الجمهورية الجزائرية الديمقراطية الشعبية
People's Democratics Republic of Algeria

Ministry of Higher Education
and Scientific Research

National Higher School of Management
University Pole of Kolea

وزارة التعليم العالي و البحث العلمي

المدرسة الوطنية العليا للمناجمنت
القليعة

A dissertation submitted in partial fulfilment of the requirements for the degree of Master of

Entrepreneurship and Project Management

Agile Leadership Practices in Industrial Project Management

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Academic Year

2025/2026

Acknowledgments

First and foremost, I would like to express my sincere gratitude to Allah for granting me the strength, patience, and perseverance to complete this work.

I would like to extend my deepest appreciation to my supervisor, Dr SABA Amine, Dr BERKAT Abdelaziz, for his valuable guidance, and constructive advice throughout the preparation of this dissertation.

I would also like to thank the members of the jury for accepting to evaluate this work and for their valuable comments and suggestions.

My sincere thanks go to the managers and professionals who participated in this study and generously shared their time, knowledge, and experience. Their contributions were indispensable to the achievement of the research objectives.

I would like to express my heartfelt gratitude to the staff of LQS Division Departement for their cooperation and assistance during the data collection process.

Finally, I am deeply grateful to my parents, family, and friends for their unconditional support, encouragement, and understanding throughout my academic journey. Their confidence in me has been a constant source of motivation.

To all those who contributed directly or indirectly to the completion of this dissertation, I extend my sincere thanks.

O. Newfel

Abstract

As organizations navigate increasingly volatile and complex environments, agile leadership has emerged as a critical organizational capability. While extensively studied in technology and software contexts, its applicability within industrial development projects, governed by sequential planning, contractual rigidity, and strict safety imperatives, remains underexplored. This study aims to examine whether and how agile leadership practices are applied in complex industrial development projects, drawing on an empirical investigation conducted within Sonatrach's Liquefaction and Separation (LQS) Activity, Development Division. Adopting an interpretive qualitative approach, data were collected through eight semi-structured interviews with project managers and team leaders, complemented by direct observation, and analysed in NVivo through node coding, word-frequency analysis, and matrix crosstabulation. Findings show that agile leadership practices are present but contextually adapted: collaboration and empowerment, flexibility and adaptability, and continuous learning emerge as the most practiced dimensions, while rigid planning and hierarchical command-and-control structures remain the primary constraints. The study's central contribution is a hybrid leadership model in which agile practices operate as an adaptive layer within, rather than replacing, traditional project management architecture.

Keywords: Agile Leadership, Industrial Project Management, Hybrid Leadership Model, Sonatrach, Qualitative Research.

الملخص

فرضت الطبيعة المتقلبة والمعقدة للأعمال اليوم ضرورة تبني "القيادة الرشيقة" كقدرة تنظيمية حيوية. ينطلق هذا البحث من فجوة أدبية تتمثل في قلة الدراسات التي تتناول القيادة الرشيقة في مشاريع التطوير الصناعي –المقيدة بالهيكلة الهرمية والتخطيط الصارم– مقارنة بوفرتها في مجال البرمجيات. وللإجابة على إشكالية مدى قابلية تطبيق هذه الممارسات في البيئات الصناعية المعقدة، أُجريت دراسة تجريبية نوعية بقسم (LQS) التابع لشركة سوناطراك. اعتمدت الدراسة على 8 مقابلات شبه منظمة مع قادة فرق ومديري مشاريع، مدعمة بالملاحظة المباشرة، وحُللت البيانات بواسطة التحليل الموضوعي والترميز المنهجي عبر برنامج NVivo. كشفت النتائج عن حضور قوي لممارسات التعاون والتمكين والمرونة كأبعاد رشيقة متكيفة مع القيود المؤسسية المتمثلة في سلاسل التحقق المعقدة والتخطيط الجامد. يقدم هذا البحث إسهاماً قيماً يتمثل في التوثيق التجريبي لنموذج قيادة هجين، حيث تعمل ممارسات أجايل كطبقة تكيفية مدروسة تعمل ضمن بنية إدارة المشاريع التقليدية الرسمية، لا كبديل لها. كما تدعو الدراسة لتجاوز فكرة الاستنساخ غير النقدي لممارسات البرمجيات، نحو تبني نموذج مرن ومكيّف يتناسب مع خصوصية القطاع الصناعي.

الكلمات المفتاحية: القيادة الرشيقة، إدارة المشاريع الصناعية، نموذج القيادة الهجين، شركة سوناطراك، البحث النوعي.

Résumé

Face à la complexité croissante du monde des affaires, le leadership agile s'impose comme une compétence organisationnelle majeure. Si ce concept est largement étudié dans le secteur technologique, sa pertinence dans les projets de développement industriel, marqués par une planification séquentielle stricte et une structure hiérarchique forte, reste peu explorée. Cette recherche a pour objectif d'examiner si et comment les pratiques de leadership agile sont appliquées dans des projets industriels complexes, à travers une étude empirique menée au sein de la division LQS de Sonatrach. L'étude adopte une démarche qualitative interprétative, fondée sur huit entretiens semi-directifs auprès de chefs de projets et une observation directe, analysés sous NVivo.

Les résultats montrent que le leadership agile est bien présent sur le terrain (collaboration, adaptabilité, apprentissage continu), malgré des contraintes institutionnelles telles que la planification rigide et les processus de validation. La contribution centrale de ce travail est un modèle de leadership hybride, où l'agilité s'intègre au management traditionnel plutôt qu'elle ne le remplace.

Mots-clés : Leadership agile, Management de projets industriels, Modèle de leadership hybride, Sonatrach, Recherche qualitative.

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GENERAL INTRODUCTION

Context

In an increasingly complex and fast-paced business environment, organizations are required to continuously adapt to rapid changes, technological disruptions, and evolving customer expectations (Ncube et al., 2024). We are currently operating in an era often defined by unprecedented volatility, uncertainty, complexity, and ambiguity. Technological advancements (ranging from artificial intelligence and automation to big data analytics) are radically rewriting the rules of industry competition at a breakneck pace. Simultaneously, globalization has interconnected markets so deeply that localized disruptions can trigger immediate global ripple effects. Furthermore, modern consumers demand higher degrees of personalization, speed, and continuous innovation, placing immense pressure on enterprises to continuously reinvent their value propositions just to maintain their market share.

Traditional management approaches, often characterized by hierarchical structures and long-term predictive planning, are becoming less effective in addressing the fluid and uncertain dynamics of the digital age (Alsawalha, 2025)These conventional models, which have their roots in the industrial era, rely heavily on rigid top-down command chains, strict divisional silos, and inflexible forecasting cycles. While these methods were highly successful in stable, predictable environments where efficiency and mass production were the primary goals, they now often result in organizational inertia. When decision-making authority is bottlenecked at the executive level and plans are locked in years in advance, organizations suffer from delayed responses, stifled creativity, and an inability to pivot quickly. This rigidity leaves them highly vulnerable to unforeseen market shocks and faster, more agile competitors.

In response to these compounding challenges, a new managerial paradigm has emerged: agility. Initially developed within the field of software development to accelerate project delivery, minimize waste, and improve product relevance for end-users, agility has progressively expanded beyond its IT origins to become a fundamental organizational capability across all functional areas. It is no longer just a set of project management tools; it is a holistic corporate philosophy. It is now understood as the ability of organizations to sense environmental changes and respond to them quickly and effectively (Fachrunnisa et al., 2020). This organizational capability requires establishing robust feedback loops, decentralizing decision-making authority to cross-functional teams, and prioritizing iterative progress over perfection. By fostering an environment where strategic pivoting is treated as

a standard operational procedure rather than an emergency measure, agility allows companies to seamlessly realign their resources and strategies as new information emerges. However, achieving organizational agility is closely dependent on leadership. Implementing new structural frameworks and adopting agile methodologies are simply insufficient on their own; an organization cannot truly become agile without leaders (Alsawalha, 2025) who embody and promote agile principles at every level of the corporate culture. Transitioning a workforce toward this dynamic mindset requires a fundamental shift in executive behaviour. Managers must abandon traditional command-and-control micromanagement in favour of servant leadership, empowering their teams, cultivating psychological safety, and actively dismantling bureaucratic hurdles that stifle innovation. This critical realization has led to the emergence of the concept of agile leadership, which represents a proactive and adaptive approach to managing change and uncertainty. Agile leaders act as visionary facilitators rather than traditional taskmasters. They align autonomous teams around a shared, compelling purpose while encouraging a "fail-fast, learn-fast" mentality. Ultimately, agile leadership enables organizations not only to respond to dynamic conditions but also to thrive within them by fostering flexibility, responsiveness, and continuous improvement (Prejean et al., 2019)

Significance of the Study :

Theoretical Significance: While agile leadership is widely discussed in tech companies (Aghina et al., 2021), there is a significant research gap regarding its application in industrial development projects. It specifically investigates how key agile principles can be effectively translated into this setting, including the notion of “unlearning” outdated practices and abandoning rigid managerial routines in favour of more adaptive approaches. Furthermore, it explores the integration of the core “3F” characteristics (Focused, Fast, and Flexible) within traditional manufacturing systems, thereby offering a more nuanced understanding of how agility can coexist with structured industrial operations (McKenzie & Aitken, 2012) .

Practical Significance : This study provides a roadmap for industrial projects managers to foster a culture of empowerment and encourage their teams to work collaboratively towards common goals, helping innovation teams achieve superior performance in the era of distributed work and digital transformation (Damien Crocq, 2026)

Objective of the Study

This research primarily aims to explore the applicability of agile leadership practices in managing industrial development projects, and how these practices contribute to adapting to the complex variables of the industrial environment and ensuring project success.

The main objective gives rise to a set of sub-objectives, as follows:

- Defining the Conceptual Framework : Highlighting the concepts and principles of agile leadership and how they intersect with traditional methodologies (such as the Waterfall methodology) in managing industrial projects.
- Assessing the Current Situation : Determining the extent to which managers and project leaders are aware of agile leadership practices and their application in the industrial development environment.
- Identifying Challenges and Obstacles : Analysing the organizational, cultural, and technical obstacles that project leaders face when attempting to implement the principles of the Agile methodology in the industrial sector (which is typically characterized by rigidity or strict physical constraints compared to the software sector).
- Highlighting the Role of Empowerment : Examining the role of agile leadership in building and empowering self-organizing teams and fostering a culture of collaboration within industrial projects.
- Providing Practical Recommendations : Developing a set of practical recommendations to help industrial companies adopt agile leadership practices that are appropriate to the nature of their project.

Problem Statement

In increasingly complex and dynamic industrial environments, traditional project management and leadership approaches (such as the Waterfall methodology) are facing significant limitations in terms of flexibility and responsiveness to change. As industrial development projects become more uncertain and multifaceted, there is a growing need for more adaptive leadership styles.

In this context, agile leadership emerges as a promising approach that emphasizes flexibility, collaboration, and continuous adaptation. However, its applicability within industrial settings often characterized by rigidity, technical constraints, and structured processes remains insufficiently explored. Thus, the central research question is :

« How are agile leadership practices applied in complex industrial projects at Sonatrach ? »

Sub-questions :

- What is agile leadership, and what are its key principles and characteristics?
- How does agile leadership intersect with traditional methodologies such as the Waterfall approach in industrial project management?
- To what extent are project managers and leaders aware of agile leadership practices?
- How widely are agile leadership practices currently applied in industrial development projects?
- What organizational and cultural challenges hinder the implementation of agile leadership in industrial projects?
- How does agile leadership help build self-organizing teams and improve collaboration and communication in industrial environments?

Methodology:

This study is grounded in an interpretive epistemological stance, in which organisational reality is understood not as an objective given but as an intersubjective construct shaped by the language, meanings, and daily interactions of social actors. This philosophical positioning provides the justification for the qualitative single-case study design adopted, which prioritises depth of understanding over statistical generalisation and attends to the contextual specificity of agile leadership practices within industrial development project environments. The empirical investigation was conducted within Sonatrach's Liquefaction and Separation activity, specifically in the Development Division, a highly structured industrial setting in which multiple investment projects are managed simultaneously under strict technical, safety, and contractual constraints. Data were collected through two complementary instruments: eight individual semi-structured interviews with project managers and

team leaders active within this division, and a complementary observational component designed to address the gap between stated and enacted leadership practices. The interview data were recorded, transcribed, and analysed using NVivo qualitative analysis software, through a combination of thematic node coding, word-frequency queries, and matrix cross-tabulation, ensuring systematic, traceable, and methodologically rigorous processing of the qualitative corpus.

Structure of the Dissertation:

This dissertation is organised into three chapters in addition to this general introduction and a general conclusion.

Chapter 1 establishes the theoretical and conceptual framework of the study. It is divided into two sections. The first section addresses the foundational concepts of project management, covering the definition and typology of projects, the importance of industrial projects, the role of the project manager, and the principal traditional and agile methodologies employed in project management contexts. The second section develops the conceptual framework of agile leadership, tracing the origins of agility, defining its core dimensions, and examining the principal leadership styles relevant to this study with particular attention to the characteristics, principles, and practices of agile leadership and its differentiation from traditional leadership models.

Chapter 2 presents the methodological and organisational framework underpinning the study. It opens with a presentation of the research organisation (Sonatrach, its Liquefaction and Separation activity, and the Development Division in which the empirical investigation was conducted) before detailing the epistemological positioning of the research, the rationale for the qualitative design, and the data collection instruments employed, namely semi-structured interviews and direct observation.

Chapter 3 presents, analyses, and discusses the empirical findings. Drawing on the full body of evidence generated through eight qualitative semi-structured interviews and processed using NVivo qualitative analysis software, it presents the coding structure, conducts node-level and word-frequency analyses, and interprets the results through matrix crosstabulation. It subsequently provides structured answers to each of the study's sub-questions and formulates a synthesised response to the central research question, before concluding with context-specific organisational and leadership development recommendations and an honest acknowledgement of the study's limitations.

CHAPTER 01 :
THEORETICAL FRAMEWORK

INTRODUCTION

The foundation of any rigorous academic inquiry rests upon a clearly constructed theoretical framework, one that not only defines the key concepts under investigation but also situates them within the broader intellectual tradition from which they emerge. This chapter fulfils that foundational function by establishing the conceptual and theoretical architecture that underpins the entire research.

The chapter is organized into two interconnected sections. The first section is dedicated to project management, beginning with a precise definition of the concept of a project and a structured typology of project categories according to their nature, client, and scale. It then examines the specific importance of industrial projects within the context of national economic development, before addressing the principles, actors, and methodologies that govern project management practice both traditional and agile. This section provides the institutional and operational context within which the empirical investigation is subsequently situated.

The second section shifts the analytical focus toward the two central concepts of this research: agility and leadership. It traces the intellectual origins of agility as an organizational philosophy, examines its key dimensions, and charts its progressive expansion from its initial software development context into broader managerial practice. It then explores leadership as a multidimensional concept, reviewing its principal definitions, skills, and styles from classical behavioural frameworks to contemporary adaptive models. The chapter culminates in a detailed examination of agile leadership as a distinct and emergent leadership paradigm, defining its core characteristics, contrasting it with traditional leadership models, and identifying the specific practices through which it manifests in organizational settings.

Together, these three sections construct the theoretical lens through which the empirical findings of this research are subsequently interpreted and discussed.

SECTION 01: Literature review

This This literature review aims to establish the conceptual and empirical foundations of agile leadership, to assess the state of the evidence across different sectors and geographical contexts, and to identify the research gap that the present study is designed to address. It draws on a body of scholarship spanning theoretical frameworks, meta-analyses, and sector-specific empirical investigations in order to situate the present research within the broader intellectual landscape.

1.1 Agile Leadership

Leadership represents a critical determinant of organisational success or failure, as overall performance is strongly influenced by the effectiveness of leadership practices (Suryana & Iskandar, 2022) In today's highly volatile and uncertain business environments, traditional leadership approaches are often inadequate. As a result, organisations increasingly adopt more adaptive and responsive styles, particularly agile leadership, which emphasises speed, flexibility, and responsiveness in decision-making (Wibowo et al., 2023).

Agile leadership is rooted in the principles of the Agile Manifesto, introduced in 2001 by a group of software developers seeking to improve project management efficiency and adaptability (Daraojimba et al., 2024). The concept was later formalised by(Joiner & Josephs, 2007), who, drawing on case studies conducted with managers across US-based organisations, defined agile leadership as the ability to take effective and thoughtful action in complex and rapidly changing environments. Their work is significant not only for this foundational definition but also for framing agile leadership as a developmental capacity (one that can be deliberately cultivated)rather than a fixed personality trait. It is important to note, however, that this framework was developed primarily in technology-adjacent and management consulting contexts, which limits its direct applicability to industrial settings without further adaptation.

Building on these foundations, (Horney et al., 2010), writing from a US-based organisational development perspective, further operationalised the concept through the '3F' model, characterising the agile leader as Focused, Fast, and Flexible. While Joiner and Josephs approach agile leadership from a developmental standpoint, asking how leaders grow their agile capacity over time. (Horney et al., 2010) adopt a more practitioner-oriented register,

translating the concept into immediately actionable behavioural dimensions. These two framings are not contradictory but complementary: one explains the underlying architecture of agile leadership, the other specifies its observable expression. (McKenzie & Aitken, 2012) working within an Australian leadership development context, added a further dimension absent from both prior frameworks: the concept of 'unlearning' (the deliberate letting go of established methods or practices that may no longer be relevant) as a defining competency of agile leaders. This contribution is particularly pertinent to industrial environments, where decades of sequential, compliance-driven practice can create entrenched routines that resist adaptation even when leaders are intellectually open to change.

1.2 Core Characteristics and Practices

At its core, agile leadership seeks to create a culture where team members feel empowered to share ideas, take initiative, and work collaboratively towards common goals (Jerab & Mabrouk, 2023) It is heavily characterised by its focus on fostering an environment conducive to collaboration among cross-functional teams (Porkodi, 2024) .Agile leaders facilitate this environment by actively listening to their teams, providing constructive feedback, and encouraging experimentation while learning from failures (Joiner & Josephs, 2007) . Horney et al. (2010) further explained that agile leadership is defined by the '3Fs': being Focused, Fast, and Flexible. Furthermore, McKenzie and Aitken (2012) elaborated that agile leadership is the ability to face pressure from conflicting demands, which involves negotiating wisely over differences in performance priorities between individuals and the organization, and crucially, engaging in 'unlearning': the process of letting go of past methods or practices that may no longer be relevant or effective in the current context.

The agile approach inherently emphasises continuous improvement and iterative progress (Jareb, 2023). Consequently, agile leaders encourage teams to regularly reflect on their processes and outcomes, fostering a culture of learning and adaptation (Akkaya et al., 2022) This requires an integration of an adaptive leadership model and the right technological infrastructure, which is not merely additive but a fundamental prerequisite for achieving superior performance in innovation teams, especially in the era of distributed work ((Purnomowati et al., 2026; Rialti & Filieri, 2024a)

It is worth highlighting a productive tension within the literature on this point. Most authors present collaborative empowerment and iterative learning as practices that are relatively

straightforward to adopt once a leader is personally committed to them. However, authors working closer to organisational and industrial realities particularly McKenzie and Aitken (2012) and, more recently, Rialti and Filieri (2024) insist that these practices can only be sustained when the broader organisational architecture decision authority structures, information flows, and accountability mechanisms is aligned with agile principles. The implication is that agile leadership is as much an organisational design question as a behavioural one, and that leaders operating within rigid institutional frameworks will necessarily practise agility in a constrained and adapted form. This tension between individual leadership orientation and structural constraint is not resolved in the existing literature and constitutes one of the motivating research questions of this study.

1.3 Cross-Sector Impact and Organisational Outcomes

Studies have consistently shown that agile leadership accelerates organizational responses, enhances interdepartmental collaboration, and fosters continuous learning and innovation (Rigby et al., 2016)This approach is typically defined as prioritizing rapid sensing and response, shortening decision-making cycles, and continuous adaptation. The most comprehensive available quantitative analysis is the meta-analysis by (Porkodi, 2024) which integrated the results of 74 empirical studies from diverse international contexts and sectors. This comprehensive analysis demonstrated positive correlations between agile leadership and four outcome categories: operational effectiveness, organizational resilience, innovation management, and interpersonal trust. The breadth of this evidence is significant, as it underscores that the positive effects of agile leadership are not limited to a specific methodology, sample, or context, but rather are reproducible across highly varied conditions. However, it is important to note that meta-analyses of this type combine results without considering the role of contextual factors in modifying them, a limitation particularly relevant when considering the generalizability of findings from studies focused on software or the service sector to industrial enterprise environments.

Given these broad benefits, the adoption and study of agile leadership has increased across various sectors. In the public sector, studies conducted in Indonesia, specifically at the National Zakat Administration Agency (BAZNAS), using employee and manager survey data, found that agile leadership is essential for increasing employee engagement, institutional accountability, and responsiveness to community needs (Ahmad et al., 2022;

Aishah et al., 2023; Ansari, 2021). In education, qualitative survey results showed that school leaders and teachers in Southeast Asia found that adaptive, collaborative, and flexible agile leadership significantly enhanced teacher and student engagement in project-based learning and the integration of digital technology (Rakhmadi et al., 2025). In the hospitality sector, a descriptive correlational study conducted with hotel managers in Subic Bay, Philippines, proposed a leadership development program aimed at fostering agile practices to effectively adapt to the post-pandemic new normal .In the manufacturing sector, which is most directly relevant to this study, qualitative interviews with managers and employees at LEM Industries, as reported by (Rialti & Filieri, 2024) . concluded that agile leadership is a critical enabler for the success of digital transformation in industrial environments, while identifying cultural resistance and structural rigidity as major barriers to its adoption.

Looking at these four sectors, convergent and divergent patterns emerge. In terms of convergence, all studies regardless of sector, country, or methodology indicate that a collaborative team culture and responsiveness to change are the most prevalent and influential dimensions of agile leadership. Whether in Indonesian public administration, the Philippine hospitality sector, Southeast Asian education, or European manufacturing, leaders who systematically promote empowerment, cross-functional collaboration, and continuous learning are associated with better organizational outcomes. This convergence is particularly strong because it applies to studies with diverse methodologies conducted in different cultural settings. In terms of divergence, studies vary considerably regarding the conditions under which agile leadership can be effectively implemented. Studies in technology, education, and public service tend to present agile leadership as broadly applicable; however, (Rialti & Filieri, 2024), in the context of industrial manufacturing, found that structural and cultural constraints such as rigid hierarchies, approval chains, and entrenched procedural cultures significantly affect the effectiveness of agile practices, and that full adoption of agile leadership was neither possible nor necessarily desirable in that environment. This difference is not trivial: it suggests that the sector of application is a significant factor in the effectiveness of agile leadership, and that the conditions in industrial organizations may require a fundamentally different approach to agile engagement than that described in the technology and service literature.

1.4 Research Gap and Thesis Focus

Although the concept of agile leadership has been widely discussed and its benefits demonstrated across various contexts, significant research gaps remain. According to(Aghina et al., 2021), who conducted a large-scale survey of agile organisations across multiple industries, most studies tend to focus predominantly on tech companies, software development, or service-oriented sectors such as hospitality and education. Industrial development projects, however, present a vastly different operational reality. These projects are characterised by high capital investment, complex hardware dependencies, long procurement lead times, and rigid physical constraints, making iterative changes far more complex than in software development. The sector-specific studies reviewed above from Indonesian public sector to Philippine hospitality were conducted in contexts where project timelines are short, deliverables are relatively flexible, and the cost of iteration is manageable. None of these conditions holds in heavy industrial project management, where a single procurement error, a safety protocol revision, or an unanticipated technical constraint can delay an entire project phase by months and generate costs of significant financial magnitude.

While some recent studies have begun to explore agile leadership in the context of digital transformations within manufacturing most notably Rialti and Filieri (2024) there remains a distinct scarcity of comprehensive research examining how agile leadership practices are adapted, applied, and sustained specifically within the core management of industrial development projects. The manufacturing context studied by Rialti and Filieri focused on digital transformation as a discrete initiative rather than on the ongoing management of capital-intensive, multi-phase development projects with their characteristic safety, procurement, and validation constraints. This distinction matters: digital transformation projects, even in manufacturing, are fundamentally different in their flexibility profile from infrastructure and facilities development projects in an energy sector context. It is this latter, underexplored territory that the present study addresses examining, through qualitative field research at Sonatrach's Liquefaction and Separation Division, how project managers and leaders understand, apply, and adapt agile leadership principles within the specific structural and cultural reality of complex industrial development project management.

SECTION 02: Project management

This section establishes the conceptual foundation of the study by examining the definition, and the project types with particular emphasis on industrial projects and the Algerian industrial context . It further explores the principles, actors, and methodologies (both traditional and agile) that govern their management, providing the operational context within which agile leadership will subsequently be examined.

2.1 The Concept of a Project

2.1.1 Definition

According to the French association AFNOR, a project is a defined work subject structured around qualitative steps that allow reaching a future reality consisting of meeting the needs and desires of customers. (AFNOR.org, 2012).

According to the British Project Management Institute (PMI), a project is a set of interrelated, non-routine activities with defined start and end times, carried out by one person or a group of people to achieve a specific performance and defined objectives within the constraints of cost, time, and quality.

From this, we can conclude that a project is an operational system that allows the transformation of specific types of inputs into defined outputs, using various scientific and practical mechanisms, under the supervision of an integrated work team that strives to respect the constraints framework (time – cost – specifications).

2.1.2 Project Types

We can distinguish project types according to several criteria :

a) Product : product development or unique product (service, construction, events, etc.); (Thierry Gidel & William Zonghero, 2019)

b) Client : internal or external; (Thierry Gidel & William Zonghero, 2019)

c) Size : small, medium, large. (Luhrmann, 2015)

a) Product :

- **New Product Development Projects**

The particularity of these projects is that they include, in addition to the product conception and realization process, the industrialization process of this new product, since it is intended to be manufactured in many copies. Furthermore, the economic objectives are directly linked to the future profitability of the new product.

These particularities lead to specific project management methods. Cost control applies to the total cost of the project, but also to the industrial cost price of the developed product. The project is driven by the profitability of exploitation and the overall profitability of the project.

This type of new product development project is very common in industrial companies. These are internal projects , because it is the organization's own know-how that is being implemented. However, the development of the production tool, which is not necessarily the core business of the industrial company, may be entrusted to an external company. Product development projects are distinguished by the relative importance of industrialization.

- **Development of a Product with Low Production Rates**

The product development part can be very important, but a manufacturing plant will not be entirely dedicated to the product: the production line for the new product will be installed in existing industrial facilities. The new manufacturing process may, for example, replace a previous manufacturing process that is at the end of its life. Industrialization will consist of creating production ranges and improving, modifying, or even acquiring some new production means to adapt the existing production line to the new product.

Examples : aeronautics, railways, shipbuilding.

- **Development of a Product with High Production Rates**

In this case, the production plant takes on great importance, as it strongly influences the quality and cost of the products. The size of the industrialization project may be greater than that of the product development project. The cost of transporting products to final customers can represent a significant part of the cost price. It is common for such production units to be installed near customers, which makes the industrialization project even more complex.

The design of the product and the manufacturing process is often carried out jointly, as one influences the other and vice versa. However, the client often decides to create a separate project to design and build the manufacturing plant; it can, for example, subcontract this project to a specialized engineering firm.

Examples : automotive, electronics, large public works.

- **The Project Product is a Unique Production**

Service Project

The service project has the particularity of not requiring external purchasing processes, because the project's product is a file or a delivered service. The project budget is mainly composed of the internal costs of the project team. External expenses are limited to travel expenses, office supplies, or, in some cases, service subcontracting.

This type of project requires a lightweight organization, as only a few project management disciplines are used; on the other hand, the level of risk is quite low. We can cite some examples of service projects: internal organizational modifications, training, consulting, technical assistance, study subcontracting, feasibility study, pre-project study, and even definition study.

Research Project

Like a service project, a research project consumes few external resources (unless the project's deliverable is a prototype or if the research requires expensive equipment or instruments). This type of project can become complex if there are numerous partners on the client or contractor side and if multidisciplinary skills are required.

IT Project

IT projects are characterized by a large number of internal stakeholders and very rigorous interfaces; they require strong coordination. The key point is the identification of needs and the rigorous drafting of the functions and performance requirements in the specifications. These projects often involve numerous validation loops and sometimes a deployment in several phases, starting with a restricted group of users.

Construction or Industrial Project

This is about creating works, for example in the fields of urban planning or architecture, which are unique by definition. This is what project management is all about. It is where the terms "project owner" (maître d'ouvrage) and "project manager" (maître d'œuvre) come in. These projects can be very expensive, especially when it comes to infrastructure or heavy industry (so-called "capitalistic" investments).

In this case, the project manager is often an external specialized company. The deliverables here are civil engineering works (dams, tunnels, highways, airports, hospitals, etc.) or production facilities for raw materials, equipment, or consumer goods (offshore platforms, chemical units, steel plants, nuclear power stations, etc.). When this type of project is

internal, it usually involves building an extension to a factory or installing a new production line. The project manager may then be the company's maintenance department or its new works department.

Organizing an Event

This involves, for example, organizing an exhibition, a sports event, a show, or a film. These projects include all the characteristics that define a project: feasibility, design, execution, budget, schedule, risks, and often many stakeholders. This type of project can also be large and complex (the Olympic Games or the filming of The Lord of the Rings: three long feature films shot at the same time). In this case, the fixed date for the event must be strictly respected: the project deadline becomes a primary objective.

b) Client :

- **Internal Project**

When the client is internal (company project), the company acts as both the maître d'ouvrage and the maître d'œuvre. If the company does not have a specialized project owner structure, the project client is the general management, one of the directors, or a steering committee. The maître d'œuvre is a project manager appointed based on their skills within the company.

The project team consists of people from the company. Some large companies are organized to carry out major projects internally; they have a project owner structure, a project management structure, and project management processes (e.g., RATP, AIRBUS, RENAULT, PEUGEOT, etc.).

The characteristics of these projects are that the project manager and their management team are appointed very early, often from the feasibility study stage. They are responsible for gathering requirements from stakeholders and users drafting of the specifications. The choice of technical concept and the elements of the specifications, as well as commitments regarding performance and economic objectives, may be delayed compared to external projects (which are, for example, managed according to the contract signing date). The relationship with the maître d'ouvrage is continuous and fluid, and control is lighter because the maître d'œuvre follows the internal procedures that apply to everyone.

- **External Project**

When the client decides to entrust the project to an external maître d'œuvre, the execution of the project is governed by a contract that binds the MOA (Maître d'Ouvrage / Project Owner) and the MOE (Maître d'Œuvre / Project Contractor). The main differences compared

to an internal project lie in the early phases of the project (feasibility and preliminary design), where the relationship between the MOA and the MOE is formalized (contractually), and the MOA's control over project quality is more pronounced. This MOA-MOE relationship depends heavily on the type of contract: quite conflictual with a fixed-price contract and more relaxed with a contract with controlled expenses .

In the case of external projects, the MOA selects the project ideas to consider, then conducts (or subcontracts) the feasibility study to support the decision to commit to the project. It then prepares the specifications and issues a call for tenders to consult a panel of potentially competent contractors. The consulted MOE prepare an offer (the equivalent of the preliminary project) in response to the call for tenders. The MOA analyzes these offers, then proceeds with negotiation The MOE that proposed the best offer to carry out the project. The project owner is remunerated by the client according to the terms of the contract.

c) Size :

projects can be divided into small, medium, and large scale :

- **Small-scale :** projects generally have less scope, fewer resources, lower risks, and better flexibility.
- **Medium-scale :** projects have moderate complexity, various stakeholders, balanced assets, longer time periods.
- **Large-scale projects : involve greater complexity, more resources, and higher risks.**

2.1.3 Importance of industrial projects

Industry represents the pulse of economic development of any nation. The goods and services provided by industry directly influence the social, political, economic, and cultural structures of any population. Thus, successful industrial project management holds a key position in advancing local, regional, and national development. A community that cannot institute and sustain industrial vitality will eventually become politically delinquent and economically retarded. Project management is the process of managing, allocating, and timing resources to achieve a given goal in an efficient and expeditious manner. The intrinsic benefits of this definition are even more pronounced in fast-paced and globally influenced industrial projects.

Industrial development is one primary path to achieving national economic development. So, industry is very vital to the development of any nation. Historical accounts abound on how the industrial revolution had a profound effect on world development. A sustainable industrial development can positively impact the political, economic, cultural, and social balance in a community. In order to achieve and sustain industrial development, both the technical and managerial aspects of industrial projects must come into play. (A. B. Badiru, 1996)

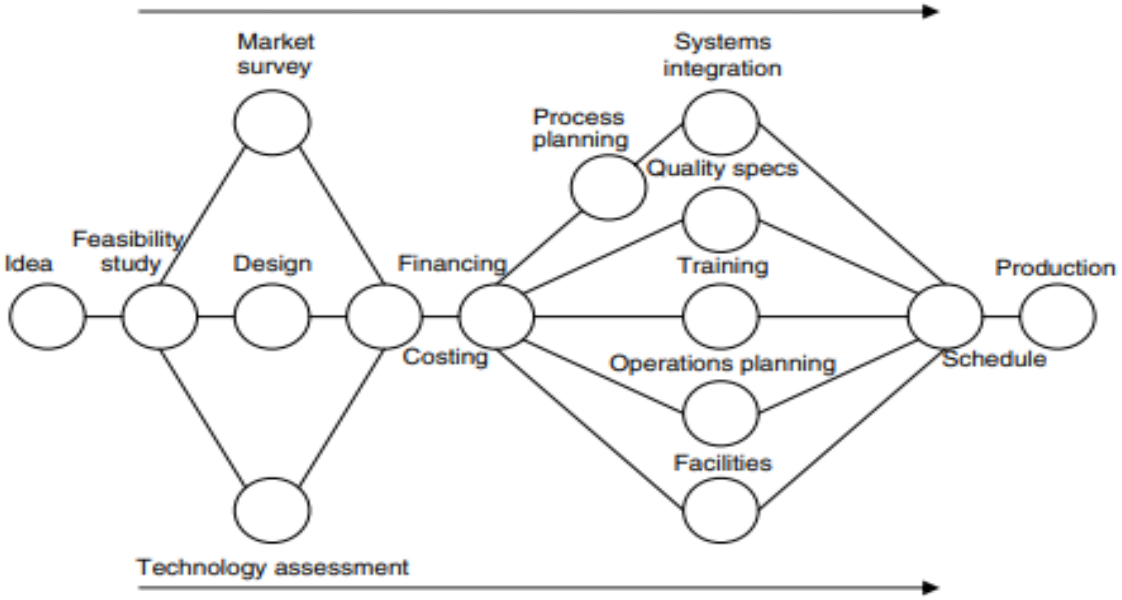
The primary goal of any industry is to plan operations ahead and allocate resources appropriately to improve industrial project efficiency, effectiveness, and productivity while reducing production waste (Lean) and improving product quality (Six Sigma). Using a formal project management approach makes it possible to achieve this goal. For projects to be effectively managed in an industrial system, managers and analysts must understand the industrial operating environment. Any high-tech industrial project is a complex undertaking that crosses diverse areas of endeavors. Both technical and organizational issues must be addressed in order to avoid system-wide project failures. This chapter covers the building blocks essential for the application of project management to industrial operations. The contents of this and the subsequent chapters will enable the project analyst to accomplish the following learning objectives : (A. Badiru et al., 2007)

- Understand the basic steps and components of project management.
- Learn best-practices approach to project planning, organizing, scheduling, and control.
- Use case examples as the basis for understanding “what went wrong” and how develop sustainable project solutions.
- Learn how to develop project scope and develop a project charter.
- Using planning as the roadmap toward project success.
- Create cohesive project teams using the Triple C model of communication, cooperation, and coordination.
- Develop project work breakdown structure.
- Use a mix of qualitative and quantitative techniques to enhance project management.

- Develop compromise or tradeoff strategies for cost, schedule, and performance constraints.

The manufacturing enterprise is a project consisting of distinct production activities. In a large organization, the industrial system may be confi gured as a multiproject endeavor, and the components of the project may be managed as any conventional project. Figure 1 shows the typical components of an industrial enterprise organized as a project network of industrial.

Figure 1 : The typical components of an industrial company organised as a project network



Source: Industrial project management: Concepts, Tools, and Techniques (Badiru et al., 2007)

The industrial network starts with the conceptualization of a product. Some of the distinct tasks required for getting the product from the idea stage to the market include the following :

1. Feasibility Study : A study conducted to ascertain the practicality of the proposed product. The practicality is considered in terms of available technology, cost constraints, production process, labour skills availability, organizational goals, and market structure.

2. Market Survey : An analysis of what the market wants in terms of cost, product functionality, and comparative manufacturer reliability.

3. Cost Estimation : Development of cost figures for the various physical and qualitative components that go into obtaining the final product. These may include machines, inventory

space, training, raw materials, transportation, advertising, design, customer service, labor wages, and so on.

4. Technology Assessment : An assessment of the current technological capabilities. This may involve questions such as: Is the technology proven and stable enough to sustain production operations? Is the technology affordable? What will be the impact of technology changes on production ?

5. Product Design and Development : The development of a full-fl edged design of the product based on the outcomes of the preceding tasks. Adaptability should be incorporated into the design so that future product changes can easily be accomplished as the technology changes.

6. Financing : The process of obtaining funds to complete the manufacturing project. Sources of funds may include top management (internal funding), external sponsors (e.g., government-backed projects), or contract awards (e.g., client-sponsored products). If the preceding tasks of feasibility study, market survey, cost estimation, and technology assessment are done with proper attention to details, the task of obtaining funds will be simplified.

7. Process Planning : The development of a plan for the manufacturing process, taking into consideration machines, tools, layouts, and raw materials. The level of process sophistication depends on the designed product configuration and availability of funds.

8. Quality Specification : The development of product quality specifications based on product functions and process capability. A process capability analysis may be very helpful in this task because a process capability analysis will determine the tolerance that a process can handle if it is statistically in control. The process, in this case, is a unique combination of machines, tools, methods, materials, and labor skills.

9. Personnel Assignment and Training : At this stage, the required personnel are acquired, either through new hires or the transfer of employees, who may be able to bring previous experience to the new product setup. Training is conducted in accordance with process requirements.

10. Operations Planning : The development of operational flow charts, raw material requirements, production rates, maintenance schedules, input/ output flows, operating costs, overhead allocation, job routing forms, capacity plans, shift schedules, operations sequences, labour classifications, space requirements, deadlines, and production standards.

11. Facilities Layout : Setup of the physical structure or the production line. It may involve the relay out of the existing facility, the installation of new equipment, or the construction of new structures.

12. System Integration : Coordinating the new production line to coexist with other lines within the manufacturing system. It may require schedule adjustments to satisfy shared-resource requirements, the development of policies to accommodate product integration, or a realignment of managerial responsibilities.

13. Production Scheduling : The generation of schedules of the various activities in the production process. This covers machine assignments, labour assignments, work releases, material supply, in-process storage, and time standards.

14. Production Run : The actual implementation of the production schedule. Production control functions may be incorporated into this task. Inspection should be included in the task definitions under "production run" or may be treated as a separate function.

15. Product Shipment : This is the final task to complete the project

2.1.4 Strengths of the Algerian Industrial Sector

An analysis of the Algerian industrial sector between 2008 and 2023 reveals several strengths and areas for development in this sector, and the most important conclusions are as follows: (LADJEDEL Khaled, 2024)

- Abundant natural resources: The sector's diversity is driven by the country's wealth of food, chemical, and mineral resources.
- Developed infrastructure: Algeria has 72 industrial zones covering more than 12,000 hectares and 450 business parks. The transportation network is also extensive, including 40 ports, a 4,200 km railway network, and more than 118,000 km of roads, including the East-West Highway and the Trans-Saharan Highway.
- Telecommunications network: The country has an extensive fiber optic network (15,000 km) and significant mobile coverage (45.8 million subscribers in 2017).
- Cost-related competitive advantages: The sector benefits from affordable energy, low-cost labor, and readily available raw materials.

- Financial capacity: The state holds a significant financial surplus thanks to hydrocarbon revenues, which supports economic stability and finances public investments.
- Geographic location: Its location is favorable to the emergence of a regional market and facilitates industrial transport.

2.2 Project Management Concept

2.2.1 Definition

It is a management process focused on a temporary and unique objective, aiming to coordinate the use of limited resources in order to meet the expectations of stakeholders (management, clients, users) within the allocated timeframes and budgets. (Alan S.Gutterman, 2023) ,The goal of project management is efficiency and economy. How to best utilize available material and human resources to deliver a quality product at a controlled cost, while respecting promised deadlines.(Thierry Gidel & William Zonghero, 2019).

Project management process is an "Art and Science (Alan S.Gutterman, 2023)

Project management is now considered both an art and a science, where :

- Science : understanding the technical tools required for planning, budgeting, and controlling resources.
- Art : demonstrating realism, flexibility, and innovation in dealing with unexpected events and inevitable changes within the project scope.

2.2.2 Project management principles

The 12 fundamental principles of project management, as defined in the seventh edition of the PMBOK Guide, are guidelines intended to direct the behaviors and actions of professionals in the field. They are not prescriptive, but rather serve as a foundation for strategy, decision-making, and problem-solving.

1. Be a diligent, respectful, and caring steward (Stewardship) : Managers act responsibly, with integrity and trustworthiness, while complying with internal and external guidelines. They are committed to the project’s financial, social, and environmental impacts.

2. Create a collaborative project team environment (Team) : Teams consist of individuals with diverse skills who, by working collaboratively, achieve common goals more effectively than by working individually.

3. Effectively engage stakeholders (Stakeholders) : This involves proactively engaging stakeholders to the appropriate extent in order to contribute to project success and customer satisfaction.

4. Focus on value (Value) : Value is the ultimate indicator of project success. Teams must continuously evaluate and adjust the project's alignment with business objectives and expected benefits.

5. Recognize, evaluate, and respond to system interactions (Systems Thinking) : A project is viewed as a system of interdependent domains. Systems thinking involves understanding how the project's components interact with one another and with external systems.

6. Demonstrate leadership behaviours (Leadership) : Leadership is not limited to a specific role; any team member can demonstrate it. Effective leadership motivates, influences, and guides individuals toward desired outcomes.

7. Tailor based on context (Tailoring) : Every project is unique. Success depends on adapting the management approach, governance, and processes according to the project's specific context, objectives, and environment.

8. Build quality into processes and deliverables (Quality) : Quality means meeting stakeholder expectations and satisfying project and product requirements. The focus is on fitness for use and compliance with acceptance criteria.

9. Navigate complexity (Complexity) : Complexity arises from human behavior, system interactions, uncertainty, and ambiguity. Teams must remain vigilant and use various methods to reduce the impact of complexity.

10. Optimize risk responses (Risk) : Risks can be negative (threats) or positive (opportunities). Teams continuously assess risk exposure to maximize positive impacts and minimize negative ones.

11. Embrace adaptability and resilience (Adaptability and Resiliency) : Adaptability is the ability to respond to changing conditions, while resilience is the ability to absorb impacts and recover quickly from failure. These attributes help projects overcome obstacles.

12. Enable change to achieve the envisioned future state (Change) : Projects are agents of change. This principle involves preparing affected people to adopt new behaviours and processes in order to move from the current state to the desired future state.

2.2.3 Project Actors : (Stakeholders)

Stakeholders can be individuals, groups, or organizations that may affect, be affected by,or perceive themselves to be affected by a decision, activity, or outcome of a portfolio, program, orproject. Stakeholders also directly or indirectly influence a project, its performance, or outcome ineither a positive or negative way.

The main stakeholders of the project are :

- **The contracting service**

"The contracting service is the legal entity of public or private law having legal capacity to enter into public contracts, particularly works contracts, under the conditions set by public procurement regulations. The contracting service can be a coordinating contracting service, within the framework of coordinated public procurement, a contracting authority (project owner), or a delegated contracting authority, within the framework of a delegated project management agreement within the meaning of the laws and regulations in force." (Executive Decree No. 21-219, 2021, p. 7).

- **The contracting authority / Project owner**

"The contracting authority is understood to be the State, as a legal entity of public law, initiating a project or program, with a view to its study and/or its realization, clearly defined and whose objectives, means, and expected results are initially established." (Executive Decree No. 21-219, 2021, p. 7)

- **The delegated contracting authority**

"The delegated contracting authority is understood to be the public establishment or body for the benefit of which a project or program, within the meaning of the regulations in force, is delegated by the contracting authority, by means of a delegated project management agreement.

Under these conditions, the delegated contracting authority is responsible for the execution and/or realization of all or part of the aforementioned project or program, in the name and on behalf of the contracting authority.

The nature of the works to be carried out within the framework of the delegated project or program must fall within the field of activity or the sphere of competence of the delegated contracting authority." (Executive Decree No. 21-219, 2021, p. 7).

- **The co-contracting partner**

"The co-contracting partner is understood to mean any economic operator, under Algerian or foreign law, which may be one or more natural and/or legal person(s), public and/or private.

This economic operator commits to the public works contract either individually, jointly, or jointly and severally within the framework of a temporary grouping of enterprises or, where applicable, within the framework of a duly established statutory legal relationship, within the meaning of the regulations in force.

Within the framework of these general administrative clauses for works contracts, 'the co-contracting partner' is designated as 'the contractor'." (Executive Decree No. 21-219, 2021, p. 7).

- **The prime contractor / Project manager**

"The prime contractor is a natural or legal person, public or private, under Algerian or foreign law, who meets the conditions of professional qualifications, technical skills, and resources necessary for the execution of project management operations, on behalf of the contracting service, by committing to the latter on the basis of a target cost, deadlines, and quality standards.

The prime contractor may notably be an architect or a specialized or multidisciplinary design office approved in accordance with the legislation and regulations in force.

The prime contractor may commit either individually or jointly and severally within the framework of a temporary grouping or, where applicable, within the framework of a duly established statutory legal relationship, within the meaning of the legislation and regulations in force." (Executive Decree No. 21-219, 2021, p. 8).

- **The technical controller**

"The technical controller is an authorized body, meeting the conditions of professional qualifications for the exercise of technical control missions for building construction, in the public works sector or specific to the hydraulics sector subject to an obligation of means, it is mainly responsible for the design and construction conformity control of structures and parts of structures with regard to applicable rules and standards and the respect of plans, modified or completed, approved by it.

The intervention of the construction technical control ensures the stability and durability of the structures, parts of structures, and works services, with a view to reducing the risks of

disorders and contributing to the prevention of various technical hazards likely to be encountered during execution." (Executive Decree No. 21-219, 2021, p. 8).

- **The assistant to the contracting authority or delegated contracting authority**

"The assistant to the contracting authority or the delegated contracting authority is a natural or legal person, public or private, under Algerian or foreign law, possessing know-how and/or advanced technical expertise not available internally and combining proven multiple skills, in administrative, technical, and financial terms, in relation to the trades, techniques, as well as the mastery of organization, scheduling, coordination, and steering of projects.

Assistance to the contracting authority or the delegated contracting authority, distinct from delegated project management, is incompatible with any mission of project management, execution of works, or technical control relating to the same project or program. It intervenes on the occasion of the realization of a complex project or program or one of particular importance." (Executive Decree No. 21-219, 2021, p. 8).

- **The subcontractor (Le sous-traitant)**

"The subcontractor is an economic operator, under Algerian or foreign law, which may be one or more natural and/or legal person(s), public and/or private.

This qualified economic operator, in terms of capacities and/or technical expertise, is engaged indirectly for part of the public works contract through a subcontracting legal relationship, governed by a subcontracting agreement concluded with the contractor holding the public works contract under the conditions provided for by the regulations in force and these general administrative clauses.

In all circumstances, the contractor, engaged in a subcontracting legal relationship, remains solely responsible vis-à-vis the contracting service for the works executed by its subcontractor." (Executive Decree No. 21-219, 2021, p. 8).

2.2.4 The project manager

Definition :

The person responsible for a project in a company is usually the project manager. He or she is responsible for completing the project on time and within budget, and is also responsible for the decisions taken in relation to the project. (Ćwiąkała et al., 2023)

PM & leadership

One of the most important personal skills a successful project manager must possess is leadership, which allows them to inspire individuals and teams and guide them toward a common goal: the success of the project.(Jones, 2018)

Among the most important of these leadership skills are those mentioned by Zakaria, namely: communication skills, problem-solving and decision-making skills, team-building skills, conflict resolution skills, planning and goal-setting skills, a sense of responsibility, and time management skills.(bt Zakaria et al., 2015)

2.2.5 Project management methods

a) Traditional Methods

Traditional project management methodologies (often called "predictive" or "sequential" frameworks) rely on thorough upfront planning, a fixed scope, and a linear progression. You finish step A before you even think about starting step B. These are perfect for projects where the requirements are set in stone and surprises are unwelcome .

- **The Waterfall method**

The Waterfall methodology is a project management approach that emphasizes a linear progression from the beginning to the end of a project. This methodology, often used by engineers, is front-loaded to rely on careful planning, detailed documentation, and consecutive execution.

The Waterfall methodology “also known as the Waterfall model” is a sequential development process that flows like a waterfall through all phases of a project (for example, analysis, design, development, and testing), with each phase completely wrapping up before the next phase begins.

It is said that the Waterfall methodology follows the adage to “measure twice, cut once.” The success of the Waterfall method depends on the amount and quality of the work done on the front end, documenting everything in advance, including the user interface, user stories, and all the features’ variations and outcomes.

- **PRINCE2 method**

PRINCE2 (PRojects IN Controlled Environments) is one of the most structured and widely used project management methodologies in the world. Originally developed by the UK government, it is now maintained by AXELOS (PeopleCert).

What makes PRINCE2 unique is that it doesn't tell you how to do the technical work (coding, building, etc.), but rather how to organize, manage, and control the project as a whole to prevent it from going off track.

- **Critical Path Method (CPM)**

Critical Path Method (CPM) was developed in the 1950 by US Navy. It is an important method being used for coordination of various activities involved in a project. It has been used in a number of fields e.g. agriculture, aerospace, building construction, manufacturing industries, hospitals and medical science industries etc. It is deterministic model of coordination tools. Critical Path Method is used for projects of repeated nature e.g. building construction, manufacturing.

Application of Critical Path Method needs to construct a model of the project that includes the following :

- A list of all activities required to complete the project (also known as Work Breakdown Structure)
- The time (duration) that each activity will take for completion
- The dependencies between the activities.

Critical path method determines longest path including all critical activities only for completion of

the project. Critical activity is the activity, delaying which results in delay in completion of entire. (Bishnoi, 2018)

- **PERT method (Program Evaluation and Review Technique)**

The PERT method is a project management method aimed at forecasting a project’s characteristics in terms of time, deadlines, and costs.

PERT is used to estimate project duration when there is a high degree of uncertainty about individual component times, using three time estimates (optimistic, pessimistic, and most likely).

Its principle consists of breaking down a project into a set of actions called tasks and representing them graphically according to a dependency graph.

Thanks to the chronology and interdependence of each task, the entire project is structured, making it possible to plan the execution of each task in relation to the others, in order to

minimize delays and reduce the impact of setbacks during the execution of the different tasks. (Wiest & Levy, 2016)

b) Agile Methods

Agile methodologies are "adaptive." Instead of planning everything out for the next two years, Agile breaks projects down into small, digestible chunks called iterations. It embraces change, prioritizes customer feedback, and assumes that the project's destination might shift as you learn more along the way.

- **Scrum method**

Scrum method is The most popular Agile framework, it is simply an agile, lightweight process for managing and controlling software and product development in rapidly changing environments.

Agile project management using the Scrum methodology allows project teams to manage projects more effectively by decreasing the amount of overhead dedicated to managing the project. Using an iterative process of continuous review and short-design time frames, the project team is better able to quickly adapt projects to rapidly evolving environments in which systems will be used.

The Scrum model is built on three core components: roles, processes, and artifacts. Work is organized into short, structured iterations called Sprints, which rely on daily stand-up meetings to ensure team alignment.

This framework is driven by key roles : (Cervone, 2011)

- The Scrum Master: Acting as a traditional project manager, this individual is primarily responsible for upholding Scrum values and removing project obstacles.
- The Product Owner: Collaborates directly with the Scrum Master to guide the Sprints.
- The Scrum Team: A dedicated, cross-functional group of five to ten full-time members. The team is self-organizing, meaning leadership dynamically adapts to the specific needs of each Sprint rather than remaining fixed. Furthermore, team membership remains strictly unchanged during an active cycle.

- **Kanban method**

Kanban was developed by Toyota and introduced in 1962 to ensure the flow of material to their car assembly plants with minimum use of resource.

Kanban Methodology has been recently used in many manufacturing systems, assembly systems and supply chain systems in very effective way. It's a work scheduling system that maximizes the productivity of a team by reducing idle time. Idle time can occur within any process, workflow or procedure & can usually be traced back to opportunities within the process itself. The Kanban system focuses on the reduction of waste in all informs over-production, unnecessary motion, defects, overprocessing & waiting. Principles of Kanban System :

- Visualize work.
- Limit work in process.
- Focus on flow.
- Continuous Improvement.

- **Lean project management method**

The Lean methodology originated from the Toyota Production System (TPS) in the manufacturing sector during the mid-20th century and was later adapted into a framework for project management and software development. Its core philosophy is to maximize customer value while minimizing waste.

Unlike frameworks that focus on precise schedule management (such as Critical Path Methodology, CPM), the Lean methodology focuses on workflow optimization and system development as a whole. (Womack & Jones, 1997)

Lean project management emerges as an approach to solve some problems of traditional project management processes: permanent environmental changes, lack of project management knowledge, lack of time management, lots of multitasking, projects delays and over budget, minimizepaperwork and bureaucracy, among others (Pitagorsky, 2006)

Lean principles

- Identify Value : Value is strictly defined from the perspective of the end customer. Any activity that does not directly contribute to this value is considered waste.

- Map the Value Stream : This involves analysing every step of the process (from raw material/concept to final delivery) to identify bottlenecks and non-value-adding activities.
- Create Flow : Once waste is removed, the remaining steps must flow smoothly without interruptions, delays, or bottlenecks.
- Establish Pull : Instead of pushing work through the system based on a schedule, work is "pulled" only when there is downstream demand (this is the foundational concept behind Kanban boards).
- Continuous Improvement (Kaizen) : A cultural commitment to constantly analyzing processes and making incremental improvements.

- **XP (Extreme Programming) method**

Kent Beck developed the Extreme Programming (XP) methodology in the late 1990s. XP is a highly disciplined and directed agile methodology specifically designed for software development. While frameworks like Scrum focus on management and organization, XP places a strong emphasis on technical engineering practices to ensure the highest possible product quality and rapid response to evolving customer requirements.

The core idea is to apply best practices in software engineering at the highest level. For example, if code review is good, it should be reviewed continuously (binary programming). If testing is good, tests should be written before code (test-driven development). (Beck, 1999)

SECTION 03: Agile leadership

This section develops the theoretical core of the research by examining the concepts of agility and leadership separately before bringing them together under the emerging paradigm of agile leadership. It defines its key characteristics, contrasts it with traditional leadership models, and identifies the specific practices through which it manifests in organizational settings.

3.1 Agility

3.1.1 Background of agility

The concept of agility originated in aerial combat and refers to the ability to change manoeuvres quickly and in a timely manner. In management science, it is considered a mindset that enables an individual to adapt to an unstable or turbulent socio-economic environment.

3.1.2 Definition of agility :

Agile : Used for describing ways of planning and doing work in which it is understood that making changes as they are needed is an important part of the job. (Cambridge University Press)

3.1.3 The concept of agility

Agile is not just a set of rules or a specific methodologyit's a mindset and a philosophy that reshapes how you think and work. It shifts your approach to tasks, collaboration, and problem-solving, emphasizing flexibility over rigid processes. Rather than being a framework you simply implement, Agile is rooted in culture: transparency, teamwork, autonomy, and regularly delivering value that makes a real impact. (Sochova, 2020)

Today, there are several different approaches to implementing agile methods but underlying all of the various agile movements are some basic concepts that turn traditional methodologies on their head. The “Manifesto for Agile Software Development” stated four core principles :

- Individuals and interactions over processes and tools.

- Working software over comprehensive documentation.

- Customer collaboration over contract negotiation.

- Responding to change over following a plan.

3.1.4 Dimensions of agility

Rather than having a single definition, agility manifests itself through four interconnected dimensions, all strongly linked to co-creation processes :

- Individual agility : This is an individual's ability to learn and make decisions.
- Team agility : This represents the collective strength of a work team to overcome daily challenges by co-creating its own meta-rules.

- Agility in project management : This is a modern, iterative, and incremental approach that aims to closely meet the expectations of users and clients by rapidly delivering project components built through discussions with them.
- Organizational agility : This is an organization's ability to respond flexibly, proactively, and differently to fluctuations in its environment in order to offer high-quality products and services tailored to its customers. (Valerie Lehmann, 2021)

3.2 Leadership

3.2.1 Definition

Leadership is generally defined as the process by which one or more individuals influence and guide the behavior of others toward achieving specific social and shared goals, thereby contributing to the fulfillment of collective and individual needs. In this sense, leadership can be defined as influencing a group of individuals to achieve a common objective (Squires, 2018). The concept of leadership is not limited to influence alone; it also encompasses the ability to motivate team members, foster their commitment, simplify complexities, communicate a clear vision, and empower individuals to work collaboratively to achieve desired outcomes. These capabilities have gained increasing importance in response to the evolving demands of the professional environment (emlyon business school, 2025). Consequently, I draw on this consensus from numerous publications that affirm effective leadership as a crucial success factor for organizations, as adopting an appropriate leadership style can significantly improve organizational and project performance (Laohavichien et al., 2009; Podsakoff et al., 1990; Turner & Müller, 2005).

3.2.2 Leadership Skills :

Personal and Interpersonal Skills

These skills refer to the traits and abilities necessary for building an individual's character, such as physical attributes, the individual's ability to acquire skills related to nature, strength, endurance, and mental capabilities, whether through their application at work or in public life, or through acquiring new skills.

Technical Skills

These are personal knowledge in a branch of scientific awareness and its development in how to handle matters with sufficient ease to achieve goals, ensuring the exploration of social and technological functions to reach desired objectives.

Behavioural or Interpersonal Skills

These skills help a leader deal with people in general, and in particular, appropriately, and to harness their efforts, recognizing the importance of this type of skill in the success or failure of leaders in managing modern institutions.

Political and Administrative Skills

Political skills refer to a leader's ability to understand the organization they lead, their skill in justifying public issues, goals, and policies, as well as the necessary link between the goals and policies of their organization on the one hand, and the goals of the general system on the other, or reconciling different needs and levels on the other.

Managerial Skills

Managerial skills refer to the ability of leaders to work effectively and align the organization's goals with its needs and adapt to changing circumstances. This is demonstrated through the ability to plan effectively and organize the independent organization optimally.

3.2.3 Leadership styles

a) The Classic Behavioural Framework (Kurt Lewin)

In 1939, a group of researchers led by psychologist Kurt Lewin set out to identify different styles of leadership (Cherry, 2006):

Autocratic leadership:
also known as authoritarian leadership, is a leadership style characterized by individual control over all decisions and little input from group members. Autocratic leaders typically make choices based on their own ideas and judgments and rarely accept advice from followers. Autocratic leadership involves absolute, authoritarian control over a group.

Characteristics of Autocratic Leadership

Some of the primary characteristics of autocratic leadership include:

- Little or no input from team members
- Leaders make the decisions
- Group leaders dictate all the work methods and processes
- Group members are rarely trusted with decisions or important tasks

Democratic leadership :

Also known as participative leadership, is a type of leadership style in which members of the group take a more participative role in the decision-making process. Researchers have found that this learning style is usually one of the most effective and lead to higher productivity, better contributions from group members, and increased group morale.

Characteristics of Democratic Leadership

Some of the primary characteristics of democratic leadership include:

- Group members are encouraged to share ideas and options, even though the leader retains the final say over decisions.
- Members of the group feel more engaged in the process.
- Creativity is encouraged and rewarded

Delegative leadership

Also known as « Laissez-faire leadership », is a type of leadership style in which leaders are hands-off and allow group members to make the decisions. Researchers have found that this is generally the leadership style that leads to the lowest productivity among group members. Laissez-faire leadership is characterized by:

- Very little guidance from leaders
- Complete freedoms for followers to make decisions
- Leaders provide the tools and resources needed
- Group members are excepted to solve problems on their own

Laissez-faire leadership can be effective in situations where group members are highly skilled, motivated and capable of working on their own. While the conventional term for this style is 'laissez-faire' and implies a completely hands-off approach, many leaders still remain open and available to group members for consultation and feedback.

b) The Motivational Framework

This model looks at the psychological contract between the leader and the employee, contrasting maintaining the status quo versus driving evolution. (Avolio et al., 1999)

Transactional Leadership : Operates on a strict system of rewards and penalties. The leader sets rigid, measurable goals and evaluates performance solely on meeting those metrics. It focuses on supervision, organization, and performance within existing boundaries.

Transformational Leadership : Focuses on inspiring the team to transcend their immediate self-interests for the good of the organization. These leaders act as charismatic role models, stimulate intellectual curiosity, and provide individualized consideration. They are heavily relied upon when managing complex organizational change.

c) The Adaptive & Modern Styles

Situational Leadership

Situational leadership is based on the premise that there is no single ideal leadership style suitable for all situations, stages, and human factors. Rather, effective leadership depends on the leader's ability to adapt their style to the specific needs of their team members at different management stages. (Hersey & Blanchard, 1982)

In this model, leadership is understood in terms of two key behavioural dimensions :

- Task behaviour: The extent to which the leader provides guidance, structure, and specific instructions.
- Relationship behaviour: The extent to which the leader engages in supportive,two-way communication, and builds rapport with team members.

Afterwards, effective leadership tries to find the right mix of these two behaviours based on the follower’s development level and the nature of the task in hand (Blanchard & Donahue, 2007)

Servant Leadership

The core philosophy behind agile frameworks is reversed; the leader is there to serve the team. Their primary function is not to direct the work, but to remove operational obstacles, facilitate communication, provide psychological security, and offer them the full and necessary support to facilitate their tasks and clarify their path, thus enabling self-management and self-regulation. (Greenleaf, 1970)

Agile Leadership

Agile Leadership is a synthesis of Servant Leadership philosophy and empirical process control. It is specifically designed to manage complex knowledge work and rapid adaptation, rather than just optimizing repeatable processes.

This approach shifts the leader's role from managing people to managing the work environment and workflow. While relying heavily on the empathy and support that servant leadership provides to maintain team well-being, it adds precise mechanical boundaries (such as the timeframes defined in the SAFe framework and the work-in-progress limits in the Kanban system) to ensure consistency and consistent, timely delivery.

And we will further elaborate on this leadership style in the following headings…

3.3 Agile leadership

As the world becomes steadily more dynamic and complex, organizations have to change to stay competitive. They must become more flexible, team-oriented, and self-organized. And as a consequence, leaders need to adopt another approach to motivate people and lead the organizations to keep up the speed. We speak about knowledge management, creativity, the need for innovations and in the past few years about agile leadership which help leaders to understand the nature of the change that is happening in business right now and prepare them to react effectively to the challenges modern organizations have brought on in all their complexity. The less predictable the business is, the more organizations are failing with traditional leadership approaches, which optimize for repetitive tasks and consistency.

3.3.1 Definition

Agile leadership refers to a manager's ability to guide their teams in an uncertain environment, prioritizing adaptability over rigidity. Unlike traditional directive management, it relies on short decision-making cycles, continuous feedback, and active delegation of authority.

This model originates from the Agile Manifesto, published in 2001 by seventeen software developers. Initially conceived for software development, it has gradually spread to marketing, human resources, and general management. Today, the concept extends far beyond IT to become a true driver of organizational transformation.

An agile leader does not position themselves at the top of a hierarchical pyramid. Rather, they act as a facilitator who creates the conditions for collective performance. This approach,

sometimes called servant leadership, consists of serving the team rather than leading it in the traditional sense.(Damien Crocq, 2026)

3.3.2 Key Characteristics of Agile Leadership

- **Servant Leadership and Empowerment**

Unlike traditional managers who assign tasks and monitor compliance, agile leaders act as facilitators. Their primary function is to remove impediments (blockers) and provide the necessary resources for the team to self-organize and execute.

Bregenzer & Jimenez highlight that agile leaders must move away from an instructing control authority to optimally supporting employees. This shift directly correlates with reduced workplace stress and improved psychological resources for the team. (Bregenzer & Jimenez, 2021)

- **High Adaptability in VUCA Environments**

In volatile, uncertain, complex, and ambiguous environments, the true characteristics of a resilient leader emerge. Such a leader possesses the necessary flexibility to adapt to new challenges and data, transforming obstacles and problems into future opportunities for growth. They implement innovative strategies that allow for a rebalancing of the situation.

Agile leaders are also characterized as adaptable, visionary, and proactive. They embrace the unknown, rely on the technical expertise of their team members, and feel comfortable working even when the optimal path is unclear. They make timely, corrective, and purposeful decisions that align with external changes, adjusting the course and achieving both immediate and long-term goals.(Neubauer et al., 2017)

- **Enhancing Learning Ability and Increasing Psychological Stability in the Workplace**

One of the most prominent characteristics of agile leaders is their pursuit of creating a "safe learning environment." By prioritizing continuous feedback and learning rather than blame, these leaders foster a culture that protects the mental well-being of their team, ensures their active participation, and increases their learning ability.

Consequently, they enable the creation of environments that support and encourage innovation. (Sherehiy & Karwowski, 2014)

- **Visionary Alignment (Focusing on the "What," not the "How")**

Despite delegating decision-making, leaders define and disseminate a guiding vision, helping employees make quick decisions and keeping them focused and inspired toward the desired goal (Parker et al., 2015).

This is emphasized by researchers Joyner and Josephus, who stated that a clear and shared vision is the link that unites agile, highly autonomous teams toward a common organizational goal without the need for detailed management.(B. Joiner & Josephs, 2007)

3.3.3 Agile leadership vs traditional leadership models

- **Traditional Leadership Models**

Command-and-Control Leadership

The oldest and most deeply rooted model of leadership in industrial organizations is the command-and-control approach, which finds its intellectual origins in ***Frederick Winslow Taylor's Scientific Management*** (1911) and ***Henri Fayol's Administrative Theory*** (1916). In this model, the leader is positioned at the top of a strict hierarchy. Decision-making is centralized, authority flows downward, and workers are expected to execute predefined tasks with precision and compliance. The underlying assumption is that leaders know best, and that organizational efficiency is achieved through standardization, specialization, and close supervision.

This model dominated industrial organizations throughout the 20th century and remains prevalent in many manufacturing, construction, and engineering environments today. While it offers clarity of roles and accountability, it suffers from critical weaknesses in volatile environments: slow decision-making, poor adaptability, low employee engagement, and suppression of innovation.

Transactional Leadership

Formalized by James MacGregor Burns (1978) and further developed by Bernard Bass (1985), transactional leadership is built on a system of exchange between leader and follower**.** The leader sets clear goals and expectations, and followers are rewarded for meeting them or penalized for failing to do so.

Key characteristics include :

- Management by exception (intervening only when standards are not met)
- Contingent reward systems (bonuses, promotions tied to performance)
- Short-term performance focus

- Compliance-driven motivation

Transactional leadership is effective in stable, routine environments where tasks are well-defined and outcomes are predictable. However, it does little to inspire creativity, long-term commitment, or adaptive thinking, qualities increasingly demanded in modern project environments.

Transformational Leadership

Also introduced by Burns (1978) and expanded by Bass & Avolio (1994), transformational leadership represents a significant evolution beyond the transactional model. Transformational leaders inspire followers through a compelling vision, intellectual stimulation, individualized consideration, and idealized influence (charisma).

Key characteristics include :

- Inspiring a shared vision and sense of purpose
- Encouraging innovation and creative problem-solving
- Developing followers' strengths and potential
- Building emotional commitment rather than mere compliance

Transformational leadership is widely regarded as more effective than transactional leadership in complex environments. However, critics argue that it remains leader-centric the vision, direction, and inspiration still emanate primarily from the individual leader, rather than from the collective intelligence of the team. In this sense, it falls short of the fully distributed, collaborative model that agile environments demand.

Agile Leadership Models

Agile leadership, as conceptualized by scholars such as (W. B. Joiner & Josephs, 2006), (Hayward, 2018), and (Denning, 2018), represents a fundamentally different philosophy of leadership, one that is less about the person at the top and more about creating the conditions for teams to thrive**.**

Rather than directing and controlling, the agile leader enables, coaches, and removes obstacles. Rather than holding decision-making authority centrally, agile leadership distributes it to the people closest to the work**.** Rather than following a fixed plan, agile leaders embrace uncertainty and treat change as a source of value rather than a threat**.**

3.3.4 Agile Leadership practices

The core practices of agile leadership include :

Flexibility and Adaptability

Agile leadership's first principles and practices are flexibility and adaptability, particularly in today's rapidly evolving business landscape (Holbeche, 2023). Agile leaders recognise that adhering to rigid structures and inflexible plans can significantly hinder progress, especially in environments characterised by constant change and uncertainty (Bwalya, 2023). Instead of clinging to outdated methodologies, these leaders foster a culture that not only accepts change but actively encourages it (Musaigwa, 2023).

They inspire their teams to remain open-minded and responsive, urging them to pivot and adjust their strategies based on new insights, feedback, and emerging trends.

Leaders who prioritise agility empower their teams to experiment, learn from failures, and iterate on their approaches (Porkodi, 2024) . This not only enhances creativity and problem-solving capabilities but also positions the organisation to seize new opportunities.

In essence, embracing flexibility and adaptability is a strategic move for success in an increasingly complex and unpredictable world .

Decentralised Decision Making

Agile leadership fundamentally challenges traditional top-down management structures by distributing decision-making authority across the organisation rather than concentrating it at the top (Kahl et al., 2022). In conventional models, decisions are reserved for upper management, which often results in bureaucratic delays that hinder creativity and slow the organisation's ability to respond to change. Agile leadership, by contrast, empowers teams to make their own decisions, enabling them to address challenges and seize opportunities in real time.

A direct manifestation of this empowerment is the promotion of self-organizing teams-groups of individuals who collaborate and coordinate their efforts without the need for constant management oversight (Kohnová & Salajová, 2021). By entrusting these teams with the autonomy needed to operate independently, agile leaders cultivate a keen sense of ownership and accountability among members.

Consequently, this shift in dynamics directly accelerates the speed and efficiency of the decision-making process (Malik et al., 2021) . when team members possess the immediate authority to act, they can respond swiftly to both market fluctuations and internal challenges.

In addition to accelerated decision-making, agile leadership also promotes collaboration and communication across different levels of the organisation. By breaking down silos and encouraging cross functional teamwork, agile leaders create an ecosystem where diverse perspectives are valued and integrated into the decision-making process (Al Shibly et al., 2025).

Customer-centricity

Agile leadership represents a transformative approach to managing teams and projects, fundamentally shifting the emphasis towards prioritising customer needs, and integrating direct feedback into every stage of the development process (Porkodi, 2024).

Agile leaders encourage their teams to adopt a continuous improvement mindset, enabling them to refine and enhance their products and services based on immediate feedback, this process not only allows for rapid adjustments but also fosters a deeper understanding of what customers truly value . By prioritizing real-world feedback, agile leadership develops effective, tailored solutions that address genuine customer needs (Prasongko & Adianto, 2019).

To effectively gather this feedback, agile leaders also promote open communication channels within their teams and with their customers to ensure complete alignment and a clear understanding of goals and objectives (Porkodi, 2024). Examples include regular follow-up sessions, feedback sessions, and collaborative planning meetings.

Crucially, to sustain this culture of continuous adaptation, agile leadership encourages a shift in thinking from viewing failure as a setback to seeing it as a valuable learning opportunity . In this way, past mistakes are analyzed, important lessons are learned, and teams are encouraged to adapt quickly, thus increasing customer satisfaction, as teams constantly seek new ways to solve problems and deliver exceptional value to customers (Almeida & Simões, 2021).

Continuous Learning and Improvement

Agile leadership places a strong emphasis on fostering a culture that prioritises continuous improvement, recognising that this is vital for both individual and organisational growth (Akkaya & Sever, 2022). Central to this culture is the perspective cultivated in an agile environment, where teams view every experience “whether a success or a failure” as a valuable opportunity for learning (Radu, 2023). By embracing this approach, the mindset shifts from merely achieving results to deeply understanding the underlying processes that

lead to those results, thereby creating a more resilient and adaptable workforce equipped to navigate ongoing challenges (Oyewusi, 2023)

Collaboration and Empowerment

Agile leadership centres on collaboration which is essential for a dynamic organisational culture (Porkodi, 2024). By prioritising teamwork, agile leaders break down silos that hinder communication and progress, fostering cross functional collaboration .

Additionally, this collaborative approach empowers team members, increasing their engagement and commitment to success (Fischer & Charef, 2021). This empowerment also enhances organisational resilience, enabling teams to adapt to changes and challenges effectively .

Chapter 1 conclusion

This chapter has constructed the conceptual and theoretical architecture necessary to situate the central research question of this study within its appropriate intellectual context. Through a structured and progressive examination of two interconnected domains (project management and agile leadership) it has established the analytical foundations upon which the empirical investigation is built.

The first section demonstrated that industrial development projects constitute a distinct and demanding category of project, characterized by their scale, technical complexity, multi-actor governance structures, and strict operational constraints. The typologies, principles, and methodologies reviewed, from the sequential logic of the Waterfall model and the structured control of PRINCE2, to the adaptive iterations of Scrum and the waste-reduction philosophy of Lean, reveal that project management is not a monolithic discipline but a field in active theoretical and practical evolution. This evolution is driven, in large part, by the growing inadequacy of purely predictive frameworks in environments defined by uncertainty, interdependence, and rapid change.

The second section traced this same evolutionary trajectory within the domain of leadership. Beginning with classical behavioral frameworks and progressing through transactional, transformational, situational, and servant leadership models, the review demonstrated that leadership theory has progressively shifted its center of gravity, from the authority of the individual leader toward the collective capacity of the team, and from control and compliance toward empowerment and adaptability. Agile leadership emerges at the convergence of these two trajectories: it is simultaneously a response to the limitations of traditional project governance and a synthesis of the most adaptive insights from contemporary leadership theory.

Critically, however, the theoretical literature also reveals a significant and persistent gap. Despite the growing scholarly interest in agile leadership, the vast majority of existing research remains anchored in technology and software development contexts. The applicability of agile leadership principles to industrial development environments, governed by physical constraints, regulatory obligations, procurement timelines, and hierarchical accountability chains, has received limited systematic attention. It is precisely this gap that the present study seeks to address.

The theoretical framework developed in this chapter thus serves a dual function: it defines the conceptual vocabulary and analytical dimensions that structure the empirical

investigation, and it positions this research as a meaningful and targeted contribution to an underexplored area of the agile leadership literature. The following chapter will establish how these theoretical dimensions are translated into an appropriate methodological and organizational research design.

CHAPTER 02 :
METHODOLOGICAL AND ORGANIZATIONAL FRAMEWORK

If the theoretical framework establishes the conceptual coordinates of a research project, the methodological and organizational framework determines how those coordinates are explored and through which empirical lens the reality of the field is accessed. This chapter presents, justifies, and describes the dual framework organizational and methodological within which this study was conducted.

The chapter is structured into two distinct but complementary sections. The first section offers a comprehensive presentation of the research site: Sonatrach, Algeria's national hydrocarbon company and the leading energy corporation on the African continent. Following a historical overview of its development and nationalization trajectory, the section details the organizational structure and operational activities of the company, before narrowing progressively toward the specific context of this study the Liquefaction and Separation (LQS) Activity and, within it, the Development Division, whose mandate encompasses the full lifecycle management of industrial investment projects. This organizational anchoring is essential, as the structural characteristics of this environment its sequential project governance, multi-level validation chains, safety imperatives, and contractual frameworks directly shape the leadership practices that constitute the object of investigation.

The second section addresses the methodological choices that govern the empirical inquiry. It begins by establishing the epistemological positioning of the study within an interpretive paradigm, explaining how this orientation shapes the researcher's relationship to the data and to the organizational reality under examination. It then presents and justifies the qualitative research design, the data collection instruments semi-structured interviews and direct observation and the analytical approach employed, centered on NVivo qualitative software. The rationale for each methodological decision is made explicit, demonstrating not only what was done, but why it constitutes the most appropriate approach given the nature of the research question and the specificities of the industrial field context.

SECTION 01: Organizational Framework

For this section, we will attempt to address the research site through a structured presentation of Sonatrach, gradually focusing on its liquefaction and separation activities and its development division. Understanding this organizational environment is crucial, as its governance structure and structural constraints directly influence the leadership practices under study.

1.1 Presentation of Sonatrach

1.1.1 Summary of Sonatrach's History :

Sonatrach's history reflects the evolution of Algeria's energy sector and its pursuit of economic sovereignty. The following overview highlights the major milestones that have shaped the company's development since its establishment in 1963:

- **Foundation & Early Dependency (1963)**

Sonatrach was founded on December 31, 1963, but the Algerian state controlled only 4.5% of exploration perimeters, with French interests dominating at 67.5%.

- **Nationalization & Sovereignty (1967–1971)**

Algeria nationalized Mobil and Esso's assets. The turning point came in February 1971, when President Boumediene nationalized all French oil and gas holdings, granting Sonatrach full control over Algeria's petrochemical resources.

- **Restructuring & Opening to Foreign Investment (1979–1991)**

In 1979–1980, Sonatrach was divided into four enterprises. From 1986 onward, foreign companies were allowed to operate in partnership with Sonatrach, a process further simplified in 1991.

- **Legislative Reforms & IOC Investment (2005–2006)**

Parliament adopted a hydrocarbon reform bill in 2005 to attract international investment, though 2006 amendments introduced a windfall tax and reinforced Sonatrach's 51% participation rights on new projects.

- **Expansion & Strategic Partnerships (2018–2022)**

Sonatrach strengthened its role through key deals with Naturgy (Spain), Eni (Italy/TransMed pipeline), and Sinopec (China). The Russian invasion of Ukraine in 2022 accelerated Algeria's emergence as a critical gas supplier to Europe, particularly Italy.

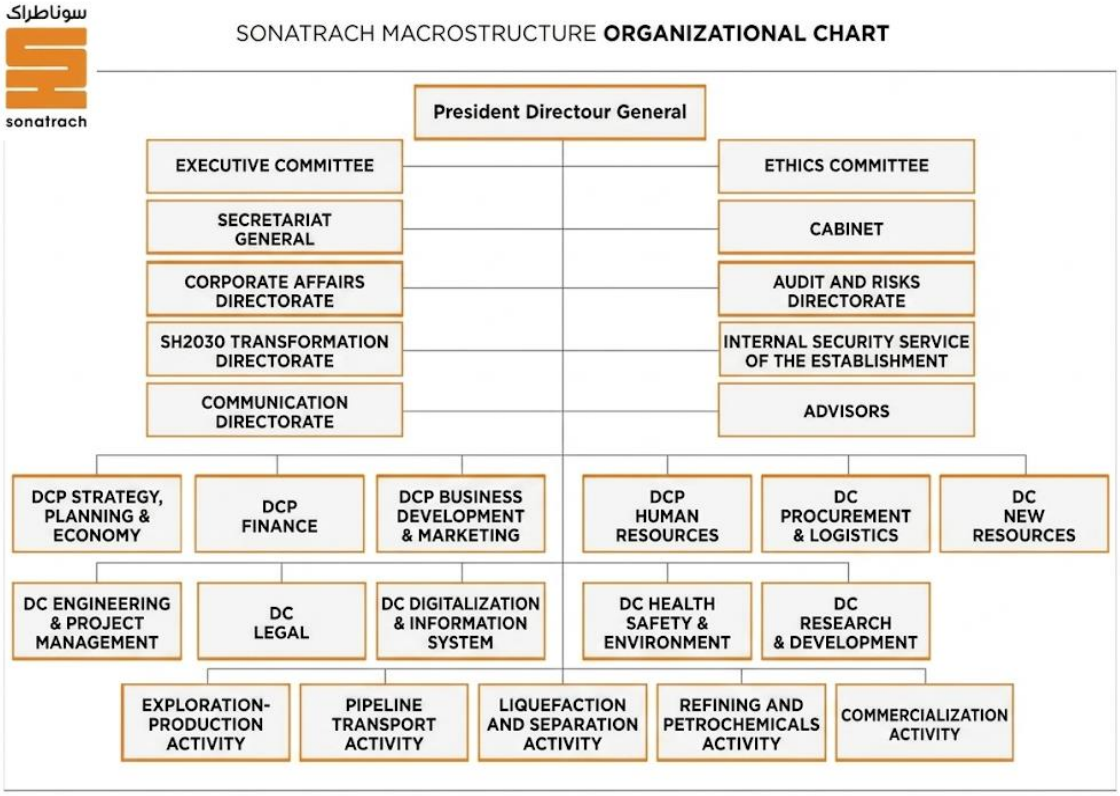
- **Energy Transition & Future Projects (2023–2024)**

Sonatrach began diversifying into renewables and hydrogen, notably through the "Hybla" hydrogen project in Sicily with Sasol, and signed new MoUs with TotalEnergies and ExxonMobil to develop southern Algerian gas resources, targeting an output of 200 million TOE annually.

1.1.2 Company Overview

SONATRACH is the Algerian company responsible for the exploration, production. transportation (via pipeline), processing, and marketing of hydrocarbons and their derivatives. It also operates in other sectors such as power generation, new and renewable energies, and seawater desalination. It conducts its business in Algeria and worldwide wherever opportunities arise. SONATRACH is the leading company on the African continent. It ranks 12th among global oil companies, is the 2nd largest exporter of LNG and LPG, and the 3rd largest exporter of natural gas. Its activities represent approximately 30% of Algeria's GDP. The Group employs 200,000 people. Today, SONATRACH believes that economic development cannot be achieved without sustainable development.

Figure 2 : SONATRACH MACROSTRUCTURE ORGANIZATIONAL CHART



Source : Internal documents of Sonatrach

1.1.2 Sonatrach Activities

Upstream : Exploration & Production (E&P)

The foundation of Sonatrach success lies in its robust Exploration and Production capabilities. The company is responsible for extracting crude oil and natural gas from some of the most challenging environments. Reserves & Discoveries: Sonatrach consistently invests in seismic surveys and drilling to renew its reserve portfolio. Recently, it has achieved multiple new hydrocarbon discoveries, ensuring long-term supply security. Major Fields: Operations span massive fields like Hassi Messaoud (oil) and Hassi R'Mel (gas), which are among the largest in the world. Partnerships: Sonatrach actively collaborates with major international energy companies to bring advanced extraction technologies to complex fields.

Midstream : Pipeline Transport (TRC)

To connect remote desert production sites with northern coastal export terminals and domestic refineries, Sonatrach manages an extensive and highly secure pipeline network. Network Scale: Over 21,000 kilometers of pipelines across the country, functioning as the

circulatory system of Algeria’s energy sector. Infrastructure: The system is supported by dozens of pumping and compressor stations to maintain flow rates over vast distances. International Links: This includes massive transcontinental pipelines like Transmed (to Italy) and Medgaz (to Spain), directly fueling Europe.

Liquefaction &amp. Separation (LQS)

Algeria was a pioneer in the LNG industry, and Sonatrach continues to be a dominant player in the Mediterranean and global gas markets. LNG Complexes: State-of-the-art liquefaction plants located in Arzew and Skikda cool natural gas to a liquid state, drastically reducing its volume for maritime transport. Strategic Advantage: This allows Sonatrach to export gas globally via specially designed LNG carrier ships, bypassing the geographical limits of physical pipelines.

Downstream : Refining & Petrochemicals

Moving up the value chain, Sonatrach transforms raw hydrocarbons into high-value consumable and industrial products. Refining: Operating several crude oil refineries across the country, Sonatrach successfully meets 100% of Algeria's domestic demand for fuels (gasoline, diesel) and exports the surplus. Petrochemicals: Sonatrach produces essential chemical compounds including ammonia, urea, methanol, and plastics. These are crucial for both domestic agriculture (fertilizers) and international industrial markets.

Commercialization and Global Reach

The commercialization branch is the financial engine of the company, responsible for marketing millions of tons of oil equivalent (TOE) annually. Market Diversification: While Europe remains the primary destination, Sonatrach is actively expanding its footprint in Asia and the Americas. Trading Operations: Sonatrach engages in sophisticated global trading to maximize the value of its crude oil, refined products, and gas cargos.

1.2 The Liquefaction and Separation (LQS)

1.2.1 Overview of the LQS Activity

The Liquefaction and Separation (LQS) activity is a cornerstone of Sonatrach midstream/downstream operations. It focuses primarily on the transformation of natural gas into liquid forms, which significantly facilitates both the high-volume storage and the global maritime transport of hydrocarbons. By drastically reducing the volume of natural gas through super-cooling, LQS allows Sonatrach to supply energy across oceans, bypassing the geographical constraints of physical pipelines.

1.2.2 Production Capacities & Operations

The LQS division is essential for managing the national supply and international export of Liquefied Natural Gas (LNG) and Liquefied Petroleum Gas (LPG). It plays a crucial role in resource optimization and operational coordination. According to the latest operational metrics, the activity boasts impressive processing capabilities:

- LNG (Liquefied Natural Gas) Complexes: A massive total processing capacity of 56 million cubic meters per year (m^3/year).
- LPG (Liquefied Petroleum Gas) Complexes: A total production capacity of 11 million tons per year.

1.2.3 Key Industrial Zones

Sonatrach liquefaction and separation operations are primarily concentrated in massive coastal industrial hubs. These specialized port zones serve as the launchpads for Algeria's energy exports to the world.

Arzew Industrial Zone

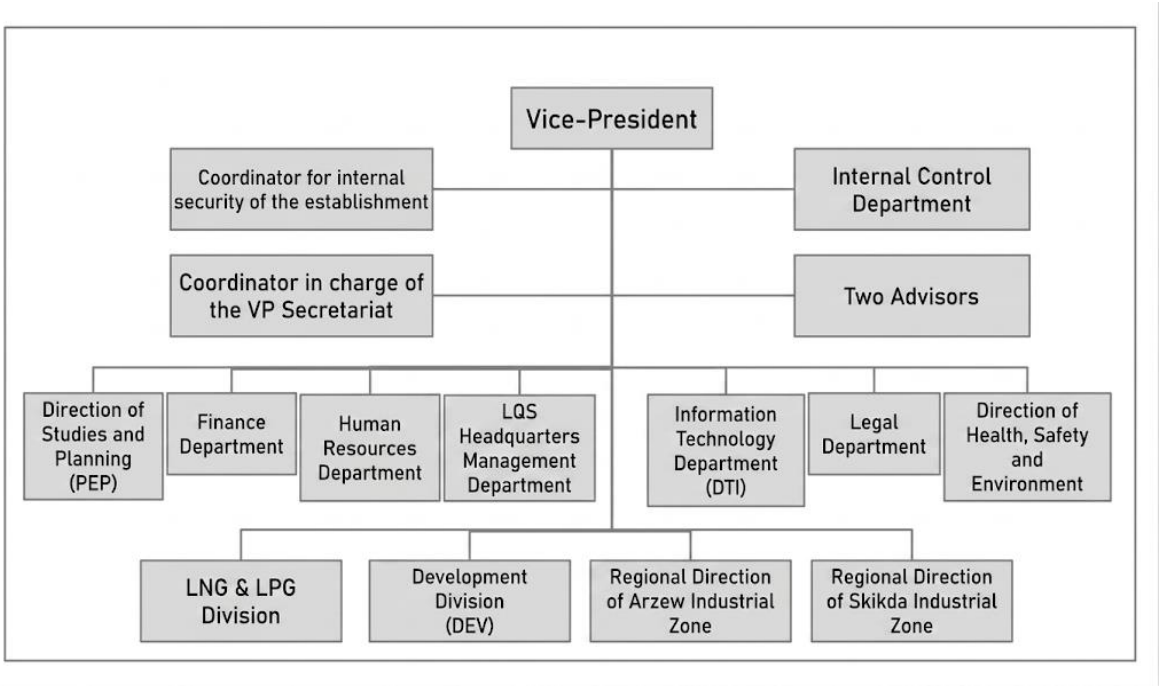
The Arzew Industrial Zone is a historical and vital hub for Algeria's LNG industry, housing multiple mega-trains. Operations within this zone are highly dedicated to maintaining the highest standards of industrial safety and environmental protection, ensuring rigorous management and adherence to strict regulations while operating complex cryogenic facilities.

Skikda Industrial Zone

Located in the eastern part of the country, the Skikda Industrial Zone covers a vast total area of 1,275 hectares. It integrates multiple state-of-the-art production units and essential

infrastructures. This mega-complex serves as a vital node for the processing, liquefaction, and export of gas extracted from deep southern fields like Hassi R'Mel.

Figure 3 : ORGANIZATION CHART OF THE LQS ACTIVITY



Source : Internal documents of Sonatrach

1.3 The Development Division (Dev)

1.3.1 The Development Division overview

The Development Division is the central engineering and project management unit of the LQS Activity, responsible for the full lifecycle of investment projects, from identification. maturation, and feasibility studies to execution and follow-up. It handles technical specifications, contract planning, and cost estimation for GNL/GPL and LQS infrastructure projects, while ensuring alignment with the company's strategy and HSE standards. It also supports complex optimization studies, assists during FEED phases in coordination with DCP BDM and DC EPM, and manages the financial, legal, and reporting aspects of all divisional projects.

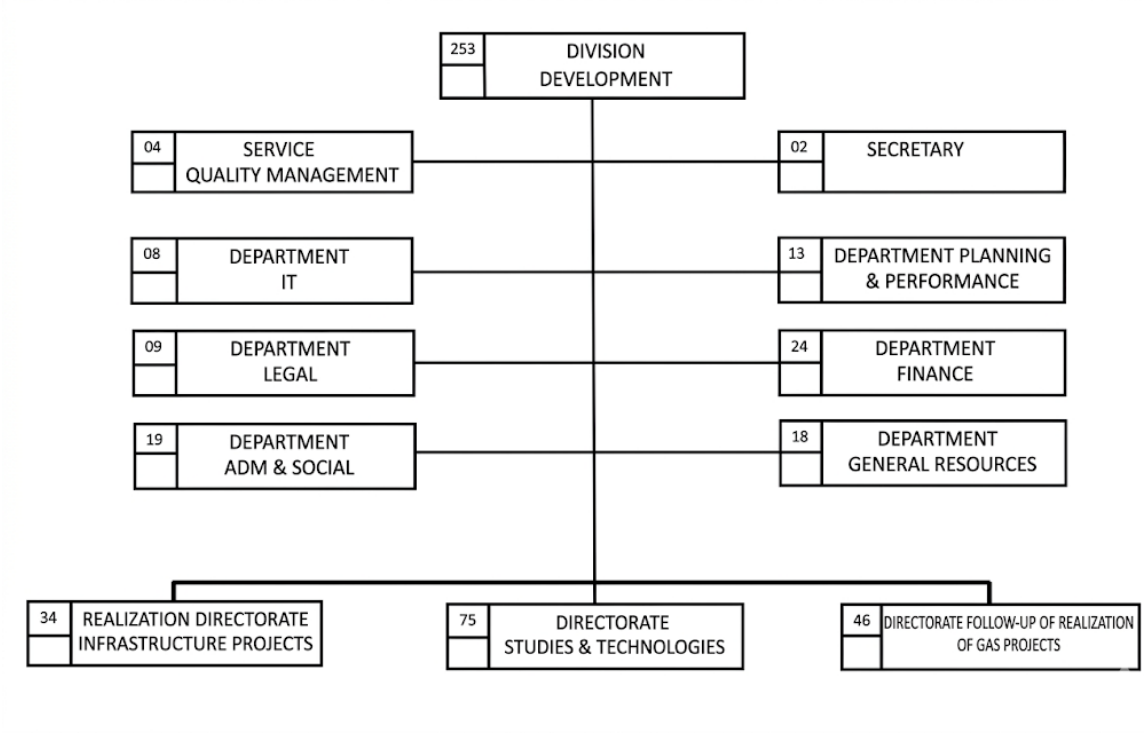
1.3.2 The Development Division missions

- The contribution to the identification, maturation, engineering, management and monitoring of the implementation of the LQS Activity investment projects, in accordance with the Company's strategy and policies.

- The realization of engineering studies and technical specifications of the Activity's investment projects.
- The realization of contract award plans for investment projects in the fields of LNG/LPG and LQS Activity infrastructures.
- The management and monitoring of the implementation of investment projects in the fields of LNG/LPG and LQS Activity infrastructures, in accordance with the Company's strategy and policies.
- The contribution to the development of referentials and expertise in the field of engineering and investment project management.
- The contribution to the development of HSE rules and procedures in the field of project design and implementation in accordance with the Company's rules and procedures.
- The assistance to LQS Activity Structures in the context of maturation of complex optimization or production tool development studies, elaboration of specifications, cost and project implementation time estimation, contract finalization and project implementation monitoring.
- The elaboration and negotiation of contracts related to the Division's projects.
- The management of financial and legal activities of the Division's projects.
- The assistance during feasibility, maturation and FEED study phases of structural projects managed by DCP BDM and with DC EPM during the project implementation phase.

- The organization of information and reporting.

Figure 4: ORGANIZATION CHART OF THE DEVELOPMENT DIVISION



Source : Internal documents of Sonatrach

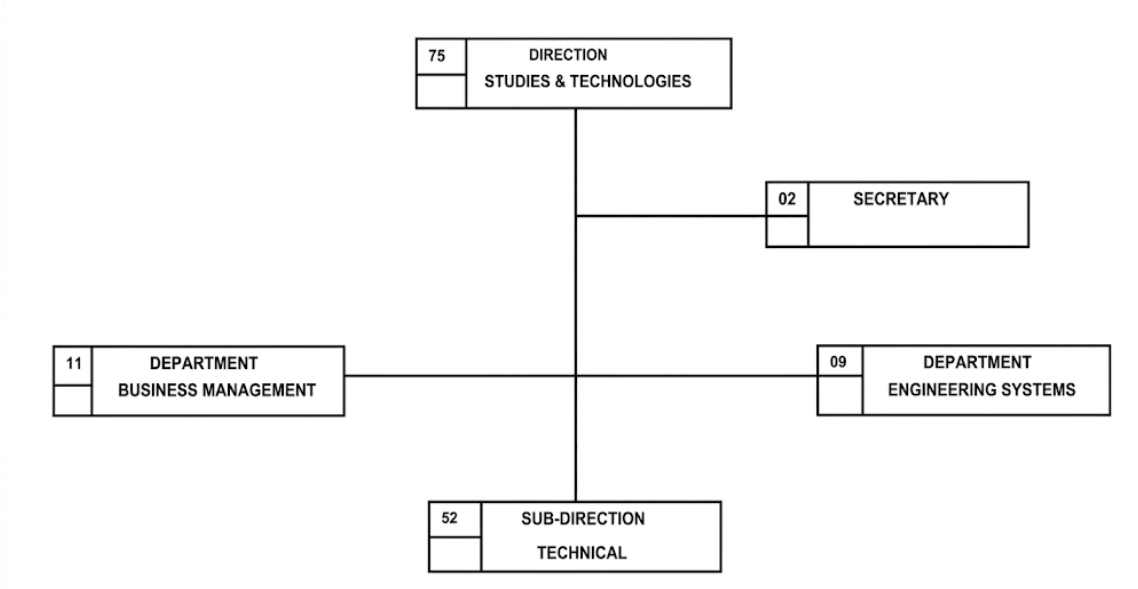
1.3.3 The Studies & Technologies department

The missions of the Studies & Technologies department

- Provision of engineering study services, document review, and control, excluding studies falling under DC EPM.
- Preparation of technical dossiers for the realization of basic engineering studies (FEED) and detailed studies related to the Activity.
- Preparation of general specifications and specific standards for cryogenics and LPG separation.
- Preparation of technical specifications for tender documents related to investment projects common to the Operational Units of the Activity.
- Development of engineering procedures.
- Preparation of IMFS tender documents common to the Operational Units.

- Establishment and revision of the Directorate's engineering manual.
- Preparation of feasibility studies related to project maturation.
- Assistance to the Development Division and the GNL & GPL Division in establishing the technical annexes of tender documents.
- Analysis and alignment of technical offers for the Activity's projects.
- Execution of basic and detailed engineering for minor modifications to production installations on behalf of the GNL & GPL Division.
- Application of HSE requirements within the framework of studies and tender documents for development projects.
- Assistance and advisory support to the GNL & GPL Division through the provision of personnel and engineering procedures in the fields of studies, procurement, and construction necessary for the execution of investment projects.
- Capitalization of knowledge and competencies in the fields of engineering and project management.
- Organization of information and reporting.

Figure 5 : ORGANIZATION CHART OF THE STUDIES & TECHNOLOGIES DEPARTMENT



Source : Internal documents of Sonatrach

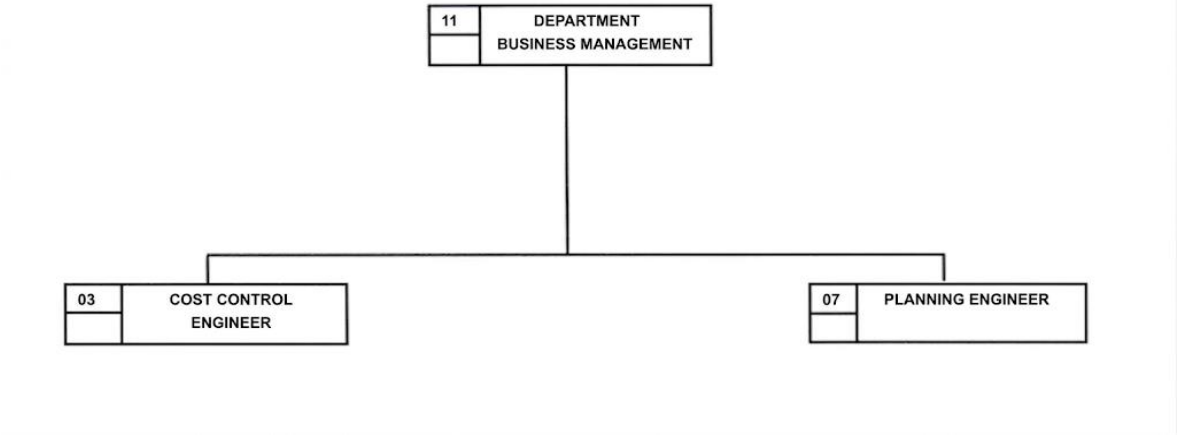
1.3.4 Business Management Department

Here are the missions of the Business Management Department :

- The management of project maturation and consolidation of technical annexes elaborated by the Direction's structures.
- The coordination of tender document elaboration works.
- The capitalization, valorization, and development of capacities in terms of estimation, cost control, planning, and business management.
- The interface with different clients in terms of clarifications and information requests.
- The provision of services on behalf of the Development Division and the GNL & GPL Division through:
    - The consolidation of technical annexes of call-for-tender documents for FEED, EPC, study services/PMC missions, supplies, and works projects.
    - The elaboration of investment cost estimations for projects and within the framework of feasibility studies.
    - The elaboration of preliminary project implementation plannings.
- The elaboration of analysis, estimation, planning, cost-control, or progress reports of projects carried out by third parties on behalf of the Development Division and the GNL & GPL Division.
- The elaboration of benchmark reports on prices applied in the context of gré à gré contract awards.
- The monitoring of compliance with Quality Management System procedures.

- The organization of information and reporting.

Figure 6 : ORGANIZATION F THE BUSINESS MANAGEMENT DEPARTMENT



Source : Internal documents of Sonatrach

SECTION 02: Methodological Framework

2.1 Choice of Research Site

The research site was selected based on its strong relevance to the study objectives. The empirical investigation is conducted within Sonatrach, specifically in the Liquefaction and Separation activity (LQS), within the Development Department. This environment represents a highly structured industrial setting where multiple development projects are managed simultaneously, often under strict technical safety, and organizational constraints. Such a context provides a valuable opportunity to examine how leadership practices evolve in response to complexity and whether agile principles can be integrated into traditional project management approaches. Furthermore, conducting this research within Sonatrach offers direct access to professionals involved in project management, enabling an in-depth qualitative exploration of their perceptions, practices, and challenges related to agile leadership. The choice of this site is therefore particularly relevant for generating practical insights and context-specific recommendations that align with the realities of industrial organizations.

2.2 Research Methodology

2.2.1 Epistemological Positioning

This study adopts an interpretive approach as a methodological framework for understanding agile leadership practices in industrial development projects. Organizational reality is not

viewed as a given or independent entity, but rather as an intersubjective reality constructed by actors through their daily language and interactions . From this perspective, the research aims for a deep understanding, rather thana dry causal explanation, striving to produce idiographic knowledge that focuses on the contextual specificity of industrial projects rather than general laws. Accordingly, the researcher positions themselves as an interpreter seeking a thick description of leadership practices, acknowledging that reaching the truth involves understanding the intentionality, meanings, and symbols exchanged by leaders and team members. This methodology also allows for the study of agile leadership as a process and a continuous flow of events and decisions, which aligns with the nature of "agility" as a flexible dynamic that evolves over time and is not limited to fixed characteristics.

2.2.2 Research Design

The qualitative method was chosen as the research approach for this study, and this choice was not arbitrary. Agile leadership, by its very nature, is a phenomenon that resists reduction to numbers: it lives in conversations, in the way a project manager responds to an unexpected technical failure, in the informal exchanges that happen outside meeting rooms. Capturing this kind of reality requires a method that can follow complexity rather than flatten it, which is precisely what the qualitative approach offers.

More specifically, since agile leadership practices are characterised by dynamism and continuous interaction between leaders and their teams, the qualitative method provides the necessary tools to achieve a deep idiographic understanding one that focuses on singular cases and the specific contextual realities of industrial projects rather than seeking generalisable statistical patterns. What matters here is not how many leaders behave in a certain way, but why they behave that way, what it means to them, and how that meaning is shaped by the particular environment they operate in.

The qualitative approach also ensures robust internal validity through what Geertz (1973) famously called "thick description" (Luhrmann, 2015) a detailed, layered account of observed practices that goes beyond surface behaviour to investigate the meanings and intentions behind leaders' actions. This depth is difficult, if not impossible, to achieve through quantitative instruments alone, which tend to measure the presence or absence of behaviours without asking what those behaviours actually mean to the people performing them.

Finally, the flexibility inherent to qualitative methodology felt particularly appropriate given the exploratory character of this research. Since the existing literature offers limited guidance

on how agile leadership operates in industrial development project contexts, it would have been methodologically premature to enter the field with a rigid, pre-structured framework. The qualitative approach allowed for an inductive and at times abductive reasoning process, where the data collected in the field became the real starting point shaping, challenging, and ultimately refining the conceptual framework rather than simply confirming it.

2.3 Data Collection

This study employs two complementary qualitative data collection instruments, selected for their capacity to generate rich, contextually grounded insights into the lived experience of agile leadership within an industrial project environment.

2.3.1 Semi-structured interviews

constitute the primary data collection tool. This instrument was chosen for its dual capacity to provide sufficient thematic structure (ensuring that the key dimensions of agile leadership identified in the theoretical framework are systematically addressed across all participants) while preserving the flexibility required to follow unexpected lines of inquiry as they emerge from respondents' accounts. The interviews aim to capture actors' subjective perceptions of agile leadership practices and to understand how they construct meaning within the specific context of the industrial development project. Each interview was conducted individually with project managers and leaders active within Sonatrach's Liquefaction and Separation Division, using an interview guide developed directly from the theoretical framework and the study's sub-questions. Responses were recorded and subsequently transcribed for analysis in NVivo, ensuring systematic and traceable coding of the qualitative data.

2.3.2 Observation

serves as a complementary instrument, designed to address one of the inherent limitations of interview-based research: the gap that can exist between what practitioners say they do and what they actually do. Observation allows the researcher to examine agile leadership practices in their temporal and situational flow - as they unfold in real project interactions rather than as they are retrospectively narrated -and to gain a deeper understanding of the unspoken organisational codes, informal communication patterns, and tacit behavioural norms that shape leadership practice but rarely surface in interview discourse alone. Together, these two instruments provide a degree of methodological triangulation that strengthens the internal validity of the study's findings.

Chapter 2 conclusion

This chapter has established the dual contextual foundation organizational and methodological within which the empirical investigation of this study unfolds. Together, its two sections define not only where and how the research was conducted, but why these specific choices constitute the most appropriate and rigorous approach for addressing the central research question.

The organizational presentation of Sonatrach, and more specifically of the Liquefaction and Separation Activity's Development Division, has revealed a research site of considerable analytical richness. As a state-affiliated energy major operating large-scale, capital-intensive industrial projects under strict technical, safety, and regulatory constraints, Sonatrach LQS represents precisely the type of industrial environment that the existing agile leadership literature has systematically overlooked. Its governance architecture characterized by sequential project phases, multi-level validation chains, formal procurement cycles, and hierarchically codified accountability structures creates the structural conditions that make the question of agile leadership applicability both theoretically significant and practically consequential. The research site was therefore not selected arbitrarily, but because its specific organizational reality is both representative of broader industrial project environments and maximally relevant to the study's investigative objectives.

The methodological section has demonstrated that the qualitative, interpretive approach adopted in this study is not merely a pragmatic convenience but an epistemologically principled choice. Agile leadership, as a phenomenon that lives in interactions, decisions, and the informal dynamics of team coordination, resists reduction to numerical indicators. Capturing its texture, its contradictions, and its contextual specificity requires an approach capable of following complexity rather than flattening it which is precisely what the interpretive qualitative framework, operationalized through semi-structured interviews, direct observation, and NVivo-assisted analysis, provides. The dual instrument design, combining interview-based accounts with observational data, further strengthens the internal validity of the study by enabling a degree of methodological triangulation between stated practices and enacted behaviors.

With the theoretical framework established and the methodological and organizational context clearly delineated, the conditions are now in place for a rigorous and contextually grounded empirical investigation. The following chapter presents the results of that investigation, moving from the architecture of the NVivo coding structure through the

detailed analysis of each thematic node toward a theoretically informed discussion of what the data reveal about the nature, scope, and structural conditions of agile leadership in complex industrial development projects

CHAPTER 03:
RESULTS AND DISCUSSION

This chapter presents, analyses, and discusses the empirical findings generated from eight qualitative semi-structured interviews conducted with project managers and team leaders within Sonatrach's Liquefaction and Separation (LQS) Activity, Development Devision. The interviews were designed to explore how agile leadership practices are understood, applied, and constrained within the context of complex industrial development projects; a setting systematically underrepresented in the agile leadership literature.

The data were processed and coded using NVivo qualitative analysis software. Two main parent nodes were constructed Agile Leadership Practices and Traditional Leadership Practices each subdivided into thematic child nodes derived inductively from the theoretical framework and the data themselves. The analysis proceeded through three complementary operations: node-level frequency coding, word-frequency analysis within each node, and a matrix crosstabulation visualised as a radar chart, which maps the contribution of each respondent across all coding dimensions.

The structure of the chapter follows an integrated logic: results are first presented systematically with supporting visual evidence from NVivo, then analysed in depth, then interpreted in light of the research context, and finally discussed in dialogue with prior scholarship. The chapter concludes by providing explicit answers to each sub-question and a synthesised response to the central research question.

SECTION 01 : Presentation and Analysis of Results

1.1 Overview of Interview Participants

Respondent Code	Role	Years of general experience	Years of project management experience
Interview_R01	Project manager	24 years	10 years
Interview_R02	Project manager	15 years	10 years
Interview_R03	Project manager	08 years	04 years
Interview_R04	PMO	25 years	12 years
Interview_R05	Business engineer	18 years	07 years
Interview_R06	Business engineer	10 years	10 years
Interview_R07	Project manager	15 years	05 years
Interview_R08	Project manager	12 years	05 years

1.2 Overview of the NVivo Coding Structure

Before turning to the substantive findings, it is necessary to establish the architecture of the coding framework that organised the qualitative data. Figure 1 displays the full node structure as generated by NVivo, showing the two parent nodes and their respective child nodes alongside the number of sources (i.e., interviews in which the theme appeared) and total references (i.e., discrete textual passages coded under each node).

Table 1: NVivo Node Structure: Agile and Traditional Leadership Practices with Source and Reference Counts

Nœuds

Nom	Sources	Références
Agile Leadership Practices	0	0
customer-centricity	4	5
continious learning and improvement	7	18
Flexibility and Adaptability	8	21
decentralised decision making	8	9
collaboration and empowerment	8	26
Traditional leadership practices	0	0
micromanagement	0	0
Blame culture	2	3
Process and Contract focus	4	8
Rigid planning	8	19
command and control	8	17

Source : Elaborated by the student using NVivo 10

As shown in Figure 1 together, the main node "Agile Leadership Practices" produced a significantly higher total encoding volume (79 references) than the main node "Traditional Leadership Practices" (47 references, excluding the subnode "Detailed Management," which did not register any references). This disparity in distribution, in itself, constitutes a preliminary empirical indication that participants' discourse naturally and more intensely gravitates toward narratives oriented toward an agile leadership methodology, even in an organizational environment characterized by entrenched structural and procedural constraints. This may be due to the interview's orientation, but it certainly has another methodological explanation.

The following sections discuss each node in detail :

1.1.1 Agile Leadership Practices : Node Analysis

- **Word Frequency Analysis**

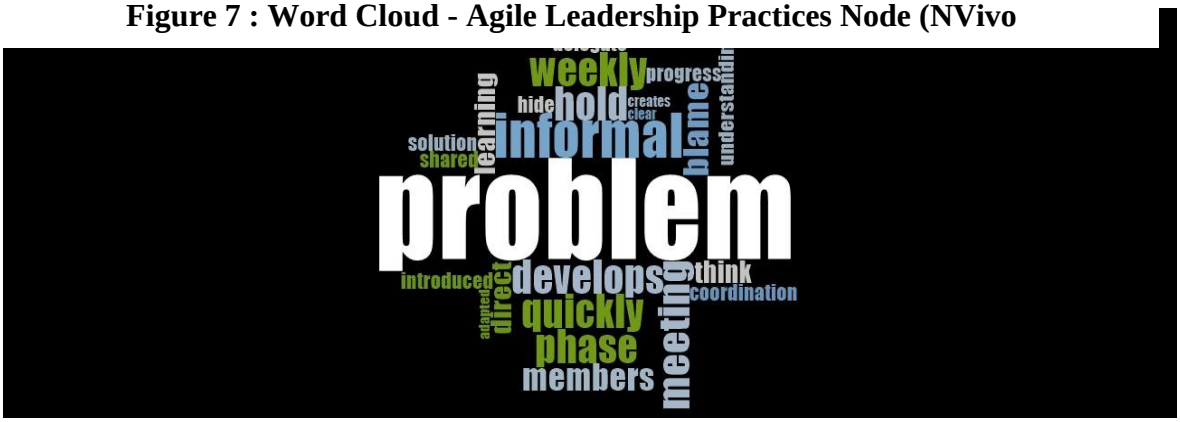
The word frequency query run against all content coded under the Agile Leadership Practices parent node (encompassing all five child nodes) reveals a distinctive lexical landscape that speaks volumes about how respondents conceptualise and enact agile leadership in their day-to-day professional reality. The results are presented in Table 2 and visualised in the word cloud in Figure 7.

Mot	Longueur	Nombre	Pourcentage pondéré (%)	Mots similaires
problem	7	20	2,60	problem, problems
informal	8	10	1,30	informal, informally, information, informed
develops	8	8	1,04	develop, developing, development, develops
hold	4	8	1,04	hold
quickly	7	8	1,04	quick, quickly
weekly	6	8	1,04	week, weekly
meeting	7	8	1,04	meeting, meetings
phase	5	8	1,04	phase, phases
blame	5	7	0,91	blame, blamed
members	7	7	0,91	members
direct	6	6	0,78	direct, directed, directive, directly
learning	8	6	0,78	learn, learned, learning
think	5	6	0,78	think
delegate	8	5	0,65	delegate, delegating, delegation
hide	4	5	0,65	hide, hiding
introduced	10	5	0,65	introduce, introduced
progress	8	5	0,65	progress, progressive
shared	6	5	0,65	share, shared, sharing
solution	8	5	0,65	solution, solutions
understanding	13	5	0,65	understand, understanding
conversations	13	5	0,65	conversations
coordination	12	5	0,65	coordination
adapted	7	4	0,52	adapted, adaptive, 'adaptive

Table 2: Word Frequency Table - Agile Leadership Practices Node (NVivo)

Source : Elaborated by the student using NVivo 10

Figure 7 : Word Cloud - Agile Leadership Practices Node (NVivo



Source : Elaborated by the student using NVivo 10

The most notable feature of this lexical group is the dominance of the word "problem," appearing 20 times and representing a weighted percentage of 2.60%, making it the most frequent and significant term in all discussions related to the Agile methodology. This finding is of considerable analytical importance, as it indicates that participants do not view agile leadership as an abstract management philosophy, but rather as a practical and tangible approach to identifying, addressing, and resolving operational problems in real time. The agile leader, as portrayed in this discourse, is essentially a problem solver who acts swiftly and collaboratively when the situation demands it. It is also clear that addressing problems is a crucial step in preventing the escalation to risk or crisis management.
The second most frequent lexical group revolves around informality: the word "informal" (10 times, 1.30%) and its semantic derivatives occupy a prominent place in the discourse surrounding the Agile methodology. This is a precise and theoretically rich finding. In an organization like Sonatrach, which operates under strict formal procedures, multi-tiered verification processes, and contractual obligations, resorting to informal communication channels is a deliberate adaptive strategy employed by leaders seeking to overcome bureaucratic hurdles. Informal conversations, informal dialogues, and spontaneous exchanges emerge as key tools through which agile-minded leaders demonstrate flexibility, responsiveness, and collaboration with their teams;

The collaborative and adaptive nature of agile practice is clearly reflected in the frequent use of the terms "weekly" (8 times), "meeting" (8 times), "conversations" (5 times), "coordinating" (5 times), and "quickly" (8 times). These three terms collectively paint a picture of a regular, periodic, and exceptional team coordination practice: leaders establish weekly contact points, or voluntary contact points (sometimes outside of work hours), to adapt to new developments and prepare immediate responses to unexpected changes. These contact points are not formal project review committees, but rather shorter, more focused coordination moments, a simplified alternative to more complex formal reporting cycles, as also observed during the internship.

The term "blame" (7 times, 0.91%) appears frequently in agile-based content, which might initially seem illogical. However, a closer examination of this pattern reveals that participants typically used blame in the context of resistance or rejection: they described creating environments where mistakes could be reported without fear of repercussions and fostering a culture of continuous learning, where the instinct to blame individuals is consciously curbed in favor of collective problem-solving, learning from mistakes, and transforming them into new

opportunities. This aligns perfectly with the psychological safety dimension of agile leadership as theorized by (Sherehiy & Karwowski, 2014).

Furthermore, the presence of the word "delegate" (5 times) and its derivatives (delegating, delegation) within the agile node may indicate the delegation of authority in some cases, which promotes team engagement and empowers members to make appropriate decisions at the right time.

Finally, the table shows indications of learning, fostering a culture of continuous learning, and information sharing through the words: "learn" and its derivatives "learning, learned" (6 times), "think" (6 times), and "share" (5 times).

- **Analysis by Child Node : Agile Practices**

1) Collaboration and Empowerment (8 sources, 26 references)

Collaboration and empowerment emerges as the most densely coded dimension of agile leadership in this study, with 26 references across all 8 interview sources. This is not a marginal finding it represents the highest reference count of any node across both parent categories, suggesting that it constitutes the central feature of what respondents experience and enact as agile leadership.

The universality of this node (8/8 sources) is equally significant. Every respondent, regardless of their seniority, technical background, or project type, discussed collaboration and empowerment in substantive terms. This convergence suggests that within the LQS Development Department, collaborative leadership is not an individual stylistic preference but has begun to take on the character of an emergent professional norm a shared expectation about what effective project leadership looks like in this context.

The nature of empowerment as described by respondents is characterised by deliberate situational delegation: leaders grant team members decision-making authority for sub-problems and technical sub-domains, while retaining accountability at the project level. This pattern is consistent with the situational leadership literature (Hersey and Blanchard, 1982), and reflects the agile principle of distributing authority to those closest to the work. Importantly, empowerment also manifests through active listening and creating genuine opportunities for team members to surface concerns, propose alternatives, and challenge prevailing assumptions behaviours that align with what Bregenzer and Jimenez (2021) describe as the transition from a controlling authority to a supporting orientation.

2) Flexibility and Adaptability (8 sources, 21 references)

The flexibility and adaptability node records 21 references across all 8 sources, making it the second most heavily coded agile practice. Its universality (8/8) mirrors that of the collaboration node, and together these two dimensions form the core of what might be called the operational agile identity of respondents: they experience themselves as leaders who adapt, who flex plans when circumstances require it, and who maintain team cohesion during disruption.

The specific texture of flexibility as described in this context is notably different from the flexibility theorised in software development contexts. Industrial development projects impose physical, contractual, and safety constraints that fundamentally restrict the degree to which scope, sequence, or deliverables can be modified mid-execution. What respondents describe, therefore, is not a wholesale iterative restructuring of project phases, but rather what might be termed 'bounded adaptability' the ability to re-sequence internal sub-tasks, re-allocate human resources, or improvise operational responses within the inviolable boundaries set by procurement timelines, safety protocols, and contractual scope definitions. This represents a contextually specific variant of agile flexibility that has not been extensively theorised in the existing literature.

This finding also directly answers one of the study's theoretical questions about the intersection between agile leadership and industrial project constraints: flexibility is not absent, but it is practiced at a different level of granularity than in software environments.

3) Continuous Learning and Improvement (7 sources, 18 references)

The continuous learning and improvement node is the third most densely coded agile dimension, with 18 references appearing across 7 of the 8 interview sources. The slight reduction in source coverage (7/8 rather than 8/8) is noteworthy: it suggests that while nearly universal, the reflective learning orientation is slightly less systematically embedded than flexibility and collaboration. One respondent's discourse did not substantially engage with this theme, which may reflect individual leadership style, project-specific constraints, or organisational culture within a particular team.

The content coded under this node reveals two distinct modalities of learning in practice. The first is structured retrospective reflection , moments in a project cycle where teams explicitly revisit what worked, what failed, and what should be done differently. The second, and more frequently mentioned, is informal and continuous , a running background orientation toward learning from emerging problems in real time, without waiting for formal retrospective

moments. The word frequency analysis confirms this pattern: 'learning' (6 occurrences) co-occurs with 'problem' (20 occurrences) and 'quickly' (8 occurrences) in the agile node, suggesting that learning is experienced primarily as reactive problem-processing rather than as formal, documented knowledge management.

Importantly, respondents also discussed the concept of 'unlearning' , letting go of established procedures when a more effective approach emerged , a theme directly anticipated in the theoretical framework through McKenzie and Aitken's (2012) agile leadership principles. This dimension of the results is theoretically significant and is discussed further in Section 3.6.

4) Decentralised Decision Making (8 sources, 9 references)

While decentralised decision making was identified across all 8 interview sources, its relatively lower reference count (9 references compared to 26 for collaboration and 21 for flexibility) signals a more cautious and conditional engagement with this practice. All respondents acknowledged delegating decisions, but the extent and depth of decentralisation they described was considerably more limited than what agile theory would prescribe as an ideal state.

The pattern that emerges from the data is one of contingent delegation: leaders empower team members to make decisions within clearly bounded domains , technical sub-questions, daily operational choices, sequencing of sub-tasks , while maintaining centralised authority over decisions that cross organisational boundaries, involve contractual commitments, or carry safety implications. This reflects the specific hierarchical and regulatory logic of an energy sector organisation like Sonatrach, where accountability chains are both legally and professionally codified.

The lower density of coding on this node, despite its universal source presence, also suggests that respondents experience decentralised decision making as more aspirational than fully realised a direction of travel rather than a current operational reality. This nuance is important for interpreting the overall answer to the central research question.

5) Customer-Centricity (4 sources, 5 references)

Customer-centricity is notably the least developed agile dimension in the data, appearing in only 4 of 8 interview sources with a mere 5 total references. This finding requires careful interpretation. In the software development context from which agile originated, the 'customer' is external, identifiable, and regularly consulted. In the context of industrial development projects at Sonatrach LQS, the 'customer' relationship is significantly more complex: the end beneficiary of development projects is often an internal division, a regulatory body, or a national

energy infrastructure, none of which engage in the iterative feedback loops that agile customer-centricity implies.

The relative absence of this dimension from respondents' discourse does not indicate a failure of agile leadership per se; rather, it reflects the structural reality that direct customer feedback loops are not a feasible operating mode in capital-intensive, long-cycle industrial projects. This finding aligns with the research gap identified in the theoretical framework: the translation of agile principles to industrial contexts requires significant contextual adaptation, and customer-centricity is the dimension that proves most resistant to translation.

1.1.2 Traditional Leadership Practices: Node Analysis

Word Frequency Analysis

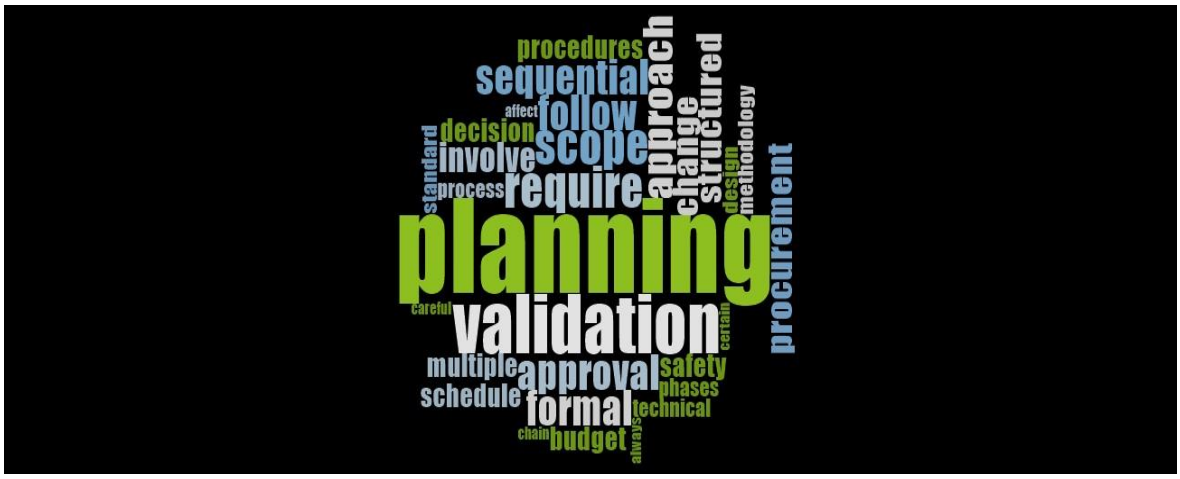
The word frequency query applied to all content coded under the Traditional Leadership Practices parent node reveals a sharply contrasting lexical universe, one dominated by the vocabulary of planning, structure, sequence, and procedural control. The results, presented in Table 3 and Figure 8, speak directly to the structural reality within which the respondents operate.

Table 3 : Word Frequency Table - Traditional Leadership Practices Node (NVivo)

Mot	Longueur	Nombre	Pourcentage pondéré (%) ▽	Mots similaires
planning	8	17	4,39	plan, planned, planning
validation	10	11	2,84	validate, validated, validation, validations
scope	5	8	2,07	scope
approval	8	7	1,81	approval, approvals
approach	8	7	1,81	approach
follow	6	7	1,81	follow
formal	6	7	1,81	formal
sequential	10	7	1,81	sequential
change	6	6	1,55	change
procurement	11	6	1,55	procurement
require	7	6	1,55	require, requires
structured	10	6	1,55	structural, structure, structured
decision	8	5	1,29	decision
multiple	8	5	1,29	multiple
safety	6	5	1,29	safety
budget	6	4	1,03	budget
design	6	4	1,03	design
involve	7	4	1,03	involve, involvement
methodology	11	4	1,03	methodology
phases	6	4	1,03	phases
procedures	10	4	1,03	procedures
process	7	4	1,03	process, processes
schedule	8	4	1,03	schedule, schedules, scheduling

Source : Elaborated by the student using NVivo 10

Figure 8: Word Cloud - Traditional Leadership Practices Node (NVivo)



Source: Elaborated by the student using NVivo 10

The term "planning" is the dominant term in the traditional leadership framework, appearing 17 times (4.39%), a significantly higher percentage than any other term. This emphasis is noteworthy: planning is an indispensable process and stage within the project management cycle, and leaders are required to follow the resulting plans and refer back to them to adjust their course. Therefore, their responses indicate a strong focus on this process, viewing adherence to formal plans as an organizational logic for project execution and a systematic approach to achieving success.

It's important to note that in industrial projects, a plan is not merely a flexible starting point; it is the contractual and technical reference document against which all subsequent decisions are measured.

The term "auditing" (11 times, 2.84%), the second most prominent term, directly reinforces this interpretation. The process of due diligence, along with its associated terms "approval" (7 times) and "formality" (7 times), collectively describes a multi-tiered management structure through which every significant project decision must pass before implementation. These approval chains, deeply embedded in Sonatrach's organizational structure, regulatory commitments, and internal governance frameworks, represent one of the key structural constraints on agile leadership practices identified in this study. They impede decision delegation and delay the flexible decision-making processes necessary to adapt to sudden changes in the industrial environment.

Furthermore, the frequent use of the term "chaining" (7 times) in the traditional framework underscores that participants recognize and explicitly name the waterfall logic and sequential processes that govern their project management methodology. This is theoretically significant:

participants are not unaware of alternative approaches, but they operate within a system that structurally imposes a hierarchical structure. The term “procurement” (6 times) adds another dimension: the long waiting periods and contractual inertia of industrial procurement represent an external constraint that makes iterative replanning not only difficult but often legally and logistically impossible.

The appearance of the term “safety” (5 times) in this context is revealing. Safety requirements in the industrial sector are not an optional regulatory burden but rather non-negotiable engineering and legal imperatives that directly define the decision-making margin available to project leaders. The presence of safety as a traditional constraint reflects the unique nature of the industrial operating environment and partially explains why complete agile decentralization is structurally impossible in this context.

Analysis by Child Node: Traditional Practices

1) **Rigid Planning (8 sources, 19 references)**

Rigid planning is the most frequently coded traditional leadership practice, appearing across all 8 interview sources with 19 references. This universality is a defining empirical finding: every single respondent discussed the constraining presence of comprehensive, upfront project planning as a reality of their professional environment. The coding density within this node (significantly higher than any other traditional practice) suggests that rigid planning is not merely a residual habit but an active, ongoing operational reality.

What the data reveal, however, is that respondents do not passively accept planning rigidity as an unproblematic given. Rather, they actively negotiate with it, identifying moments where informal flexibility can be exercised within formally planned phases, and finding micro-spaces of adaptation that formal plans do not foreclose. This negotiated relationship between planned structure and practised flexibility is a central finding of this study.

2) **Command and Control (8 sources, 17 references)**

Command and control structures are discussed across all 8 sources with 17 references, making them the second most prevalent traditional practice identified in the data. The ubiquity of this theme reflects the enduring influence of hierarchical authority in Sonatrach's organisational culture, a dynamic typical of large, state-affiliated energy organisations where accountability chains are formally codified and strictly maintained.

Importantly, however, the manner in which respondents engage with command-and-control structures is nuanced. They do not uniformly endorse or unconditionally reproduce these

structures; rather, they describe actively working around them where possible, and selectively engaging them where required by the demands of safety or accountability. This suggests a generational or contextual shift in leadership orientation: leaders who are personally oriented toward more agile, collaborative styles nonetheless operate within an institutional architecture that periodically requires command-and-control responses.

3) Process and Contract Focus (4 sources, 8 references)

Process and contract focus is identified in 4 of 8 sources with 8 references. Its more limited source coverage (50% of respondents) suggests that this dimension of traditional practice is more contextually variable, reflecting the specific types of projects managed by each respondent and the degree to which contractual constraints are foregrounded in their particular project portfolios.

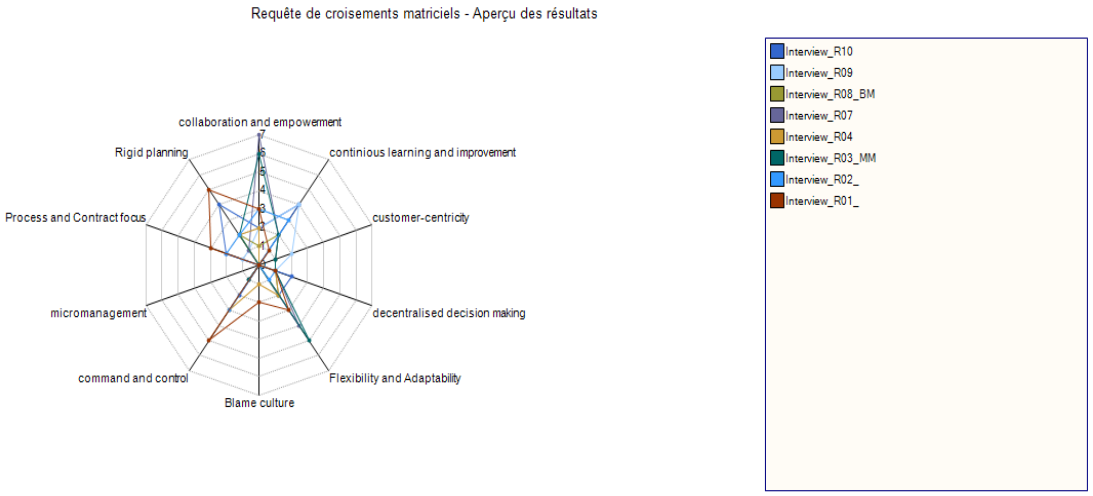
4) Blame Culture (2 sources, 3 references) and Micromanagement (0 sources, 0 references)

Two traditional leadership practices are notably marginal in the data: blame culture (2 sources, 3 references) and micromanagement (0 sources, 0 references). The near-absence of blame culture and the complete absence of micromanagement as coded themes are themselves substantively meaningful findings. They suggest that within the population of respondents " who are, it should be emphasised, project leaders rather than frontline workers" neither blame-oriented nor micromanagement-oriented leadership is a recognised or self-described practice. Rather than delegating this absence, respondents describe active efforts to create psychologically safe environments, a finding that bridges the traditional and agile nodes and reinforces the collaborative leadership orientation documented across the study.

1.1.3 Matrix Crosstabulation: Individual Respondent Profiles Across All Nodes

The matrix crosstabulation query performed in NVivo, visualised as a radar chart in Figure 9- extends the node-level analysis by mapping the individual contribution of each of the 8 respondents across all 10 coding dimensions simultaneously. This multi-dimensional representation enables the identification of individual variation within the overall patterns described above and reveals the heterogeneity of leadership profiles within the LQS Development Department.

Figure 9: Matrix Crosstabulation: Distribution of Coding References Across All Nodes for 8 Respondents (NVivo Radar Chart)



Source : Elaborated by the student using NVivo 10

Several significant observations emerge from the radar chart. First, the dimensions of collaboration and empowerment and flexibility and adaptability visibly extend furthest from the centre across the majority of respondents' profiles, confirming the quantitative finding from the node analysis that these are the most universally discussed and richly elaborated practices. Second, rigid planning and command and control also extend notably outward, particularly in profiles that also show strong agile engagement.

Third, and perhaps most revealing, the radar chart shows that the respondents' profiles are not uniform. Some respondents extend notably more strongly on the agile dimensions (particularly continuous learning and decentralised decision making), while others show a more balanced distribution between agile and traditional nodes. This heterogeneity within a shared institutional context suggests that individual leadership style and personal orientation remain significant moderating variables, even when structural constraints are held roughly constant. This finding has important implications for leadership development recommendations, which are developed in the conclusion of this thesis.

Fourth, micromanagement and blame culture are visually almost absent from the radar chart across all respondents confirming their near-zero reference counts and supporting the interpretation that these dimensions of traditional leadership are not part of the lived professional identity of the respondents in this study.

SECTION 02 : Discussion and Recommendations

2.1 Discussion

2.1.1 The Hybrid Leadership Model: Agile Practices Within Traditional Structures

The central empirical contribution of this chapter is the documentation of what the data clearly show: a hybrid leadership model in which agile practices coexist with, rather than replace, traditional management structures. This finding is neither a failure of agile leadership implementation nor a simple transitional phase toward full agile adoption; it is, rather, a structurally necessitated and functionally coherent response to the specific operational reality of industrial development projects in an energy sector context.

This hybrid model is consistent with theoretical arguments for contextually adapted agility. (Aghina et al., 2021)cautioned that agile frameworks developed in technology contexts cannot be transposed wholesale into other organisational environments, and called for context-sensitive research into how agile principles are actually adapted in non-tech settings. The findings of this study respond directly to that call: they document, empirically and with qualitative depth, what contextually adapted agility looks like in an industrial development project environment. It involves the selective appropriation of agile practices primarily collaboration, flexibility, and continuous learning within a structural frame that remains sequential, validation-heavy, and hierarchically accountable.

This finding can also be interpreted through the lens of Joiner and Josephs' (2007) conceptualisation of agile leadership as the capacity to act effectively under competing pressures. The respondents in this study are, in precisely this sense, agile leaders: they navigate the competing demands of formal planning structures and the need for adaptive responses, of hierarchical accountability and team empowerment, of contractual rigidity and operational flexibility. The skill they demonstrate is not the wholesale abandonment of traditional management but the judicious, situationally calibrated integration of agile practices within a traditional institutional architecture.

2.1.2 Collaboration and Empowerment as the Anchoring Practice

The identification of collaboration and empowerment as the most densely coded dimension of agile leadership 26 references across all 8 respondents is not merely a statistical artefact. It represents a qualitatively meaningful finding about where agile leadership actually lives in this context. In the absence of formal agile frameworks (no Scrum sprints, no Kanban boards, no

formal retrospectives), collaboration and empowerment becomes the primary vehicle through which leaders exercise agile-oriented influence.

This finding resonates strongly with Jerab and Mabrouk's (2023) conceptualisation of agile leadership as the creation of environments where team members feel empowered to share ideas, take initiative, and work toward common goals. It also aligns with the servant leadership model (Greenleaf, 1970) which underpins the agile leadership literature, in which the leader's primary function is to create the conditions for team performance rather than to direct and control work. That this dimension registers most strongly across all respondents suggests that the servant leadership orientation, even if not named as such by respondents, is the most widely internalised aspect of agile leadership in this industrial context.

2.1.3 Rigid Planning and Command and Control as Structural Constraints Not Cultural Preferences

The high coding density of rigid planning (19 references, 8/8 sources) and command and control (17 references, 8/8 sources) within the traditional leadership node might initially be read as evidence that the respondents are traditional leaders who happen to use some agile vocabulary. A more careful reading, however, reveals a crucial distinction: respondents do not describe these structures as expressions of their leadership identity. Rather, they describe them as institutional realities within which they operate and against which they actively manage.

This interpretive distinction is supported by the comparative absence of micromanagement (0 references) and the near-absence of blame culture (3 references) two dimensions that would be expected to appear if respondents' leadership orientation were genuinely traditional and hierarchical. The absence of these softer dimensions of traditional leadership from the data suggests that what is being captured in the rigid planning and command-and-control nodes is structural constraint, not personal leadership philosophy.

This finding aligns with Rialti and Filieri's (2024) research on digital transformation in manufacturing, which identified the tension between institutional rigidity and individual leadership adaptability as a defining feature of industrial leadership in transition. It also resonates with the broader VUCA literature (Neubauer et al., 2017), which positions agile leaders as individuals who must navigate pre-existing organisational structures rather than simply replace them.

2.1.4 The Marginalisation of Customer-Centricity: An Industrial-Specific Finding

The limited definition of the concept of "customer focus" (5 references, 4 out of 8 sources) is a significant theoretical finding that warrants open discussion. In the Agile methodology and its software literature, client collaboration is a core value and perhaps the most prominent practical feature of agile project management. Therefore, its relative absence from the discourse of industrial project leaders is not a simple oversight.

The explanation lies in the structural characteristics of industrial development projects. In capital-intensive, multi-year infrastructure and development projects, the "client" is typically an internal stakeholder (another Sonatrach division), a regulatory body, or a national political mandate. The feedback loop between project teams and this "client" is institutionally managed, non-recurring, and governed by formal specifications rather than iterative consultation. This structural reality makes the concept of "customer focus" in the agile sense, continuous, direct, and participatory practically impossible in most phases of industrial project implementation. This finding reinforces the theoretical argument that Agile principles require contextualized application. While collaboration, learning, and agility can be adapted to industrial contexts without compromising the core logic of Agile, customer focus necessitates a complete overhaul or, in some cases, an explicit acknowledgment of its ineffectiveness in a specific industrial setting. This conclusion is both accurate and practically important for organizations seeking to adopt Agile leadership in industrial environments.

2.1.5 Informal Communication as an Agile Adaptation Strategy

One of the most analytically rich findings of the word frequency analysis is the prominence of 'informal' (10 occurrences, 1.30%) within the agile leadership node. This term does not appear prominently in the theoretical literature on agile leadership, yet it emerges with significant frequency from the discourse of respondents in this industrial context, suggesting that it constitutes a locally developed, contextually adaptive strategy for exercising agility within a formal institutional framework.

What respondents describe is a deliberate dual-track communication practice: formal communication follows the prescribed organisational channels written reports, validation memos, structured project reviews while informal communication corridor conversations, brief phone exchanges, ad hoc team huddles serves as the agile layer of the leadership system. The informal layer allows for the rapid, flexible, collaborative exchange of information that agile leadership requires, without violating the formal procedural requirements of the institutional environment.

This finding has a direct practical implication: organisations seeking to foster agile leadership in industrial contexts should recognise and value informal communication networks as a legitimate and valuable component of the leadership architecture, rather than treating them as workarounds or procedural anomalies.

2.1.6 Answers to the Research Sub-Questions

Having presented, analysed, and discussed the data in depth, this section provides explicit, structured answers to each of the six sub-questions that guided the empirical investigation.

Table 4 : Table 4 Summary of Answers to Sub-Questions

SQ	Sub-Question	Answer / Key Finding
SQ1	What is agile leadership and its principles?	Respondents defined it through practices: rapid problem-solving, informal communication, delegation, and continuous learning , consistent with the 3F model (Focused, Fast, Flexible).
SQ2	Intersection with traditional methodologies?	A hybrid coexistence: sequential planning and validation structures remain dominant, while agile practices emerge pragmatically within phase boundaries.
SQ3	Awareness of agile practices?	7 of 8 respondents engaged substantively with continuous learning concepts; all 8 reflected awareness of flexibility and collaborative leadership.
SQ4	How widely are practices applied?	Collaboration/empowerment (26 refs, 8/8 sources) and flexibility (21 refs, 8/8) are universally applied; customer-centricity remains marginal (5 refs, 4/8).
SQ5	Organizational and cultural challenges?	Rigid planning (19 refs, 8/8) and command-and-control structures (17 refs, 8/8) are the primary constraints. Procurement timelines and multi-level validation chains compound the difficulty.

SQ6	How does agile leadership build self-organizing teams?	Collaboration and empowerment is the single most coded node (26 refs). Leaders deliberately create space for team autonomy through informal channels, shared responsibility, and weekly coordination.

Source: presented by the author

What is agile leadership, and what are its key principles and characteristics ?

The empirical data generated by this study confirm and enrich the theoretical definition of agile leadership established in the literature review. Respondents do not conceptualise agile leadership in abstract terms but describe it through concrete practices: solving problems quickly, communicating informally and frequently, delegating authority situationally, learning continuously from operational experience, and fostering collaborative team environments. These empirical descriptors map directly onto the theoretical characteristics of agile leadership as defined by(Joiner & Josephs, 2007) effective action under complexity , and the 3F model of(Horney et al., 2010):being Focuse,d, Fast, and Flexible. The study thus stablishes that the theoretical framework of agile leadership has a coherent empirical correlate in the professional experience of industrial proect managers at Sonatrach.

How does agile leadership intersect with traditional methodologies ?

The data reveals a pattern of coexistence, rather than a dynamic replacement, between the two methodologies. The Waterfall methodology, with its sequential, verification-focused, and procurement-constrained logic, remains structurally dominant within Sonatrach's LQS project management framework. Agile leadership practices are not implemented as an alternative to this framework, but rather are practically integrated into it, particularly at the phase level, where leaders exercise flexibility in task sequencing, resource allocation, and team coordination without formally altering the overall project plan. This hybrid intersection represents a context-specific model for integrating agile and traditional methodologies, a model that has not yet been systematically documented in the current literature.

To what extent are project managers and leaders aware of agile leadership practices ?

The data demonstrate a substantive, if not always formally labelled, awareness of agile leadership principles among respondents. All 8 respondents engaged meaningfully with the agile leadership concepts explored in the interview (as evidenced by the universal source coverage of all major agile nodes except customer-centricity), and 7 of 8 discussed continuous

learning and improvement in substantive terms. Awareness, however, is predominantly experiential rather than formally trained: respondents describe having arrived at agile-oriented practices through career experience, operational necessity, and personal reflection rather than through structured agile training programmes. This suggests a significant opportunity for organisations to formalise and deepen this latent awareness through targeted leadership development.

How widely are agile leadership practices currently applied in industrial development projects ?

The application of agile leadership practices is broad but uneven. The two most fundamental agile dimensions , collaboration and empowerment (26 references, 8/8 sources) and flexibility and adaptability (21 references, 8/8 sources) , are universally and densely present, suggesting that these practices have become an embedded feature of effective project leadership at Sonatrach LQS, even if they are not formally named as agile. Continuous learning (18 references, 7/8 sources) and decentralised decision making (9 references, 8/8 sources) are present but less deeply elaborated, reflecting structural constraints that limit their full expression. Customer-centricity remains marginal (5 references, 4/8 sources), for the structural reasons discussed above. The overall picture is one of partial but meaningful agile practice, a finding of nuance and theoretical significance.

What organisational and cultural challenges hinder the implementation of agile leadership ?

The data identify several interconnected barriers. Structural constraints are paramount: rigid planning requirements (19 references, 8/8 sources), multi-level validation and approval chains (11 word-frequency occurrences in the traditional node), and long procurement lead times collectively constitute an institutional architecture that is fundamentally at odds with iterative, adaptive project management. Hierarchical command-and-control structures (17 references, 8/8 sources) compound this by concentrating decision-making authority in ways that limit the autonomy of project teams. Safety imperatives (5 occurrences in the traditional node) add a further, non-negotiable constraint: in an energy sector context, the tolerance for unplanned changes is minimal, and agile experimentation must be carefully bounded to avoid safety compromise. Cultural resistance, while not explicitly coded as a standalone node, is implicitly present in the coexistence of agile and traditional practices: change is gradual, contextually negotiated, and dependent on individual leadership initiative rather than systemic organisational commitment.

How does agile leadership help build self-organising teams and improve collaboration and communication ?

The data provide a rich and affirmative answer to this question. Collaboration and empowerment is the single most coded node in the entire study (26 references, 8/8 sources), establishing beyond analytical doubt that the building of collaborative, empowered team environments is the primary and most universally practised expression of agile leadership in this context. Respondents describe a range of concrete mechanisms: weekly informal coordination meetings, situational delegation of technical sub-decisions, active psychological safety-building, open knowledge-sharing across functional boundaries, and the explicit suppression of blame attribution. These practices collectively constitute what the agile leadership literature calls the enabling of self-organising teams, groups that possess sufficient autonomy, cohesion, and trust to coordinate their own work effectively within a shared goal framework.

2.1.7 Final Answer to the Central Research Question

« How are agile leadership practices applied in complex industrial projects at Sonatrach ? »

The empirical evidence gathered through eight qualitative interviews with project managers and LQS development leaders at Sonatrach, analyzed using NVivo qualitative software and validated through node repetition, word repetition, and cross-table methods, provides a precise and empirically grounded answer to the main research question.

Yes, agile leadership practices are applied in complex industrial development projects, but in a contextually specific and structurally constrained manner, unlike the agile model described in software development literature. This application is real and impacts project and team outcomes; however, it is not universal, formalized, or systematically institutionalized.

The empirical data collected allows for a precise, detailed, and empirically grounded answer to the main research question. The most established and prevalent Agile practices are collaboration and empowerment (implemented by all eight participants, with the highest coding intensity among all groups in the study), flexibility and adaptability (implemented by all eight participants, with the second-highest coding intensity for Agile), and continuous learning and improvement (implemented by seven out of eight participants). These three practices form the core of agile leadership as it is actually practiced in this industrial context.

These agile practices do not exist in isolation; rather, they intersect with established traditional leadership structures: rigid pre-planning, multi-level validation and approval processes,

hierarchical accountability chains based on command and control, and restrictive procurement processes. The simultaneous presence of these agile and traditional dimensions among all eight participants and across the entire coded dataset is the defining empirical feature of this study's findings. This interaction does not produce a transitional state awaiting resolution, but rather a structurally stable hybrid model: a style of industrial project leadership where agile practices act as a practical layer on top of a traditional institutional framework. This enables adaptation, collaboration, and learning within, not in place of, the formal structures required by industrial safety, contractual accountability, and organizational governance. This hybrid model is the authentic form agile leadership takes upon entering the industrial development project environment and represents the main empirical finding and key theoretical contribution of this research.

Therefore, we can say that agile leadership practices are applied within the context of industrial projects, and that they belong to the mindset of the leader in this environment, especially when it comes to achieving flexibility and adapting to unforeseen changes that may occur, also when it comes to achieving cooperation within project teams, which is indispensable for achieving balance and moving towards common goals, as well as achieving empowerment, although limited in view of the traditional hierarchical nature of decision-making, leaders have revealed underlying empowerment processes related to technical and engineering matters. In addition to this, through observation within the organization, several agile practices have been observed, the most important of which is continuous learning, through weekly meetings during which mistakes are presented, discussed, and transformed into future opportunities, and also through members sharing their experiences and skills with each other, and also through training courses for individuals and leaders in various fields: English language, management, quality management... while other practices remain little implemented, which may be due to the complexity of industrial projects and formal structures, and perhaps the lack of theoretical framing of the concepts of agility and agile leadership.

2.2 Recommendations and Limitations

The following recommendations emerge directly from the empirical findings of this study. They are not generic prescriptions imported from the software agile literature, but context-specific propositions grounded in the NVivo data: each is paired with its specific evidential basis so that practitioners and researchers can evaluate and adapt them intelligently.

2.2.1 Organisational Recommendations

- Institutionalise lightweight weekly coordination. 'Weekly' and 'meeting' each appear 8 times in the agile node, making brief informal coordination the primary vehicle through which respondents exercise agility within a formal structure. Organisations should formally recognise and protect these touchpoints, not as additional bureaucratic meetings, but as a standing protocol that gives teams legitimate authority to convene quickly without justification within the formal reporting chain.
- Introduce tiered decision-making authority. 'Validation' (11 occ.) and 'approval' (7 occ.) dominate the traditional leadership node, reflecting multi-level approval chains that apply indiscriminately to decisions of very different risk profiles. A tiered decision-authority matrix should formally distinguish low-risk, reversible decisions which should be delegated to team level from contractual or safety-critical decisions that legitimately require upward validation. This would create structural space for the decentralised decision making that all 8 respondents discussed but that remains constrained to only 9 references.
- Create 'agile pockets' within the Waterfall framework. The hybrid coexistence finding flexibility (21 refs) operating within rigid planning (19 refs) suggests that the path forward is not replacing Waterfall with agile but creating intra-phase adaptive planning windows: bounded periods in which teams can resequence tasks and reallocate resources without modifying the overarching project plan. In practice, this could take the form of a Kanban board within each phase or a fortnightly internal review cycle, preserving phase-gate discipline while enabling iterative adaptation.
- Formalise phase-gate retrospectives. Fourth proposal: Revitalize training courses. Continuous learning (18 references, 7 out of 8 sources) is the third most common flexible methodology practice, but it should be revitalized through teaching agile leadership practices.
- Embed a psychological safety framework. The near-absence of blame culture (3 refs / 2 sources) and the complete absence of micromanagement (0 refs) indicate that respondents actively resist blame-attributing leadership but this orientation is currently dependent on individual initiative. Explicit leader behavioural norms, anonymous problem-reporting channels, and recognition systems that

reward early problem identification would institutionalise this orientation and make it independent of any single leader's personal style.

2.2.2 Leadership Development Recommendations

- Design a contextualised agile leadership programme. All agile nodes are universally present in the data, confirming that the practice base exists; what is absent is formal recognition and development of these practices. A programme built around the hybrid model not imported from a software context should cover three areas: conceptual grounding in agile leadership principles and their industrial adaptations; practical skill development in collaborative facilitation, situational delegation, and structured retrospection; and organisational navigation how to create agile space within formal structures and advocate upward for more adaptive approaches.

- Cultivate 'unlearning' as an explicit leadership competency. McKenzie and Aitken's (2012) concept of 'unlearning' letting go of established procedures when a more effective approach has been identified is directly relevant to an environment where decades of sequential project management have created deeply embedded routines. Leadership development exercises should create structured opportunities for leaders to identify and critically examine their habitual practices, experiment with alternative approaches in a safe context, and be formally recognised for departing productively from established procedures when circumstances warrant it.

should operationalise the key dimensions of this model, specify the conditions under which different agile practices are applicable, and test the organisational outcomes associated with different hybrid configurations.

2.3 Limitations

The limitations of this study define its scope; the recommendations extend its reach. Together they reflect the responsible practice of interpretive research: acknowledging what cannot be claimed with the same precision with which findings are reported, and translating those findings into actionable directions for practitioners and scholars alike. Both the constraints and the propositions point toward the same horizon: a richer, more contextually grounded, and more methodologically diversified body of knowledge on agile leadership in industrial environments a field that is as consequential as it remains underexplored.

Every research project is bounded by the choices made during its design. Acknowledging those boundaries openly is a requirement of academic rigour, not an admission of failure. The limitations below define the conditions under which the findings of this study should be read and applied; they do not invalidate those findings, but they determine their appropriate scope.

2.3.1 Sample Size and Single Research Site

Eight interviews were conducted within a single organisational division. From a qualitative standpoint this is appropriate thematic saturation was achieved and all major nodes showed cross-respondent convergence but it constrains transferability. The findings are analytically generalisable to similar industrial contexts, not statistically representative of the wider population. Sonatrach LQS is furthermore a specific environment: a state-affiliated energy major with its own governance logic, regulatory obligations, and organisational culture. Patterns that are structurally strong here such as rigid planning and multi-level validation may operate differently in private firms or other sectors. Comparative multi-site research is the natural next step.

2.3.2 Leader-Only Perspective and Self-Reporting Bias

Only project leaders were interviewed; the team member experience of their leadership remains unexamined. Research in organisational psychology consistently shows that leaders and followers hold divergent perceptions of the same behaviours, and that this divergence matters for outcomes. Additionally, all data are self-reported: respondents describe their own practices in an academic interview context, which introduces social desirability effects. The near-total absence of micromanagement (0 references) and the very low presence of blame culture (3 references) may partly reflect the genuine character of respondents' leadership, but may also partly reflect the undesirability of these behaviours in a self-presentation context. Future research should triangulate leader accounts with team member interviews and observational data.

2.3.3 Cross-Sectional Design and Limited Observation

Data were collected at a single point in time, which means the study captures a snapshot rather than a process. Industrial projects unfold across extended and varied phases; the leadership practices that are adaptive and collaborative in one phase may become more directive in another. A longitudinal design tracking the same leaders across full project lifecycles would yield significantly richer insights. Compounding this, the planned observational component was limited in scope due to access constraints: actual leadership behaviours cannot be fully triangulated against stated ones, and the documentary analysis was restricted by standard confidentiality limitations common to large industrial organisations.

2.3.4 Researcher Positionality

This study adopts an interpretive epistemological stance, which means the researcher is the primary analytical instrument. The coding framework, the thematic choices, the theoretical lenses applied all reflect a particular interpretive reading of the data. This is appropriate for the research objectives and is consistent with the methodological tradition within which the study operates. It does, however, mean that alternative codings are possible, and reflexivity about this fact is itself a mark of interpretive rigour.

Table 5: Summary of Limitations

Limitation	**Nature**	**Implication**
Sample size (n = 8)	Purposive qualitative sampling; single division.	Findings are analytically not statistically generalisable.
Single research site	One division of one state-affiliated energy company.	Contextual specificity limits cross-sector claims.
Leader-only perspective	Team members were not interviewed.	Team experience of agile leadership remains unexamined.
Self-reporting bias	Interview data reflect respondents' own accounts.	Social desirability may inflate agile self-descriptions.
Cross-sectional design	Data collected at a single point in time.	Cannot capture change in practices across project phases.
Limited direct observation	Observational component was restricted in scope.	Stated and actual behaviours cannot be fully triangulated.
Researcher positionality	Interpretive epistemology; researcher is the analytical instrument.	Alternative codings of the same data remain possible.

CONCLUSION

This chapter has presented a systematic, multi-layered analysis of qualitative data generated through eight semi-structured interviews at Sonatrach's LQS Development Department. Through node-level coding, word-frequency analysis, and matrix crosstabulation in NVivo, the chapter has documented the concrete texture of agile leadership practice in an industrial development project context its most prevalent dimensions, its specific vocabulary, its individual variation across respondents, and its structural conditions of possibility and constraint.

The findings establish that collaboration and empowerment, flexibility and adaptability, and continuous learning and improvement are the dominant agile practices in this context, while rigid planning and command-and-control structures represent the primary traditional constraints. The resulting hybrid leadership model in which agile practices are selectively layered within a formal traditional architecture constitutes the distinctive and theoretically original empirical contribution of this research.

The chapter has also demonstrated how the findings respond to each of the six sub-questions of the study and provide a nuanced, evidence-based answer to the central research question. The answer that agile leadership practices are applied, but in a contextually bounded and structurally adapted hybrid form challenges both the uncritical optimism of agile enthusiasts who assume that agile can be seamlessly transposed into any setting, and the dismissive scepticism of those who regard agile as incompatible with industrial environments. The reality documented here is more complex, more interesting, and more instructive than either extreme position allows.

The findings, limitations, and practical implications of this research are developed in the concluding chapter of this thesis, which also presents recommendations for organisational leadership development and directions for future research.

GENERAL CONCLUSION

This research was driven by a fundamental observation: as industrial environments grow increasingly volatile and complex, the traditional leadership frameworks governing project management have struggled to keep pace. Agile leadership emerged as a promising response to this challenge yet its applicability within industrial development projects, governed by sequential planning, contractual rigidity, and strict safety imperatives, remained largely unexplored in the existing literature. It was this gap that defined the central question of the present study : “How are agile leadership practices applied in complex industrial projects in Algeria ? ”

To answer this question, an interpretive qualitative investigation was conducted within Sonatrach's Liquefaction and Separation Activity, Development Division a research site whose structural characteristics make it both representative of and analytically relevant to the broader industrial project management context. Eight semi-structured interviews with project managers and team leaders, complemented by direct observation and analyzed through NVivo qualitative software, generated the empirical foundation upon which the findings rest.

The results confirm that agile leadership practices are genuinely present in this industrial context, though in a form that is contextually adapted and structurally constrained. Collaboration and empowerment, flexibility and adaptability, and continuous learning emerge as the dominant and most universally enacted agile dimensions, while rigid planning, hierarchical command-and-control structures, and multi-level validation chains constitute the primary institutional constraints. The interaction between these two orientations produces the central theoretical contribution of this research: the empirical documentation of a hybrid leadership model, in which agile practices function as a deliberate adaptive layer operating within rather than replacing a formal traditional project architecture. The concept of bounded adaptability is introduced to characterize the specific texture of flexibility as practiced in this context, and informal communication is identified as a key behavioral mechanism through which leaders exercise agility within a highly formalized institutional environment.

These findings challenge both the uncritical assumption that agile frameworks can be seamlessly transposed into any organizational setting, and the dismissive view that industrial environments are fundamentally incompatible with agile principles. The reality documented here is more complex and more instructive than either position allows: agile leadership does

not transform industrial project management it quietly and purposefully inhabits it, bending toward collaboration, learning, and adaptability within the boundaries that safety, contract, and governance impose. This study is not without limitations. Its findings are grounded in a single organizational division, draw exclusively on leader perspectives, and capture a cross-sectional snapshot rather than a longitudinal process. Future research should extend this work through multi-site comparative designs, incorporate team member perspectives to triangulate leader accounts, and pursue longitudinal inquiry capable of tracking how hybrid leadership practices evolve across the full lifecycle of industrial projects. Ultimately, this research affirms that agile leadership in industrial contexts is neither an illusion nor a wholesale revolution it is a disciplined, contextually negotiated practice, enacted daily by leaders who have learned, often without formal training, to be focused, fast, and flexible within the most demanding of operational constraints.

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APPENDICES

SEMI-STRUCTURED INTERVIEW GUIDE

Agile Leadership Practices in Industrial Projects Management in Algeria

Research Details

- **Research Institution:** Higher National School Of Management (ENSM)
- **Programme:** Master in Project Management & Entrepreneurship
- **Research Site:** Sonatrach, LQS Division, Development Department
- **Document Type:** Semi-Structured Qualitative Interview Guide
- **Estimated Duration:** 30 to 45 minutes per session
- **Confidentiality:** Strictly anonymous | Academic use only

Introduction:

Thank you for agreeing to participate in this study. I am conducting research for my master's dissertation in Project Management and Entrepreneurship at the Higher school of management (ENSM).

My research explores how agile leadership practices are applied (or can be applied) within industrial development projects, specifically within the LQS division at Sonatrach.

This interview is entirely confidential. There are no right or wrong answers. What matters is your professional experience and your personal perspective as a practitioner. I may ask follow-up questions to better understand your point of view. With your permission, I would like to record this conversation solely for transcription purposes. The recording will not be shared with anyone and will be destroyed after analysis.

SECTION 1: Professional Background and Project Context

Purpose: Understand the respondent's professional trajectory, the nature of their projects, and the operational environment they navigate.

- **Q1:** Could you briefly introduce yourself, your professional background, your current role?
- **Probe:** How long have you been working in project management specifically? Has

your role evolved over the years, and if so, in what direction?

- **Q2:** How would you describe the projects you currently manage in terms of complexity, scale, and duration?
- **Probe:** What makes these projects particularly demanding compared to simpler or shorter-cycle projects? Do the constraints tend to be more technical, organizational, or both?
- **Q3:** In your experience, what are the most recurrent sources of uncertainty or unpredictability in the industrial development projects you manage at Sonatrach?
- **Probe:** Would you say these sources of complexity have increased in recent years? What has changed in your operating environment?

SECTION 2: Understanding and Perception of Agile Leadership

Purpose: Assess the respondent's level of familiarity with agile leadership as a nuanced understanding. Addresses Sub-questions 1 and 3.

- **Q4:** When you hear the term "agile leadership," what comes to mind? How would you personally define it in the context of your work?
- **Probe:** Do you distinguish between agile leadership and agile project management methodologies like Scrum or Kanban? How do you see the relationship between the two?
- **Q5:** Have you encountered the concept of agile leadership through formal training, reading, or professional exchange? How has your understanding of it developed over time?
- **Probe:** Were there specific moments in your career (particular projects or crises) that made you more interested in more adaptive or flexible ways of leading?
- **Q6:** How would you differentiate the way you lead your team today from how a more traditional, directive manager might operate in a similar industrial setting?
- **Probe:** Do you see yourself as closer to what theorists call a "command-and-control" leader, a "servant leader," or something in between? How did you arrive at your current style?

SECTION 3: Leadership in Practice: Decisions, Adaptation, and Team Dynamics

Purpose: To explore how project managers lead their teams day-to-day, adapt to uncertainty, apply agile-inspired practices, and foster a culture of empowerment, collaboration, and continuous improvement within the industrial context.

- **Q7:** How do you make decisions within your projects, and to what extent do you involve your team in that process? How do you balance delegating authority with maintaining accountability?
- **Probe:** Do you adjust your decision-making style depending on the complexity or urgency of the situation? Have you ever deliberately given a team member more authority than their role formally required, what prompted that, and how did it affect the sense of ownership within the team?
- **Q8:** How do you manage communication and knowledge-sharing within your project team particularly when members come from different technical backgrounds or departments?
- **Probe:** What tools, rhythms, or formats do you use to keep the team aligned and surface problems early? Are there moments when technical silos create friction? How do you break those down, through structured mechanisms or informal exchanges?
- **Q9:** What project management methodology do you primarily use, and how does it fit the realities of your projects? Have you found yourself departing from that framework in certain situations, and if so, what drove that shift?
- **Probe:** Agile leadership involves the capacity to 'unlearn', to let go of familiar procedures when a more effective approach exists. Have you experienced that? Was it driven by your own initiative, by your team, or by the pressure of circumstances?
- **Q10:** When an unforeseen event disrupts a project (such as a supply delay, a technical failure, or a sudden change in scope) what is your typical response? And more broadly, how do you incorporate flexibility and iterative thinking into your planning?
- **Probe:** Do you have established rapid-response mechanisms, or is each disruption handled ad hoc? Are there structural or contractual constraints that limit your ability to plan in shorter, adjustable cycles? How do you navigate the tension between long industrial procurement timelines and the need to remain adaptive?
- **Q11:** How do you handle mistakes and failures within your team — and how do you

create an environment where people feel safe enough to raise concerns, challenge assumptions, or try new approaches without fear of blame?

- **Probe:** In a context governed by strict safety and technical standards, how do you reconcile the industrial imperative of zero error with the value of learning from failure? Have there been situations where a team member's candid input, or an unconventional idea, proved critical to the project's progress?
- **Q12:** Do you build structured moments for collective reflection and continuous improvement into your project cycles, or does improvement tend to happen informally and reactively?
- **Probe:** After a completed phase or a significant challenge, do you and your team systematically review what worked and what did not? What happens to those lessons, are they documented, shared, acted upon, or do they remain informal? How do you prevent the same problems from recurring across projects?

SECTION 4: Obstacles and Challenges to Agile Leadership in the Industrial Context

Purpose: Systematically explore the barriers that limit agile leadership in an industrial and organizational context like Sonatrach. Central to Sub-question 5.

- **Q13:** What are the most significant structural or organizational obstacles that prevent a more adaptive and agile approach to project leadership at Sonatrach?
- **Probe:** Do you feel that hierarchical structures, validation chains, or bureaucratic processes limit your ability to respond quickly to change? Can you give a concrete example?
- **Q14:** Beyond structural constraints, do you perceive cultural or behavioral resistance within your team, your peers, or higher management to more flexible and collaborative ways of working?
- **Probe:** Where does this resistance tend to come from? Is it a matter of habit, risk aversion, a lack of trust, or something else? How do you navigate it?
- **Q15:** Do you feel adequately equipped "in terms of training, tools, and institutional support" to practice a more agile style of leadership? What resources or conditions are currently lacking?
- **Probe:** If you could change one thing about your organizational environment to make adaptive leadership more feasible, what would it be?

SECTION 5: Conditions for Success and Forward-Looking Perspectives

Purpose: Gather the respondent's vision of what would enable agile leadership to take root more deeply in their industrial environment. Oriented toward the study's practical recommendations.

- **Q16:** Based on your experience, what conditions (cultural, organizational, technical, or human) are most essential for agile leadership to be successfully and sustainably practiced in an industrial project environment like yours?
- **Probe:** Are there particular moments in a project's lifecycle where you find agile principles most naturally applicable? Where do they tend to break down?
- **Q17:** Finally, if you were advising a newly appointed project manager at Sonatrach on how to lead effectively in complex industrial development projects, what would your core guidance be?
- **Probe:** What do you wish someone had told you earlier in your career about navigating the specific tensions between industrial rigor and leadership adaptability?

CLOSING STATEMENT: To be delivered at the end of each interview

Thank you very much for your time and for the quality of your reflections. Your contribution is genuinely valuable to this research. If you think of anything else you would like to add after this conversation, please feel free to get in touch. Once the analysis is complete, I would be happy to share the findings with you if you are interested.

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