansen, 2018; Alshibani et al., 2023).

Delay and poor performance repetitive causes (GCC context). The studies on GCC focus regularly attribute the cause of performance erosion to deficiencies in planning and schedule, inability to control site performance, and poor coordination of vendors; problems in supply and sourcing like not on time delivery of necessary equipment; scope definition and risk distribution ambiguity; unrealistic cost and schedule goals; and friction due to contractual provisions, misalignment of stakeholders, and slowness in decision making (Ruqaishi and Bashir, 2015; Fallahnejad, 2013; Olaniran et al., 2 More updated GCC data still highlights the themes of poor site management, materials shortages, payment/approval delays, and communication breakdowns as common factors which contribute to delay in all types of projects (Al-Saadi et al., 2024; Al-Emad et al., 2025). These trends promote performance strategies that are well balanced between good governance and proactive risk management, high interface and procurement control, and practices involving communication which maintain alignment between owners, contractors and vendors.

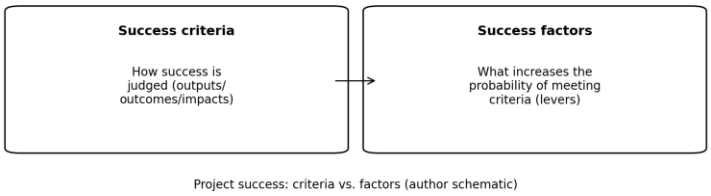


Figure 4. Success criteria versus success factors (author schematic).

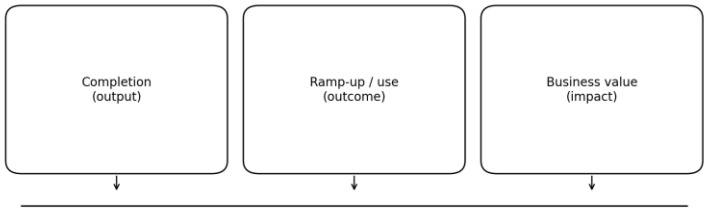


Figure 5. Time horizons for evaluating project success (author schematic).

II.vi Risk Management (Moderating Variable)

Risk management (RM) is broadly placed as a core competence towards enhancing reliability in multifaceted projects. RM aims to determine, examine, and react to uncertainties that can impact goals by preventing, reducing, transferring, or accepting them (PMI, 2022; Hillson, 2018). RM in oil and gas has become a life-cycle governance that incorporates both technical and commercial views and HSE, in that the exposure to a high hazard and lengthy projects, where introducing a late surprise can quickly multiply the cost, schedule, and safety impacts (Suslik et al., 2009; PMI, 2024).

The literature rests on the consistent point that the effectiveness of RM is based on an active nature as opposed to a documentary one. More successful projects connect risks with responsible owners and due dates, decision gateways and points, and combine treatment measures with schedule and cost systems so that responses are resourced, monitored, and closed (Carvalho and Rabechini Jr., 2015; Olechowski et al., 2016). Practical RM in the case of long-lead items (LLIs) involves the early supplier qualification, vendor-data control, inspection/ expediting plan, logistics risk mapping and calibrated contingency. In the case of shutdown/turnaround (TAR) implementation, RM is concerned with readiness

standards, SIMOPS/permit constraints, contingency plans of critical-path work packs, and cross- operation, HSE, contractor, and OEM interface controls.

The Risk management as a mediator between project management approach and performance. As indicated by empirical literature, performance may be affected by project management ways, yet the impact relies on the contextual fit and the excellence of uncertainty management (Joslin and Muller, 2015; PMI, 2022). In this reasoning, the RM can be theorized as a conditioning mechanism which reinforces (or undermines) the way management practices are translated into outcomes. Timely, continuous, and decision oriented RM reduces variance by bringing to light threats at an early stage, prioritizing responses and stabilizing interfaces especially at the location of LLIs and TAR windows, thus enhancing schedule and cost consistency. On the other hand, loose RM, which is not connected to decision-making, may lead to the discovery of design, procurement, or constructability problems in their late stages that will destroy the performance, no matter which strategy has been selected (Hillson, 2018; Olechowski et al., 2016).

The view is consistent with contingency arguments that do not consider any single set of practices to be better than the rest; instead, performance is enhanced through a synergistic combination of practices and governance schemes that mutually adapt to uncertainty, coupling, and regulatory needs (Romero-Silva et al., 2018). Also, it is related to dynamic capabilities logic: organizations that perceive the threat emerging, capitalize on the opportunities because of timely decision making, and reorganize the resources are able to insulate delivery against the volatility and maintain the performance; RM operationalizes these capabilities turning the uncertainty signals into the coordinated actions and controlled trade-offs (Deligonul et al., 2024)

III. STUDY FRAMEWORK

The empirical literature shows that the effectiveness of the project management strategies is contingent on the proximity between the managerial practices and contextual details and the effectiveness of the uncertainty management (Joslin and Muller, 2015; PMI, 2022). It is under this logic of fit RM can be theorized as a kind of conditioning process which reinforces (or weakens) the process of turning the management practices into performance outcomes. RM is able to reduce the variance when done in time, continuously and decision-based and thus when the main threats are revealed in the initial phases, when the responses are prioritized and interfaces are stabilized, particularly between the LLIs and TAR windows, thus improving the dependability of schedules and costs. Quite the opposite, when the RM in relation to the decision is weak or not linked, the design, procurement, or constructability issues can be revealed late and negatively impact on the performance with the chosen management strategy (Hillson, 2018; Olechowski et al., 2016).

This opinion is consistent with contingency arguments that no fixed set of practices is always best; performance will be enhanced where practices and the governance mechanism complement in the presence of uncertainty, coupling and regulatory requirement of the project (Romero-Silva et al., 2018). It is also entirely agreeable with dynamic capabilities reasoning: the organizations that sense the risks that are evolving, borrow the opportunities that arise with a prompt choice and reorganize resources can act on the volatility in delivery and preserve the performance (R. Silva et al., 2024). RM provides a viable platform to these abilities in capital-intensive O&G endeavors, where the indicators of uncertainty are transformed into co-ordinated behaviour and regulated trade-offs.

Figure 6. Conceptual research framework: PM approach, project performance, and RM moderation

According to the conceptual model, Project Performance (PP) represents a dependant variable, whereas Project Management Approach (PMA) represents an independent variable. PMA is handled in general terms of the extent to which a project employs a unified collection of project management practices (planning, coordination, monitoring, change control and stakeholder engagement), which arranges the delivery. Risk Management maturity (RM) is postulated as a direct predictor of PP and a moderating ability that qualifies the degree of PMA to performance conversion.

The moderation logic is particularly applied to the GCC O&G projects. Even with a well designed PMA, delivery may be put at risk even when risk signals are not brought to the surface early (e.g. supplier slippage on LLIs), ownership and tracking of the treatment actions are not owned and the latency in the decision process is increased by preparation and actual execution in TAR. Maturing RM practices, in turn, systematic identification, quantitated assessment, responsibilities of response, and ongoing monitoring in connection with milestone decisions, can be applied to stabilize the plans, make sure that the critical path items are not endangered, and re-work at the end of the stage can be prevented, contributing to performance advantages of a sound PMA (Hillson, 2018; PMI, 2017).

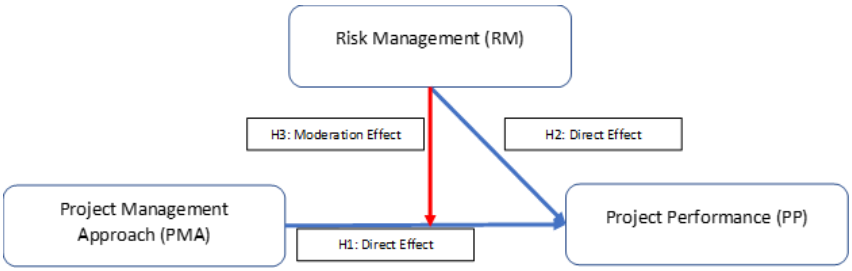


Figure 7. Research framework: PM approach, project performance, and RM moderation.

IV. HYPOTHESES DEVELOPMENT AND VARIABLES RELATIONSHIP DISCUSSION

Performance and Style of Project Management. The achievement of common plans, definition of roles and interfaces, scope change management and synchronized implementation of the engineering-procurement-construction handoffs all improves the performance of Coherent PMA. The mechanisms would be useful in improving schedule compliance, cost management, quality compliance and stakeholder outcomes in high-consequential projects. Therefore:

H 1: Project Performance (PP) is positively affected by Project Management Approach (PMA).

Risk Management Maturity and Performance. The contribution of RM maturity to PP is the reduction of uncertainties and the alleviation of the effects of bad fortunes (i.e. procurement delays, constructability conflicts or operational constraints). Advanced RM increases visibility of the exposure and responsiveness of response implementation and helps make proactive decisions. Therefore:

H2: Risk Management maturity (RM) has a significant positive influence on Project Performance (PP).

Position of Risk Management to be arbitrated. Besides the outlined direct positive effects, the maturity of RM is also likely to enhance the PMA→PP relationship in terms of converting plans into robust execution. The earlier the teams in mature RM spot the problems, the more the treatment is prioritized and the mitigation activities are synchronized with the milestone decisions, in particular those of the LLIs and TAR windows, the better the realized performance of that PMA is created. The weaker RM implies that plans are more likely to be interrupted and their changes become late, reducing the impact of PMA that was reached. Therefore:

H3: PMA and PP are positively moderated by Risk Management maturity (RM) whereby the more the maturity of RM, the more PMA impacts on PP.

V. STUDY METHODOLOGY

The hypothesis behind completing the quantitative, explanatory survey design is as follows: Project Management Approach (PMA) is correlated with Project Performance (PP) in GCC oil and gas (O&G) projects and the relationship between risk management (RM) maturity and the Project Management Approach (PMA) reinforces (moderates) their relationship. The justification is deductive: the data of practitioner responses of active O&G capital projects make the testing of the hypotheses basing on the project governance and performance literature.

V.i Population

The targeted population will be project delivery professionals working under GCC O&G capital projects (e.g., project managers, engineers, planners, cost/ controls, construction/commissioning lead and project consultants). Census was not possible and therefore the study used purposive access in the large operators and delivery systems and snowball recruiting with professional contacts. To reduce the selection bias, invitations were sent to a diverse group of people in which the contact lists of organizations could be accessed.

Data collection was done through a structured anonymous web-based questionnaire. A question that demanded the respondents to answer according to the last project done or in progress was asked to improve the accuracy of recall and anchoring response to a real life context of delivery.

The planning of the sample size was determined in accordance with the popular applied-research directions (e.g., Krejcie and Morgan). A small sample of the order of the hundreds of professionals in a relatively small population (say of thousands) dealing with the project should be enough to estimate relationships to a respectable degree of accuracy; larger samples increase stability with interaction (moderation) tests.

The population of 3300 requires at least 346 responses to test the proposed relationships with acceptable precision using Krejcie and Morgan (1970).

V.ii Measurements

Each construct was operationalised as a multi-item scale. The existing project management and risk management tools were modified and transformed into artifacts, which were created based on some of them and adapted to the O&G environment. Specific anchors were chosen unless otherwise with items being in a 5-point format. The composite indices were developed following reliability and validity tests.

Project Management Approach (PMA) – Independent Variable

PMA reflects the degree of the application of the structured project management practices in the project (e.g., the discipline of planning, routine coordination, change control, visual management/communication mechanisms, iterative review cycle and interface management). According to the respondents, there was a level of utilization/penetration of these practices in 5 point scale (low-high implementation). The item level diagnostics were not abolished to help in refinement in case there were practices that behaved differently in different projects.

Project Performance (PP) - Dependent Variable

PP is measured through the classical iron triangle (time, cost, quality) with the extensions to make the measurements of the outcomes of stakeholders where needed to be short. The respondents rated on performance based on approved baselines (schedule and budget), and technical requirements/acceptance. The greater the score the greater the performance

Risk Management (RM) – Moderating Variable

RM maturity is used to assess the extent of systemized risks identification, assessment, treatment, monitoring, and escalation during the project life cycle. The key indicators include: Early RM intitiation, which prescribes the roles and responsibility during the development planning phase, which implies a definitive approach to the RM reviews, which are in accordance with the project planned cost and schedule, and which provides the establishment of the tracking. The higher the score is, the more proactive and decision-oriented RM.

V.iii Pilot Study

The pilot study was done to check on the questionnaire to ensure that it was clear, reliable, and applicable to measure Project Management Approach (PMA), Risk Management (RM) as moderator and Project Performance (PP) in GCC oil and gas projects. The ambiguity, sequencing problems, and weak items can be identified through piloting and improved in time before they can be applied at large scale (Saunders et al., 2024; Sekaran and Bougie, 2016).

A pilot sample of 30 project delivery professionals was used to fill the draft instrument. Internal consistency reliability was calculated through SPSS 27 using Cronbach alpha. The accepted criteria would provide that 0.70 and more are acceptable reliability, 0.80 and more good reliability and 0.90 and more very high internal consistency; below 0.60 would begin the process of reviewing or dropping items. The pilot result indicated that there was high reliability of the core scales (PMA, RM and PP) which meant that the items could measure the targeted constructs continuously.

In the initial tests of construct validity, item-total correlation and Pearson bi-variate correlation between the item and the corresponding constructs scores were applied in order to assure the convergence. The ones with weak and non-significant relationship would have been edited or eliminated. The level of statistical significance is set at $p < 0.05$ (Pallant, 2016), and the presence of the correlation patterns was the reality of how the instrument was to be organized like RM scale to test the level of moderation.

In general, the pilot research showed that a survey tool had a suitable design and only required minor modifications in words and formats to be distributed to the participants.

VI. DATA ANALYSIS

VI.i Sample Profile and Data Screening

The feedback was filtered both by completeness and quality. Multivariate outliers were verified by means of Mahalanobis distance, with observations that were not outliers being kept at conventional values (D 2/df< 3.5). The data to be analysed in the ultimate analysis was 339 valid responses by the professionals of project-delivery who had been involved in working in GCC oil and gas capital projects in terms of owner, EPC/EPCM, contractor, and advisory organisations.

Table 1: gives the profile of respondents that will be analyzed.

Dimension	Category	n	%
Gender	Male	322	95.0%
Gender	Female	17	5.0%
Country	Qatar	115	33.9%
Country	UAE	139	41.0%
Country	Saudi Arabia	85	25.1%
PM experience	< 5 Years	14	4.1%
PM experience	5 - 10 Years	24	7.1%
PM experience	10 - 15 Years	91	26.8%
PM experience	> 15 Years	210	61.9%

VI.ii Measurement Model Check

The measurement quality was tested prior to testing hypothesis. There has been an acceptable level of internal consistency (Cronbach 8000 and composite reliability above.70). The support was accounted on convergent validity (AVE >.50). Discriminant validity was tested using Fornell-Larcker and HTMT criteria (HTMT <.90). The weak indicators were also removed to create more clarity in constructs throughout final estimation..

VI.iii Direct effects on project performance

diagnostics (VIF is less than 3.3) there was no problem. The model at the fundamental level was able to find a good amount of performance variance (R 2 =0.739).

Table 2: indicates the immediate impacts of PMA and RM on PP

Hypothesis	Path	β	t	p	f^2	Effect size
H1	PMA-1 → PP	0.308	8.384	0.000	0.181	Medium
H2	PMA-2 → PP	0.246	6.665	0.000	0.370	Large
H3	RM → PP	0.447	11.229	0.000	0.379	Large

The positive direct relationship between RM and PP was very positive and meant that the more the systematic risk was identified, assessed, and followed through, the better the delivery outcomes.

VI.iv Moderating role of risk management

Moderation was mentioned and terms of interaction between RM and PMA were introduced. These two interaction effects were positive and significant and it can be concluded that RM promotes the relationship between PMA and PP. When the interaction terms were added, the explanatory power of the relationship increased to $R^2 = 0.789$ ($\Delta R^2 = 0.050$).

Table 3: presents the moderation results

Hypothesis	Interaction path	β	t	p	f^2	Decision
H4	RM × PMA-1 → PP	0.102	3.819	0.000	0.236	Supported
H5	RM × PMA-2 → PP	0.109	4.454	0.000		Supported

According to the interaction patterns, the analysis reveals that:

- The performance gains associated with PMA are boosted (steep positive slopes) in case the RM practices are high.
- It is found that when RM is weak the same PMA features do not translate to performance gains with similar consistency.
- Taking into consideration the nature of long-lead procurement and short shutdown/turnaround in GCC oil and gas projects, RM will most likely reinforce the performance (reducing the decision latency and preventing last-minute-rework).5. Moderation plots

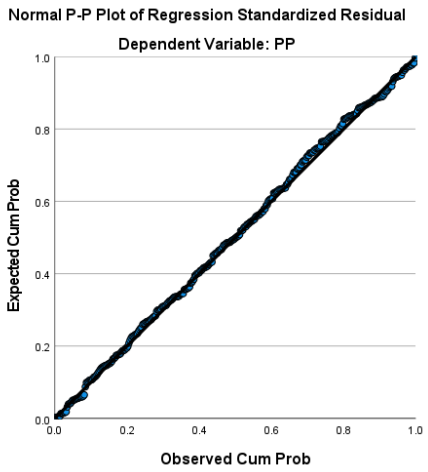


Figure 8. Simple-slope plot: RM moderating the PMA → PP relationship.

VII. DISCUSSION OF THE FINDINGS

Overall, the survey results indicate that the higher the more mature and contextual project management practices used by the organization, the higher the performance of the projects. The risk management capability (RM) and performance is of positive nature as well, and the most crucial to the purpose of this paper, risk management capability improves the relationship between the chosen project management strategy and project performance. In other words, the systematic risk practice and life-cycle risk practices can be used to increase the outcomes of the approach.

The empirical effect of RM on the project performance is also dramatic (standardized $\beta \approx 0.45$, $p < .001$), as the opinion states that O&G projects are more fortunate when the risk identification, risk assessment, risk treatment, and the risk monitoring are tied to the daily decision-making process, rather than a document in itself. The degree of interaction between the project management approach and RM is also significant in a statistical sense ($\beta \approx 0.10$, $p < .01$), which means that the performance payoff of the selected approach to delivery is improved by the heightened RM capability.

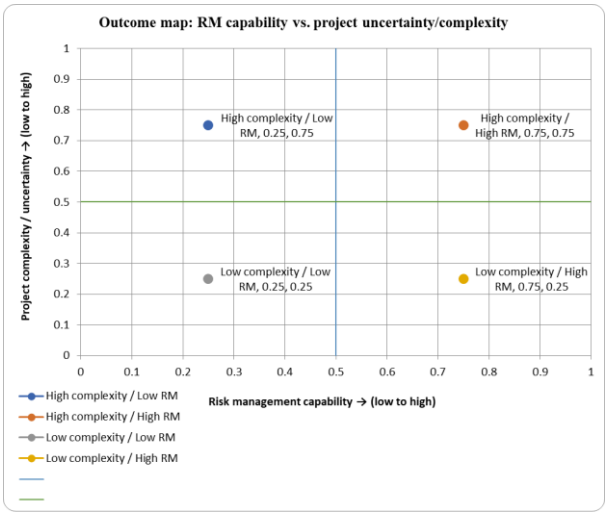
It was measured using project performance (PP) index of the study, which reflected the iron triangle (time-cost-quality) as well as the results of the stakeholders and was compared to the main dimensions of the Risk Management (RM) indices (objectives, internal factors, work processes, communication/monitoring). The strongest RM elements (where they receive the highest loadings) according to the measurement model are RM communication, RM objectives, and RM work processes, then internal factors, with a significantly less significant influence on the budget/time. Substantially, the trend is that mature and decision-oriented RM is positively correlated with performance in four aspects: (1) there is earlier detection of the cross disciplinary conflicts, through organized risk workshops and reference-class estimates; (2) there are reduced late scope changes because the risk triggers are linked to the phase-gate requirement and LLI milestones; (3) the RFCs and the technical risks are closed in a smaller time-span than the visible registers with named owners and dated action leads to the consistency of quality and scope results; (4) the consistency of quality and scope results The statistically significant differences in the schedule, quality, and stakeholder outcomes were the projects where the RM maturity is higher, i.e. continuous identification, quantified exposure, clear ownership and time-bound treatments, which is consistent with the previous findings concerning the fact that RM enhances the project success when it is used as an integrated system of control-and-decision making, but not as paperwork. The second more feasible lesson that can be learnt through the findings is that RM needs to be scaled and adjusted to the project delivery rate: excessive formalization of it can create bureaucracy and delay the decision making process.

Figure 9. RM Management Intensity VS Project Performance

It is reasonable to have these trends in the portfolio delivery of GCC O&G industry because they are characterised by (i) long-lead items (LLIs) that can dominate the critical path and (ii) bottlenecked shutdown/turnaround (TAR) windows in which the latency of decisions is high and safety is at risk. The other system that has already been applied with the Integrated Risk Management approach will require the specification of clear distinct ownership and responsibilities, in accordance with both the stakeholder authorities and the project timeline, vendors onboarding and alignment, which will bring to protective the Shutdown and Turnaround windows and milestones. Conversely, bad RM has propensity to translate uncertainty to the downstream distraction that blunts the merit of any project management approach.

On the other hand, the results reveal that the Risk Management (RM) capability modifies the magnitude of the reaction of the project performance towards Project Management Approach (PMA) particularly under the complex/ uncertain conditions. In the case where the complexity is high and the capability of RM is low, unreliable decision-making and reactive firefighting in the projects are most likely to occur, which increases the instability of the deliveries and deteriorates the performance outcomes. However, on the contrary, high RM ability in high complexity is also associated with more stable decisions, and performance in projects, as well-structured identification, ownership, monitoring activities, and timely treatment activities eliminate further deterioration of issues into subsequent rework and interference.

Another characteristic that is being described in the figure is a principle of proportionality: in a low-complexity project, extremely high RM can introduce an unnecessary overhead (meetings, documentation load, and slow approvals) and therefore a lean RM setup will be more appropriate. As a rule, the main conclusion that can be drawn with the help of the outcome map is that in complicated GCC O&G projects RM must be applied as a performance stabilizer rather than to replace PMA, but to provide an opportunity to prioritize the processes more efficiently, identify risks and technical questions in a timely and efficient way, which will safeguard the integrity of the schedule and the quality of delivery.



Stable outcomes can also be related to the Contingency Theory and the Dynamic Capabilities View. According to Contingency Theory, it is true that, when uncertainty in organizational practices is in place, coupled and regulatory intensity

on performance is enhanced; RM can provide information and discipline needed to realize and maintain the fit throughout the entire life cycle. RM practices help make dynamic capabilities (sensing, seizing and reconfiguring) operational creating threats in their infancy, ensuring prompt response and controlled re-sequencing or scope trade-offs before they occur as schedule or quality failures.

Table 4:Summary of tested relationships

Hypothesis	Relationship	Result	Std. β (approx.)	Interpretation
H1	Project management approach → Project performance	Supported	≈ 0.25–0.35	Medium positive direct effect
H2	Risk management capability → Project performance	Supported	≈ 0.45	Substantial positive direct effect
H3	Risk management × approach → Project performance	Supported	≈ 0.10	RM amplifies approach benefits

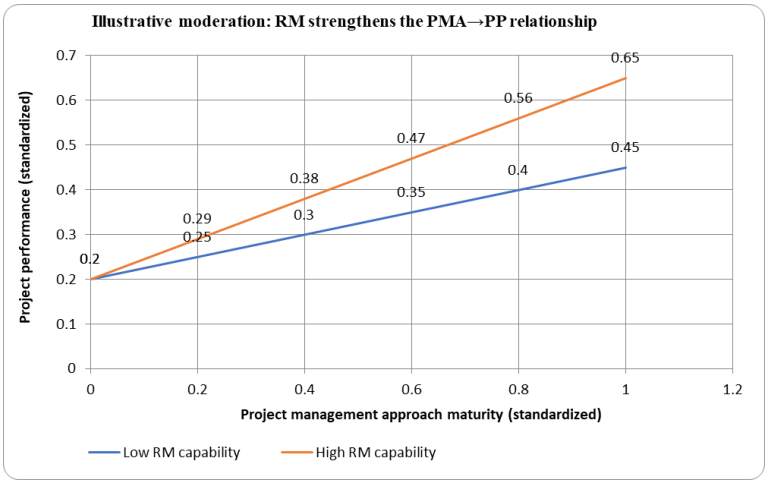


Figure 10. Illustrative simple slopes: higher RM capability strengthens the approach–performance link

Table 5 summarizes how stronger risk management can condition the performance impact of a chosen project management approach in GCC oil and gas projects

RM mechanism (moderation channel)	What it alters in the execution	Relevance in GCC O&G
Previously sensitized risk escalation	Minimal late surprises and decision latency	interface risks; brownfield tie-ins; hand-offs in multi-party settings
Improvement in seizing decisions (obvious owners, response)	Converts identified risks into date/budgeted action plans	Vendor slippage; bottlenecks in permitting/approvals
Adjustment and Reconfiguration	It insulates the path of criticality and takes up change.	LLI procurement windows TAR outage constraints.
Financial- Similar learning cycles	Turns learning cycles into audit-compliant iterations	HSE hold points; commissioning readiness.

VIII. FUTURE STUDIES

The future research could provide stronger causal support on the impact of Agile and Hybrid-Agile on oil and gas project performance in the GCC based on longitudinal and mixed research. Better insights into the learning impacts between FEL/FEED/EPC and commissioning would be derived by the time-based tracking of the projects in terms of archival indicators (e.g., SPI/CPI, change-cycle time, rework hours, NCRs, and stakeholder satisfaction) and survey data. The design of quasi-experiments (e.g. introduction of Hybrid-Agile to similar portfolios by stages) would be a more appropriate inference. Finally, the wider sample must be encompassed not only flagship NOCs but also EPC / EPCM companies, subcontractors, and JV partners in order to receive the multilevel analysis of the impact of governance, the degree of interface, and the contracting conditions on the development of the performance results.

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