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The Impact of Applying Agile Approach on the Project Performance of the Oil & Gas Projects in GCC Countries

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Abstract: **GCC oil and gas industry has large, expensive and complex projects, and this has led to an increased adoption of Agile and Hybrid-Agile to enhance delivery. The paper will examine the impact of pure Agile and Hybrid-Agile project management on project performance in the GCC oil and gas projects with reference to survey information and statistical review of the project performance. The findings are empirical evidence of the adoption of agile in the context of asset-intensive environments and applicable recommendations on the method that is more likely to deliver better project outcomes**.

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

GCC oil-export economies are relying on national oil companies and major capital projects as the means of providing strategic development objectives, but the performance of the project is still disrupted by frequent delays, cost increase, and quality discrepancies. Long life cycles, high-integrity technical systems, multi-party interfaces, and stringent safety and regulatory requirements drive these outcomes and create uncertainty and amplify initial decisions in the planning process. Although conventional plan-based approaches offer governance and control, it is too rigid and fails to offer responsiveness as requirements change.

With growing indications that project approaches are most effective when contextually tailored, more attention has been given to more adaptive approaches. Agile Project Management (APM), which is based on iterative delivery and continuous feedback and incremental learning, has extended to engineering facilities, such as where it has been associated with better collaboration and reliability of delivery where it is customized to suit project conditions. Within the oil and gas industry, Hybrid-Agile methodologies are a combination of agile routines and stage-gate governance to trade off flexibility and guarantee and compliance.

This paper thus focuses on the effects of pure Agile and Hybrid-Agile methodologies on the performance of projects within the GCC oil and gas projects to provide empirical evidence in asset-intensive and high-stakes settings.

II. PREVIOUS STUDIES REVIEW

II.i Search Strategy & Sources

The search strategy employed in the literature review involved a systematic search of Emerald, EBSCOhost, Science direct, Scopus as well as Google Scholar and peer-reviewed articles (2008-2025) on GCC oil and gas project performance, project characteristics, Agile/Hybrid-Agile methodologies, agile best practices, and delay drivers. The best practices were established as practice-proven routines which are superior to alternatives (e.g. cross-functional teamwork, iterative planning, continuous feedback). A search was conducted based on the criteria of the validity of the studies by Farrington (2003) (as used by Al-Sobai, 2020) and more than 135 articles were selected to support the review.

II.ii GCC Oil & Gas Project Context and Characteristics

Gulf Cooperation Council (GCC), which consists of Saudi Arabia, Kuwait, UAE, Qatar, Oman and Bahrain, is still a key oil and gas hub in the world with huge reserves and production capacity. In the context, large capital projects to deliver national development priorities are the primary mode of operation in which project performance and execution capability through national oil companies (NOCs).

Key Characteristics of GCC Oil & Gas Projects

The GCC oil and gas projects are normally characterized by:

- Massive intensity: huge budgets, long-term, and volatility of finances.
- Sophisticated technology application: increased utilization of electronic devices, automation and data-driven controls.
- Strict regulatory and HSE requirements: far-reaching assurance, permitting and compliance requirements throughout the lifecycle.
- Sustainability pressure: growing demand on environmental and social performance.
- Operation-specific project constraints (24/7 operations and narrow Shutdown/ Turnaround windows): most of the projects have to be performed with facilities online, or during short TAR shutdowns- this makes coordination more difficult and makes delays expensive.
- Procurement limitations (special procurement of Long Lead Items): critical equipment and vendor packages (LLIs) must be specified early, and design freeze discipline, expedite, and strict coordination of the suppliers since the delays pose a direct threat to the critical path.

Common classifications of oil and gas projects to facilitate planning, resourcing, and the performance assessment of oil and gas projects can be made based on two factors, namely project stage (calling on Exploration and Evaluation (reserve identification/appraisal), Development (building wells and facilities), Production (optimal and sustaining output in operating assets), and Decommissioning (safe shutdown and site restoration) and by the context of execution, with Greenfield projects (new developments requiring higher permitting/infrastructure) and Brownfield **projects (modifications to active facilities, limited by integration risks).**

II.iii Project Management in Oil & Gas Sector

Project Management (PM) is an essential skill in oil and gas since it has large, capital-intensive, and technical projects. PM is the systematic coordination of people, resources, and decisions to deliver concurring results within time, cost, scope, and quality limits, and remain in line with governance, HSE, and regulatory anticipations (PMI, 2017; Kerzner, 2017).

In GCC projects involving oil and gas, the performance is frequently defined by the manner in which two milestones are handled:

- Long-Lead Items (LLIs): Long procuring items/equipment whose manufacturing/procurement cycle is extended often appear on the critical path. Schedule overrun, rework, and cost increase can be caused by late specifications, vendor delays, or logistics slippage so that schedule overrun, design freeze discipline, and vendor coordination should be identified at the earliest stage.
- Shutdown/ Turnaround (SD/TAR) windows: The fixed outage windows of many brownfield tie-ins and upgrades have to be undertaken. Lack of pre-readiness operations or interface organization may lead to significant losses of production, and more HSE-exposed, which is why the planning process and fast decision-making are crucial.

The complex work is controlled systematically with support of oil and gas projects that often have a stage-based lifecycle: definition/feasibility, development planning, organization/governance setup, execution, and close-out/commissioning (Field, 2015; Kerzner, 2017). Agile and Hybrid-Agile are still able to work in this lifecycle since PM processes are iterative: teams may use brief planning/reviewing cycles within stages, whilst safeguarding the vital governance areas, in particular, LLI commitments and SD/TAR readiness (Sliger, 2008; PMI, 2017).

Project Management Models

Software and engineering projects have been driven on several development and delivery models that have been in use since the 1970s. One such model that has been widely used was the linear sequential (waterfall) model, which was in turn modified by several variants, including the sashimi-based models where stages overlap with one another, and the V-Model where the development and testing phases were aligned (McConnell, 1996; Matkovic and Tumbas, 2010; Andrei, 2019).

There are two commonly mentioned frameworks, which are PMBOK(r) and PRINCE2. PMBOK(r) provides a framework of well-organized processes and best practices and, in general, makes the project manager the most important integrator of delivery decisions (PMI, 2017). PRINCE2 focuses on executive control by way of project board, and its project manager represents the board to control delivery (Jamali and Oveisi, 2016).

Figure 1: PRINCE2 governance model (Adopted from AXELOS, 2019).

PRINCE2 has been criticized to pay little explicit focus on non-technical (softer) competencies of the project manager (Matos & Lopes, 2013). This approach can be widely characterized by seven principles: management by exception, management by stage, continued business justification, defined roles and responsibility, learning by experience, product focus and customizing to project environment; new changes also emphasize configurability to suit different project environments.

As a matter of practice, oil and gas delivery methods tend to be encapsulated as Traditional Project Management (TPM) and Agile Project Management (APM). Despite the prevalence of TPM, in most capital programs, schedule underperformance continues to be a problem, which leads to the desire to explore more flexible models, such as agile and hybrid structures (Nafisah, 2019; KPMG, 2019).

A. Traditional Project Management Methodologies

A.a Waterfall model

The waterfall is the sequential model best applicable to projects that have fixed requirements and where the expected change is minimal (Andrei, 2019). It usually follows the requirements/specification, the design, implementation, tests, deployment, and operations/maintenance (Balaji, 2012; Kramer, 2018; Kannan, 2014). The model provides high predictability with a lot of documentation and set control baselines, with restless feedback in late steps that is costly and disruptive to change (Dima & Maassen, 2018; Larman, 2004; Ali, 2017).

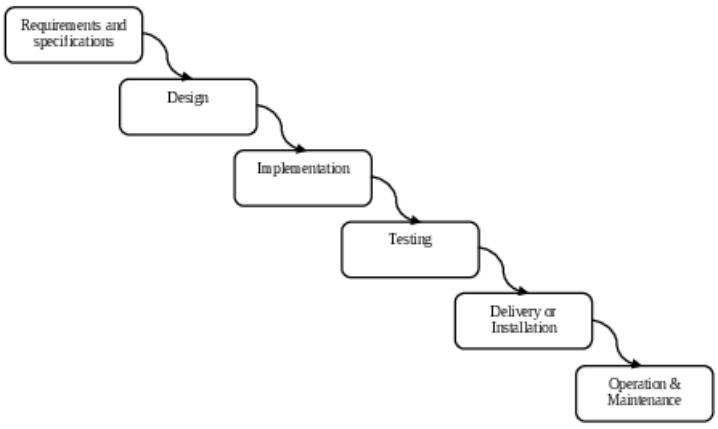

Figure 2: Waterfall project management model.

Strengths

- Clearly defined phase structure and points of governance that upheld orderly execution (Amlani, 2012; Kannan, 2014).
- Extensive documentation that justifies onboarding, tracing and maintenance (post-handover) (Amlani, 2012; Kannan, 2014).
- Reduces the coordination complexity in instances where the scope is certain, and the deliverables are clear-cut (Amlani, 2012).

Limitations

- Lack of flexibility to changing requirements; change is frequently late, and leads to rework and cost/time increases (Dima and Maassen, 2018; Kramer, 2018).
- The propagation of defects and specification errors is possible due to the late testing/validation (Ali, 2017).
- Possible lack of efficiency and wastage of time when downstream activities cannot begin until upstream activities are over (Amlani, 2012).
- Limited feedback loops of stakeholders in comparison to iterative methods (Dima & Maassen, 2018).

A.b Gate (stage-gate) processes

The stage-gate methods organize the delivery into stages that are separated by review gates. In oil and gas, gate systems provide to enhance the governance, provide investment decisions, and mitigate the execution risk by stages of assurance and go/no-go approvals (Al-Salem, 2018; Alyatama, 2021).

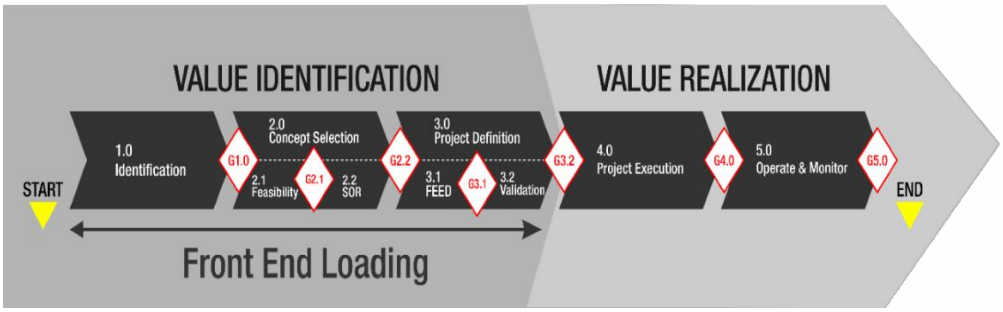

Figure 3. Project Gate System (PGS) generic framework (Al-Salem, 2018).

One such implementation of a GCC example is the use of a Project Gate System (PGS) in some surface-facility projects of Kuwait oil Company. The system implements stepped decision-making and needs a clear approval of the gatekeepers before proceeding, to enhance the discipline of prioritization and execution (Al-Salem, 2018). The other case is the scalable gate process of RasGas, to be applied to both major and minor projects and based on such principles as early testing of options, staged retesting of scope and plans, capacity building, readiness checks, performance monitoring, and quick capturing of lessons learned (Bacon and Al-Kuwari, 2014).

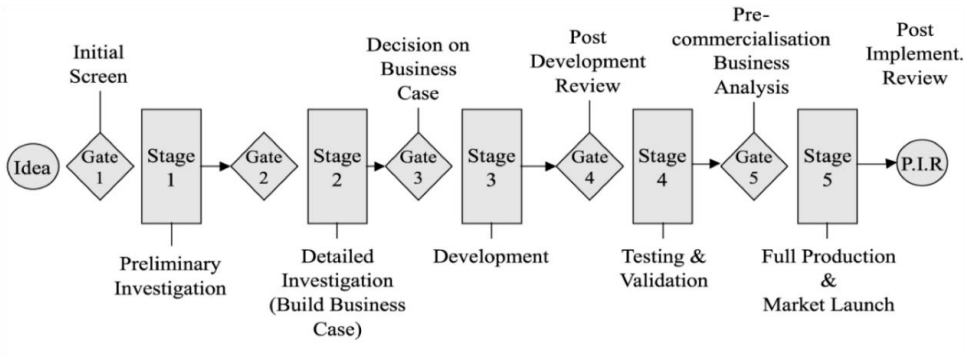

Figure 4. Example phase-gate methodology (Adopted from Martikainen, 2017).

Strengths

- Comprehensive decision authority and responsibility with incremental approvals.
- Early availability of scope, schedule and budget to facilitate business-case decisions.
- Good quality and assurance orientation by independent reviews and written deliverables.

Limitations

- Rigidity Workers need quick repeat, discovery, or reprioritisation.
- Increased overhead to establish scope and early and sustaining gate deliverables.
- Threat of less interaction between the team and the ownership in case of too high hierarchy in governance.

A.c Managing change in traditional systems

Late change is usually disproportionate in terms of cost and schedule in capital projects. Based on this, gate-based systems tend to be founded on the progressive estimate-confidence packages and a solid Management of Change (MoC) process, especially within the brownfield environments where integration constraints are high (RGPMS, 2014).

The following figure describe the influence versus cost of change across the project lifecycle.

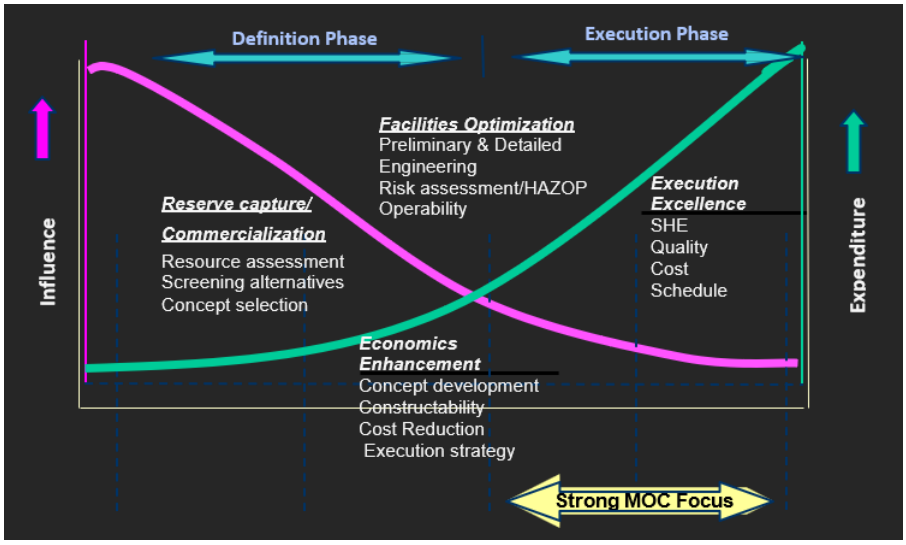

Figure 5. Influence versus cost of change across the project lifecycle (Adopted from RGPMS, 2014).

In general, the traditional models are very good in governance and assurance which are vital in the high hazard oil and gas work but may be less adaptable in the face of uncertainty. This tension is the reason why there is an increase in focus on the agile practices and hybrid models, which do preserve the stage-gate controls but facilitate the iterative learning and faster feedback loops.

B. Agile Project Management Models (Agile & Hybrid Agile) and Project Performance in GCC Oil & Gas Projects

GCC countries generally have their oil and gas projects capital intensive, technologically complicated and with a stringent assurance and regulatory regime. In this circumstance, pure plan-based delivery might be unable to accommodate emergent uncertainty and changing stakeholder priorities. Therefore, Agile Project Management (APM) and Hybrid Agile are being considered by many organizations to enhance responsiveness, maintain governance and compliance expectations (Alyatama, 2021; Spundak, 2014).

B.a Agile Project Management (APM) in Oil & Gas Projects

APM focuses on iterative and incremental delivery, on-going feedback and on-going inspection-adaptation. It is based on the fact that the Agile Manifesto is people-focused and interaction-focused, working output-based, customer-based, and responsive to change (Beck et al., 2001). In projects with a heavy presence of assets, working outputs are understood as verifiable packages, subsystems or deliverables which can be reviewed frequently and on a regular basis.

- Flexibility: short iterations allow prioritizing in time in case of the appearance of new technical information or external constraints (Khan et al., 2023).
- The stakeholder engagement: the frequent planning and reviewing activities ensure the consistency of the owners, operators, contractors, and regulators (Smith and Johnson, 2023).
- Risk visibility in early stage: frequent reviews bring up integration problems, interface problems, procurement problems earlier and enhance the speed of correction (Nafisah, 2019).
- Team performance: Agile practices may help make decisions faster and enhance teamwork, allowing to shorten the delivery cycle (Al-Shammari and Al-Mansoori, 2022).

Agile is mostly executed in bundles of practice as opposed to a single standardized approach. There are such common families as Scrum (roles, sprints, and inspect-adapt events) (Schwaber and Sutherland, 2017), Kanban (workflow visualization and work-in-progress limits) (Anderson, 2010; Ahmad et al., 2018), and Lean principles modified to minimize waste and focus on value (Poppendieck and Poppendieck, 2003; Rodriguez et al., 2019). Other methods include Extreme Programming (XP), Dynamic Systems Development Method(DSDM), Crystal and Feature Driven Development (FDD) which provide strategies on quality, prioritization, lightweight governance, and feature-based planning (Dudziak, 2000; Richards, 2007; Cockburn, 2004; Pang and Blair, 2004). Out of the non-software oil and gas context, non-software teams usually borrow some practices of these families instead of using any of the methods as it is.

B.b Hybrid Agile (Agile + Traditional Governance)

As the Hybrid Agile an outcome of the combinations of the Agile best practices (like, sprint, retrospective meetings, daily standup, visual flow)and the traditional conventional governance systems (Stages Approval, Assurance Controls, Regulation documentation Baseline). The structure is especially applicable to oil and gas GCC environments, where the compliance, HSE assurance, and investment control are non-negotiable (Al-Harbi, 2023; Zhang and Ali, 2024).

- Method fit: the team has the chance to customize the combination of controls and Agile practices based on project type, project stage, and risk exposure (Zhang and Ali, 2024).
- Light-hearted governance: the gated decision rights are retained, and conditions of learning through iterations within the stages are facilitated (Cooper and Sommer, 2018; Sommer et al., 2015).
- interface and coordination benefit: Agile practices can result in the alleviation of silo effects in the conditions of multi-disciplinary and multi-contractors (Smith and Johnson, 2023).
- Better risk management: the review process is more formal and can be enhanced through iterative review which increases the risk visibility and response time (Khan et al., 2023).

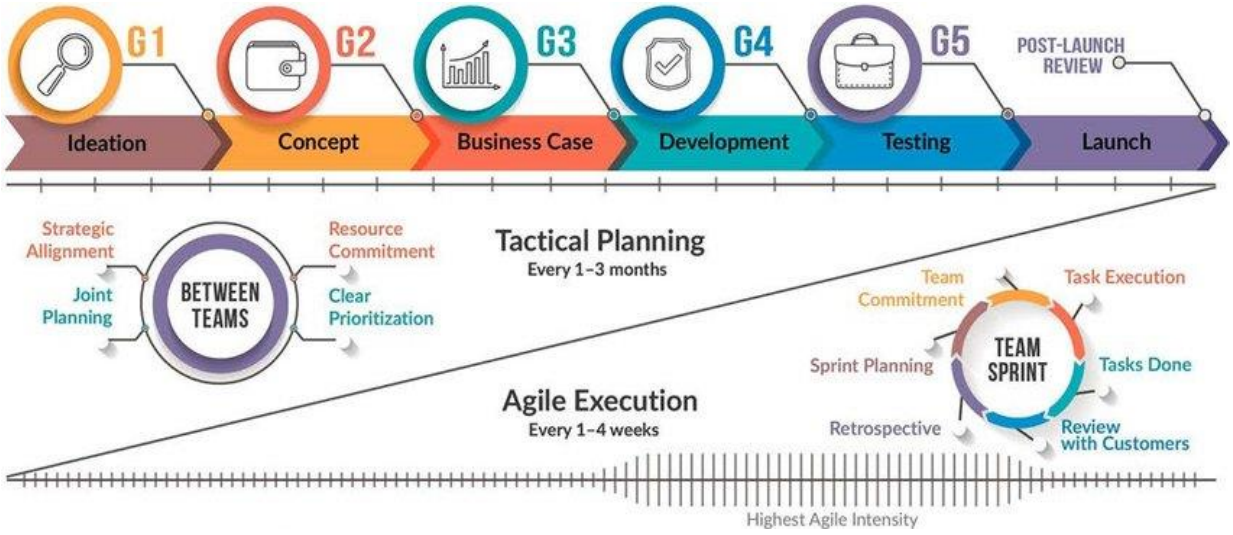

Figure 6: Typical Agile-Stage-Gate hybrid model, with Agile sprint built into stages (Cooper et al., 2018)

II.iv Project Performance (Dependent Variable)

Why Project Performance Remains Challenging

Throughout the last three decades, during which the system of performance management has improved, large petrochemical and facility projects still experience consistent shortfalls, which indicate the technical interdependence, complex contracting interfaces, and uncertainty about the execution (VDMA, 2010; Gepp, 2014; Merrow, 2012; Johensen, 2018). Performance evaluation is also a complicated issue due to disagreement over the definition of success and the consideration of various evaluation frames and basis periods that are used by stakeholders (Els, 2012; Prabhakar, 2008; Kerzner, 1998).

Success Criteria vs. Success Factors

We have to distinguish between:

- Success criteria: criteria on which one would determine whether it is a successful project or not (Lim and Mohamed, 1999; Jugdev and Muller, 2005).
- Success factors: management-specific levers of control and situational provisions of the probability of meeting the requirements (Cooke-Davies, 2002; Zakari Tsiga et al., 2017; Johensen, 2018).

The success criteria are often not limited to the iron triangle in oil and gas projects. The most common ones are time, cost, quality, stakeholder satisfaction, and sustainability outcomes (Muller and Jugdev, 2018; Khan et al., 2020; Awan et al., 2021; Santos et al., 2022; Smith and Wang, 2023).

Time Horizons for Evaluating Success

The criteria of success are important at various time horizons: at an immediate project output (delivery at the point of completion), medium-term project output (capability through the delivered asset), and, lastly, longer-term outputs or impacts (strategic and business value) (Turner and Zolin, 2012; Zakari Tsiga et al., 2017; Johensen, 2018).

Key Success Factor Domains in Oil & Gas Projects

The recurring CSF domains that are identified in integrative reviews of oil and gas project studies include uncertainty in the external environment; client capacity and decision-making; top management sponsorship; institutional compliance; project nature (type, size, complexity, technology); project manager and team competence; project organization and interface management; contractual and procurement strategy (including long-lead items); project risk management; and requirements/scope management (Zakari Tsiga et al., 2017; Johensen, 2018).

Recurring Drivers of Delay and Under-Performance (GCC Context)

In GCC-oriented research, onset of delays and erosion of performances have been consistently connected to:

- The weaknesses include planning and scheduling, inability to control the site/schedule, and ineffective interaction with vendors (Ruqaishi and Bashir, 2015).
- Supplies and sourcing issues (e.g. late delivery of essential equipment) (Dey, 2012).
- Lack of balance between the scope, time, and cost, and ambiguity in the definition of the scope/risks (Sylvester, 2011; Jergeas and Ruwanpura, 2009).
- Problems of financial realism and realism in terms of time (Fallahnejad, 2013).
- Friction to slow down execution, due to contractual, stakeholder, and decision-making frictions (Olaniran, 2015; Kassem, 2019).

Such trends endorse performance strategies that integrate effective governance with active risk management, rigorous interface and procurement regulation and quality communication practices.

Implications for Project Performance

In the reviewed work, the most effective performance effects are achieved when Agile or Hybrid Agile practices are chosen and adjusted to the context instead of those transplanted whole. The positive aspects include quicker learning rates and enhanced teamwork that rest on disciplined governance, organizational potential, and enduring the incorporation of the selected routines (Conforto et al., 2016; Pace, 2019; Stettina and Horz, 2015).

III. THEORETICAL FRAMEWORK

This study is grounded in Dynamic Capabilities Theory and Contingency Theory.

- The Dynamic Capabilities Theory illustrates why Oil and Gas organizations (particularly within the GCC contexts) should constantly feel changes, exploit opportunities and re-design resources/processes in order to remain at par. Agile and Hybrid Agile practices are discussed in this study as the mechanisms to enhance these capabilities and enhance the project performance by enabling faster adaptation, learning through iterations, and having a better fit with the emerging requirements.
- The Contingency Theory provides the notion that human beings cannot have a universal and best project management approach of all projects. On the contrary, the performance is enhanced when the choice of the methodology is appropriate (e.g., it fits the project context (complexity, uncertainty, regulatory pressure, and risk exposure).

IV. HYPOTHESES DEVELOPMENT AND VARIABLES RELATIONSHIP DISCUSSION

According to the previous studies, the choice of project management methods is a decisive situational aspect that defines the project outcomes since the method of delivery works best when it is referenced to the situational needs like uncertainty, interdependence, and the intensity of governance (Gemino et al., 2020; PMI, 2021; Serrador and Pinto, 2015). The logic of fit is especially applicable to GCC oil and gas (O&G) capital projects that are typically typified by safety-crucial measuring points, complicated technical interfaces, protracted life cycles, and multi-party delivery provisions. In such circumstances, Agile Project Management (APM) or Hybrid Agile (H-APM) gain more and more popularity as methods of enhancing responsiveness without compromising control needs in organizations (Cooper and Sommer, 2018; Dingsoyr et al., 2018; Niederman et al., 2018).

Simultaneously, there has been a development of project performance beyond cost-time-quality factors. The core idea of the iron triangle still exists, but in the literature, the authors focus on extensive performance indicators, like stakeholder satisfaction, operational stability, and organizational benefits realization (Atkinson, 1999; Dubois and Silvius, 2020). Notably, project success or achievement of the overall project objectives and benefits is not the same as project management success or efficiency in delivering on time, costs and quality according to the set targets (Baccarini, 1999; De Wit, 1999). This difference is particularly acute in O&G, where the performance of the activity is not only determined by technical delivery, but also by coordination across interfaces and managing the changes in requirements by preserving the safety and compliance expectations.

IV.i Agile Project Management (APM) and Project Performance (PP)

Agile management is meant to bring the best performance in a situation where requirements are dynamic and where the unpredictability is a reality. It is focused on the iterative planning, incremental delivery, fast feedback, and constant learning, which allows teams to change the direction fast and minimize re-work of the last stages. There is some evidence that agile routines are capable of enhancing reliability of delivery and alignment of stakeholders in the event of disciplined implementation and enabling conditions such as clear definition of deliverables, realistic estimation, clear acceptance criteria and good communication between teams and stakeholders (Cherie Noteboom et al., 2021; Martinson Ofori et al., 2021).

APM can facilitate more effective collaboration and quicker solution to problems in GCC O&G projects, where the knowledge is frequently shared between the owners of the project, its EPCs, subcontractors, and vendors, by encouraging intentional interaction patterns, which can result in enhanced cost, schedule, quality, and stakeholder-related results (Alyatama, 2020; Bosch-Sijtsema & Henriksson, 2014). Based on that, in this study it is anticipated that increased use of Agile practices would be correlated with increased project performance.

H1: Agile Project Management Methodology (APM) has a significant effect on Project Performance (PP) of Oil & Gas projects in GCC countries.

IV.ii Hybrid Agile Project Management (H-APM) and Project Performance (PP)

Hybrid Agile practices have emerged due to the need in most O&G to provide structure, documentation and assurance that cannot be maintained in a pure Agile throughout the full life cycle. The hybrid Agile combines the Agile practices (e.g., short iterations, reviews, ongoing coordination) with the plan-driven structures (e.g., stage-gate decision points, formal controls), in the quest to maintain flexibility and compliance and predictability (Cooper & Sommer, 2018; Pace, 2020).

The literature also explains that an approach would be the governing principles that guide a project, whereas a methodology would be the delivery delivery system of techniques, procedures and rules which are practical in delivering the project

(PMI, 2017; Spundak, 2014). In practice, organizations often mix practices between traditional and agile forms, which result in the formation of so-called hybrid-like configurations due to both the need to adapt to local team autonomy and organizational control (Gemino et al., 2020; Niederman et al., 2018). This hybridization should enhance performance in a GCC O&G environment as it will maintain the discipline in the delivery and at the same time be responsive to adaptive learning as the conditions change.

H2: Hybrid Agile Project Management Methodology (H-APM) has a significant effect on Project Performance (PP) of Oil & Gas projects in GCC countries.

V. STUDY METHODOLOGY

This study is based on a quantitative, explanatory paradigm to establish whether Agile Project Management (APM) and Hybrid Agile Project Management (H-APM) enhance the performance (PP) of the GCC projects in the oil and gas sector. Deductive approach is used, and the hypotheses are based on previous research conducted on method-context fit and the results of the project. The research data will be gathered using a structured questionnaire that will be sent to the O&G project practitioners in GCC (e.g. project managers, engineers, planners, and controls staff, etc.). The survey assesses APM and H-APM adoption (important agile practices and hybrid governance routines) and makes an evaluation of PP based on multi-dimensional indicators that are time, cost, and quality-focused (and, in some cases, extended outcome perceptions). Hypothesis tests are done after data has been screened to ensure completeness and reliability/validity of scales. Regression-based models (with some group comparisons (where appropriate) to support the claim) are utilized to study relationships, with control variables (e.g., project size/complexity and delivery context) to isolate both the effects of APM and H-APM. Results are discussed through the prism of GCC O&G project limitations who necessitate the choice between flexibility and regulation.

V.i Population

The sample population will include individuals in the GCC oil and gas capital project provision (owner, EPC/EPCM, and consultants) with a sampling frame based on ARAMCO, QatarEnergy and ADNOC and snowballed; the size of the eligible sample is estimated to be around 3,300 practitioners.

V.ii Sample Size

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

V.iii Measurements

In this study, (1) Agile Approach is used as the independent variable and (2) Project Performance (PP) is used as the dependent variable measured using a structured questionnaire. To minimize the contextual bias, controls (e.g., country, age, education, years of experience, project type/size, business line) are gathered.

Independent Variable: Agile Approach (APM-Pure, H-APM)

The instrument is based on the previous work and adjusted to GCC O&G projects; it comprises 17 items:

✓ APM-Pure (10 items): level of Agile practices (e.g. iterations, day-to-day meetings, retrospectives, cross-functional working, self-organizing teams, continuous skill development, disciplined change/contract management).

✓ H-APM (7 items): the presence of a hybrid (Agile + phase-gate/traditional controls) that enhances the results of delivery and balanced KPI governance.

Scale (APM-Pure practice penetration): 5-point anchored scale of adoption:

1 ≈ 20%, 2 ≈ 40%, 3 ≈ 60%, 4 ≈ 80%, 5 ≈ ~100% adoption.

Dependent Variable: Project Performance (PP)

Indicators PP is primarily measured with the help of the iron triangle (time-cost-quality), which is suited to capital projects:

✓ Time performance: variance of approved schedule.

✓ Cost performance: variance to budget.

✓ Quality performance: adherence to technical/specification guidelines.

In line with broad success perspectives, scope/requirements and stakeholder satisfaction brief items are also added (based on Gemino et al., 2021).

Scale (PP items): 5-point Likert, 1 = Very low / Not successful to 5 = Very high / Highly successful.

V.iv Pilot Study

To ensure that the questionnaire is understandable, valid, and capable of measuring Agile Project Management (APM), Hybrid Agile Project Management (H-APM), and Project Performance (PP) found in GCC oil and gas project, a pilot study will be carried out. Piloting can also be suggested to identify ambiguities, sequencing problems, and weak measurement items, which can be improved before implementation (Saunders et al., 2024; Sekaran and Bougie, 2016).

The draft instrument was taken by a pilot sample of 30 project delivery professionals. The internal consistency reliability was measured with SPSS 27 by using Cronbach alpha. Based on the common thresholds, α 0.70 shows good reliability, 0.80 excellent reliability and 0.90 very high internal consistency; a lower value of 0.60 would raise item review or elimination. The pilot results revealed high reliability of the core study scales, which indicates that the items are always good capturers of APM, H-APM and PP.

Pearson bivariate correlations of items and their parent construct scores were used to check construct validity to ensure that items measure what they are supposed to measure (convergent validity). Products with low or insignificant correlates would be updated or deleted. The level of significance was assessed according to $p < 0.05$ (Pallant, 2016), and correlation patterns assisted in the desired structure of the questionnaire.

All in all, the pilot study showed that the survey instrument was reliable and correct enough to use in actual data collection although a few word and formatting changes will be necessary before making the final distribution.

VI. DATA ANALYSIS

VI.i Sample Profile and Data Screening

Three hundred and thirty-nine valid responses were accepted to be analyzed. The respondents were project facing professionals (e.g. project engineers, planners, coordinators, project/program managers and consultants) who worked in GCC oil and gas capital projects.

Males (95% of the respondent profile, n = 339) predominate in the sample with the majority of participants in the age group of 41-50 (41% of the sample) and 31-40 (31% of the sample), which is mainly mid-career. In the field of education, the respondents are very well-educated with the majority of them having a Master degree (51%), then a Bachelor degree (31%), and a PhD degree (13%). Most jobs are of senior type with the majority of them being Project Managers (20.1%), Technical Leads (16.8%), and Project Leads (15.0%), as well as Senior Engineers (14.2) and Consultants (11.8). The experience is significant with 61.9% of them reporting over 15 years of experience in projects, and 26.8 years reporting 10-15 years experience which depicts highly experienced population. Geographically, the UAE (41%) is the largest contributor to the responses followed by Qatar (33.9) and Saudi Arabia (25.1). The majority of participants engage in oil and gas process/production facilities individually (31%), or in combination with the related scopes (such as piping, power, infrastructure), and this proves applicable to the core capital-project delivery. The size of teams is generally moderate-to-large with the most frequent range being 61-80 employees (26%), and almost a quarter of 100+ (24.2%). Lastly, the dominant working mode is hybrid (72%), 20.9 onsite and 7.1 online indicating a coordination environment is blended.

Table 2. Multivariate outlier screening (Mahalanobis distance)

Case number	Mahalanobis distance (D2)	D2/df (df: Degree of Freedom)
134	78.332	1.703
306	77.695	1.689
15	76.864	1.671
44	76.527	1.664
278	74.116	1.611
319	71.979	1.565
198	71.900	1.563

255	70.580	1.534
71	70.142	1.525
262	68.794	1.496

Screening indicated no influential multivariate outliers based on Mahalanobis distance, supporting the stability of subsequent estimates.

VI.ii Measurement Quality (Reliability and Validity)

The three focal constructs (APM, H -APM, and PP) were evaluated on internal consistency and convergent validity. Cronbach alpha and composite reliability (CR) were used to measure reliability, whereas average variance extracted (AVE) was used to measure convergent validity.

Table 3: Construct reliability and convergent validity

Construct	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
APM (Agile)	0.924	0.937	0.622
H-APM (Hybrid Agile)	0.918	0.935	0.671
PP (Project Performance)	0.960	0.966	0.780

The Fornell-Larcker and the HTMT ratio were used to determine discriminant validity. Both tests suggest that there is an empirical distinction between the constructs and each of them represents a different element of the project delivery environment and outcomes.

Table 4: Discriminant validity (Fornell–Larcker)

Construct	APM	H-APM	PP
APM	0.789		
H-APM	0.526	0.819	
PP	0.707	0.699	0.883

Table 5: Discriminant validity (HTMT)

Construct	APM	H-APM	PP
APM			
H-APM	0.569		
PP	0.749	0.744	

VI.iii Structural Model Results (Agile → Performance)

Hypothesis testing was conducted using a structural model in which APM and H-APM are used to predict PP. Project Performance can be viewed as a combination of delivery outcomes (budget/time, scope/quality, and stakeholder-related success indicators) reported to the respondent, regarding the last project he/she worked on.

Table 6: Hypotheses testing results (direct effects)

Hypothesis	Relationship	Path Coefficient (β)	t	p	Decision
H1	APM -> PP	0.308	8.384	0.000	Supported
H2	H-APM -> PP	0.246	6.665	0.000	Supported

Table 7: Explained variance in Project Performance

Outcome	R^2	Adjusted R^2
PP	0.739	0.737

Both APM and H-APM exhibit statistically significant positive project performance. The value of explained variance (R^2) implies that Agile-oriented delivery practices explain a large proportion of variability in performance between the sampled GCC oil and gas projects.

VII. DISCUSSION OF THE FINDINGS

The results of the survey show both the positivity of Agile Project Management (APM) and Hybrid-Agile Project Management (H-APM) towards Project Performance (PP) in oil and gas projects in the GCC. In general, the projects that reported greater implementation of Agile practices were more successful in terms of schedule compliance, cost management, quality delivered, and performance related to the stakeholders. The resulting effects are statistically significant and of practical (medium) scale, which contributes to the idea that the process of iterative coordination and regular review would serve to improve the delivery reliability in interface-intensive settings.

VII.i H1 – Agile Project Management (APM) and Project Performance (PP)

The hypothesis H1 was that APM enhances PP in GCC O&Gs projects. The hypothesis is accepted: APM positively, significantly, and significantly influences PP (0.308, t = 8.384, p < 0.05; CI does not exclude zero) with a medium effect size (f 2 = 0.181). This implies that the Agile practices, especially iterative planning and formal reviews, enable the team to identify integration problems at an earlier stage, make technical decisions faster, and eliminate the unnecessary undoing of late teams.

Patterns on an item level also show that not every ceremony is equally beneficial in every type of project. Iteration planning, retrospectives and disciplined contract/change handling practices were reported to have a greater contribution to measurement than daily meetings, suggesting that Agile is right-sized depending on how many interface points, work-pack structure and operational constraints (e.g. shutdown/turnaround windows) are present in the project. The most useful forms of APM in practice are those in which feedback loops can be maintained very short, and where decision authority is highly decentralized to the extent of translating learning into action in a timely manner.

VII.ii H2 – Hybrid Agile (H-APM) and Project Performance (PP)

H2 hypothesized the use of H-APM enhances PP in GCC projects of O&G. The hypothesis is accepted: H -APM is a significant predictor of PP (6.64 H -APM = 0.246, t = 6.645, p = 0.05 H -APM = 0.246 -0.05). This dataset shows a larger effect size than APM (f 2 = 0.370) implying that the hybrid configurations can be more reliably employed in those settings in which formal governance, documentation, and assurance gateways need to be maintained.

These findings correlate with the real-world experience of delivering O&G capitals: Hybrid solutions will be able to retain phase-gate discipline (permits, HSE hold points, design freezes, LLI procurement milestones) yet inject Agile micro-cycles within each of these stages to reduce the feedback loop and enhance the interface coordination. Schedule adherence and alignment with stakeholders, the best results of which are quite sensitive to decision latency and cross-party coordination in multi-vendor projects, were most positively influenced by performance uplift.

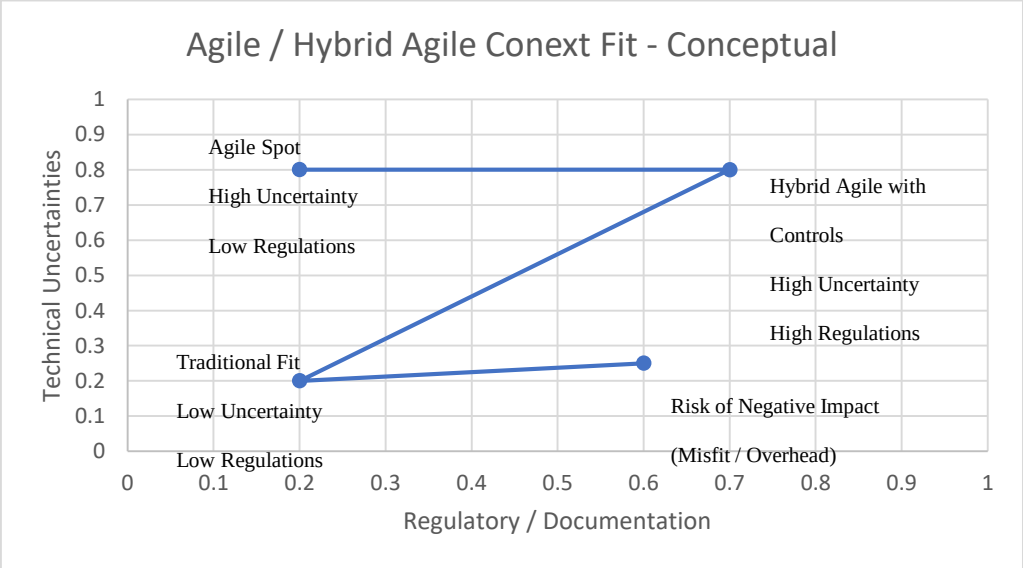

Figure 7: Context Fit for Agile/Hybrid (Conceptual).

VII.iii Conclusion

Collectively, the evidence can be used to make a straightforward suggestion: Agile and Hybrid-Agile models correlate with better project performance (PP) when it comes to GCC oil and gas portfolios, especially when there is a high value of uncertainty, the interface density, and a high value of coordination requirements. Agile routines used in projects like iterative planning, frequent reviews, visual control of workflow, and organised collaboration have been demonstrated to produce better results in terms of schedule compliance, cost-control, quality delivered, and stakeholder satisfaction.

The results also indicate that method- context fit is conclusive. Pure Agile is most likely to generate the most value in limited scopes where short feedback loops can be found and decisions are as close to the work as possible (e.g., brownfield packages, tie-ins, commissioning work packs). Hybrid-Agile can be more reliably used in capital-intensive and safety-critical delivery due to maintaining phase-gate governance and assurance checkpoints and allowing iterative learning and coordination across the stages.

In practice, the actionable model, which is the agility with controls in O&G Project, the adoption of the Agile best practices within the traditional phase gate framework, the advantage of shorter decision life cycle which reveals the integration issues at the earliest stage (development planning stage) and enhances the stakeholder alignment without any compromising with SHE and Quality.

Key implications:

1. The context-method fit motivates performance of GCC O&G portfolios; there is no method that will perform best everywhere.
2. Agile enhances delivery in case of iteration whenever the iteration is possible thus making late rework less plausible.
3. High-consequence environments have performance that is stabilized by Hybrid-Agile, a combination of responsiveness and governance.
4. Failure modes are foreseeable (e.g. ceremony without empowerment, unsynchronized change around freeze points, and poor interface control).

VIII. RECOMMENDATIONS (COMMON FAILURE PATTERNS AND HOW TO FIX THEM)

According to the discussion of the findings and the analysis of the survey results in the form of a cross-sectional assessment of the variables constructs and their relationship and effects in the outcome, the conclusion and recommendations on actions to solve possible problems according to the signals can be as follows:

Failure Point	Required Mitigation
Portfolio method misfit	Apply Hybrid -Agile as the default when the capital work is high risk, multi-disciplinary and tightly bound packages; apply Agile when the capital work is tightly constrained; and apply traditional when the requirements are fixed and the uncertainty is low.
“Ceremonial” Agile/Hybrid (rituals without decision change)	Ceremony; define decision rights and decision escalation pathways; eliminate multiple approvals, instead of overlaying new events.
Scope Vs. Milestones Checkpoints (LLI, Permits, SD, TAR)	Defining the key checkpoints and the frozen windows and linking the iteration to each particular gate milestones, emphasizing the authority flexibility near these mentioned checkpoints, and ensuring the alignment between all the PMT Authorities.
Agile in tightly coupled, safety-critical systems	Tightly-coupled systems Reduce development of increments that can be reviewed; incorporate constructability/operability reviews; reinforce interface management and early integration testing (in particular, during commissioning).

Contractual/ Supplying Misalignment	Contracts to be developed in line with the iteration plan to avoid the penalty clauses and the claims.
The exposure to Long-Lead Item (LLI) is not controlled	Early LLI Identification, Supplier readiness, and the inspection test plans aligned with the frozen windows (Shutdown, Turnaround Windows).
Performance not measured to scale-up	Define a small KPI set to evidence rollout decisions: Schedule and Cost Performance Tracking to be in place (SPI, CPI) from the earliest stage. Quality Tracking: NCR's, Defect Escape Rework Hours) Integrity and Alignment: Gate Readiness, Interface Management, design change tracking. Stakeholder Alignment: Sponsor/Client, In-Charge, Authorized.

IX. THEORETICAL AND PRACTICAL IMPLICATIONS

IX.i Theoretical Implications

- Contingency Theory validated: the performance is enhanced when the delivery method is compatible with uncertainty, coupling, interface density and governance intensity.
- Dynamic Capabilities rationality maintained: Agile routines enhanced project teams in sensing problems in early stages, acting upon opportunities by making decisions faster, and reconfiguring plans to mitigate disruptions at late stages.
- Boundary conditions de-mystified: Agile/Hybrid works mediocre as a mere ceremony, as change is not aligned with freezes, or the interface discipline is not big.

IX.ii Practical Implications (GCC O&G Focus)

- A base to provide a method selection playbook: the recommended method/approach based on the uncertainties, Interfaces, Regulation Load, and LLI Exposure.
- Hybrid-Agile governance: the use of phase-gates still exists, but sprint-like cycles can be used within each stage (e.g. 30/60/90% package readiness).
- Ensuring the reinforcement of cross-functional performance processes (Engineering- Procurement-Construction-HSE-Operations) that have clear ownership and interface controls.
- Standardization Schedule/cost/quality/stakeholders dashboards can be made to ensure that decisions have less latency and that they are capable of adapting in a disciplined manner.
- Develop a usable workbook, defining (Roles & Responsibilities, artefacts, Frozen Rules, Interfaces workflow, KPI package, etc.) for scaling.

IX.iii Future Studies

Further studies are needed to provide more causal evidence on the effect of Agile and Hybrid-Agile on the project performance in the GCC oil and gas through the application of longitudinal and mixed-method designs. Long-term monitoring of initiatives using archival measures (e.g., SPI/CPI, change-cycle time, rework hours, NCRs and stakeholder satisfaction) and survey data would be more predictive of the learning impacts within FEL/FEED/EPC and commissioning. Inference could be enhanced by quasi-experimental methods (e.g. rolling out Hybrid-Agile in similar portfolios). Lastly, it would be possible to broaden the sample to cover EPC/EPCM companies, subcontractors, and JV partners to conduct the multi-level analysis of the impact of governance, interface density, and conditions of contracts on performance.

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