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Theme:

Optimization of Planning through Management Tools: Case Study: FTTH, Algérie Télécom, Tipasa

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ABSTRACT

This research investigates how the optimization of planning tools and methods can improve project schedule reliability within infrastructure project environments. Facing systematic gaps between theoretical planning and field execution, a mixed-method approach was adopted, combining semi-structured interviews analyzed via NVivo, a questionnaire processed via SPSS, and a project management software simulation for the optimized model, using a case study of a telecommunications infrastructure project. The results show that delays are primarily caused by external administrative constraints, that the internal monitoring platform is descriptive rather than corrective, and that proactive planning integrating external constraints from the start can substantially reduce active execution duration. The study concludes that developing a customized planning application adapted to the specific organizational context is necessary to improve project reliability.

Keywords: Planning optimization, management tools, project management software, administrative delays, Earned Value Management, schedule reliability.

RÉSUMÉ

Cette recherche examine comment l'optimisation des outils et méthodes de planification peut améliorer la fiabilité des plannings de projets dans les environnements d'infrastructure. Face à des écarts systématiques entre la planification théorique et l'exécution terrain, une approche mixte a été adoptée, combinant des entretiens semi-directifs analysés par NVivo, un questionnaire traité par SPSS, et une simulation sur logiciel de gestion de projet pour le modèle optimisé, à travers une étude de cas d'un projet d'infrastructure télécoms. Les résultats montrent que les retards sont principalement causés par les contraintes administratives externes, que la plateforme de suivi interne est descriptive et non corrective, et qu'une planification proactive intégrant les contraintes externes dès le départ peut réduire significativement la durée active d'exécution. L'étude conclut à la nécessité de développer une application de planification sur mesure, adaptée au contexte organisationnel spécifique, pour améliorer la fiabilité des projets.

Mots-clés : Optimisation de la planification, outils de gestion, logiciel de gestion de projet, délais administratifs, valeur acquise, fiabilité des plannings.

ملخص الدراسة

تبحث هذه الدراسة في كيفية تحسين أدوات وأساليب التخطيط من أجل تعزيز موثوقية الجداول الزمنية للمشاريع ضمن بيئات مشاريع البنية التحتية. وفي ظل وجود فجوات منهجية بين التخطيط النظري والتنفيذ الميداني، تم اعتماد منهجية مختلطة تجمع بين المقابلات شبه الموجهة التي تم تحليلها باستخدام NVivo، واستبيان تم معالجته بواسطة SPSS، و محاكاة باستخدام برنامج لإدارة المشاريع للنموذج المحسن، وذلك من خلال دراسة حالة لمشروع بنية تحتية في قطاع الاتصالات.

أظهرت النتائج أن التأخيرات ناتجة أساسًا عن قيود إدارية خارجية، وأن منصة المتابعة الداخلية ذات طابع وصفي أكثر من كونها تصحيحيًا، وأن التخطيط الاستباقي الذي يدمج القيود الخارجية منذ البداية يمكن أن يقلل بشكل كبير من مدة التنفيذ الفعلية. وخلصت الدراسة إلى أن تطوير تطبيق تخطيط مخصص ومكيف مع السياق التنظيمي المحدد يعد ضروريًا لتحسين موثوقية المشاريع.

الكلمات المفتاحية: تحسين التخطيط، أدوات الإدارة، برامج إدارة المشاريع، التأخيرات الإدارية، إدارة القيمة المكتسبة، موثوقية الجدول الزمني.

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LIST OF ABBREVIATIONS

ADSL : Asymmetric Digital Subscriber Line

AHP : Analytic Hierarchy Process

MPA : Municipal People's Assembly

DDP : Detailed Design Plan

BIM : Building Information Modeling

CNPE : National Council of State Participations (Conseil National des Participations de l'État)

CPM : Critical Path Method

CPI : Cost Performance Index

CV : Cost Variance

DMAIC : Define, Measure, Analyze, Improve, Control

OTD : Operational Telecommunications Directorate

DPW : Directorate of Public Works

DZD : Algerian Dinar

EPS : Enterprise Project Structure

EVM : Earned Value Management

FAT: Fiber Access Terminal

FTTB : Fiber To The Building

FTTC : Fiber To The Curb

FTTH : Fiber To The Home

GPS : Global Positioning System

HDPE : High-Density Polyethylene

KPI : Key Performance Indicator

LPS : Last Planner System

LSS : Lean Six Sigma

Mbps : Megabits per second

MPM : Métra Potentiel Méthode (French Precedence Diagramming Method)

MS Project : Microsoft Project

ODN: Optical Distribution Node

ODS : Optical Distribution Segment

ONT : Optical Network Terminal

PERT : Program Evaluation and Review Technique

PI : Performance Indicator / Composite Indicator

PMBOK : Project Management Body of Knowledge

PMI : Project Management Institute

PMO : Project Management Office

POM : Performance Optimization Model

PPC : Percent Plan Complete

PTO : Optical Terminal Outlet (Prise Terminale Optique)

SPA : Société Par Actions (Joint-Stock Company)

SPI : Schedule Performance Index

SPSS : Statistical Package for the Social Sciences

SV : Schedule Variance

VPN : Virtual Private Network

WBS : Work Breakdown Structure

WLL : Wireless Local Loop

INTRODUCTION

INTRODUCTION

1. Context and Theme Interest

In today's highly competitive and rapidly evolving business environment, organizations are compelled to continuously enhance their operational efficiency, flexibility, and competitiveness to maintain long-term advantage. Traditional management styles, characterized by rigid planning structures, hierarchical decision-making processes, and long-term forecasting, have increasingly revealed their shortcomings in adapting to constant changes in customer expectations, market dynamics, and emerging technologies. As industries grow in complexity and integration, businesses must develop the capacity to respond swiftly to changing conditions, streamline processes, and make real-time decisions to remain agile, responsive, and competitive.

Project management has evolved significantly in response to these challenges. Planning—the fundamental phase of any project—determines the trajectory of project execution and ultimately influences success or failure. Yet, across many sectors, a persistent gap remains between what is planned and what is actually achieved on the ground. This gap is not merely a matter of poor execution; it often reflects deeper weaknesses in the management tools and methods employed, as well as an insufficient integration of technical and external constraints into the planning process.

While traditional tools such as Gantt charts, PERT networks, and project management software have provided valuable support for structuring and visualizing project schedules, their effectiveness is neither automatic nor universal. Research has shown that the rigidity of these tools, their linear and static vision of project progress, and their tendency to disconnect planning from field realities can paradoxically hinder responsiveness rather than enhance it. The challenge, therefore, is not simply to plan, but to plan reliably—to develop schedules that reflect actual execution conditions and adapt to unforeseen events without losing strategic coherence.

In Algeria, these challenges are particularly acute. Infrastructure projects across multiple sectors—construction, telecommunications, energy, and logistics—routinely experience systematic delays. Common root causes include administrative permit delays, fragmented coordination between stakeholders, underestimation of field constraints, weak monitoring systems, and a reactive rather than proactive approach to risk management. These problems are not sector-specific; they reflect structural characteristics of project management in the Algerian public sector context, where bureaucracy, centralization, and limited digital transformation slow decision-making and hinder responsiveness.

2. Purpose of the Study

This research aims to investigate how the reliability of project planning can be improved through better utilization of management tools and more effective integration of technical and external constraints. Rather than focusing on a single methodology or tool, the study adopts a comprehensive perspective that examines the entire planning system: from initial schedule development to real-time monitoring, from internal coordination to external stakeholder management, from diagnostic analysis to optimized modeling.

The study is grounded in a case study of FTTH network deployment projects within Algeria Telecom's Tipaza Operational Directorate. FTTH projects are particularly well-suited for this investigation because they encapsulate the typical challenges of infrastructure projects in Algeria: technical complexity, administrative dependencies, subcontractor coordination, field unpredictability, and the need for real-time communication between office-based planners and field technicians.

However, it is essential to clarify that FTTH deployment serves as a case study—a concrete empirical context—and not as the exclusive focus of the research. The objective is not to produce findings limited to telecommunications infrastructure but to draw insights that are transferable to other project management contexts facing similar challenges. By examining in depth how planning functions in a real-world setting, the research aims to identify generic weaknesses in planning systems and propose solutions—such as proactive constraint integration, real-time field reporting, critical path optimization, and performance metrics—that can be adapted across sectors.

Thus, the research seeks to achieve the following specific objectives:

Diagnose the current state of project planning within the case study context, identifying the root causes of systematic delays and the specific weaknesses of existing management tools.

Analyze the gap between planned schedules and actual field execution, quantifying the extent of schedule deviation and identifying the primary contributing factors.

Propose an optimized planning model that integrates external constraints directly into the schedule rather than treating them as reactive risks to be managed after delays occur.

Demonstrate how critical path analysis, resource leveling, baseline tracking, and performance measurement metrics can transform planning from a descriptive, lagging process into a proactive, predictive, and corrective one.

Provide actionable recommendations for organizations seeking to improve planning reliability.

3. Research Problem

The central problem driving this research emerges from a persistent observation across multiple project contexts: schedules are established, resources are allocated, and monitoring systems are in place—yet execution systematically lags behind planning. The gap between forecast and reality is not exceptional but normative, suggesting fundamental weaknesses in planning systems rather than isolated execution failures.

This observation raises critical questions about the effectiveness of current management tools and methods. Why do structured planning processes fail to produce reliable schedules? Why do external constraints consistently disrupt execution despite being predictable? Why do monitoring platforms describe what has already happened rather than enabling corrective action before delays become critical? And most importantly, what changes to tools, methods, and organizational practices would transform planning from a reactive, descriptive exercise into a proactive, predictive, and corrective driver of project performance?

Therefore, the research problem can be formulated as follows:

"To what extent can the optimization of planning tools and methods improve the reliability of project schedules through better integration of technical and external constraints?"

This main question is accompanied by the following sub-questions:

What are the primary causes of planning delays in infrastructure projects? Are these causes predominantly technical, organizational, or external in nature?

How do current management tools contribute to or fail to address the gap between planned and actual progress?

What functionalities would an optimized planning system need to integrate to effectively address identified weaknesses?

To what extent can the proactive integration of external constraints directly into the planning process improve schedule reliability?

4. Research Field

The research is conducted at the Tipaza Operational Directorate of Algeria Telecom, a decentralized structure responsible for the management, operation, and development of telecommunications networks throughout the territory of the wilaya of Tipaza. This directorate manages FTTH deployment projects in an area characterized by strong urban growth and high demand for connectivity, making it an ideal field for studying planning challenges in a real-world context.

The choice of this field is strategic for several reasons. First, FTTH projects encapsulate the complexity typical of modern infrastructure projects: multiple interdependent technical stages, coordination with external subcontractors, dependency on administrative permits, and unpredictable field conditions. Second, the implementation model—Algeria Telecom acts as project owner while outsourcing execution to subcontractors—introduces contractual fragmentation and coordination challenges that are common across many sectors. Third, the systematic delays observed in these projects provide rich material for diagnosing planning system weaknesses and testing optimization solutions.

The study focuses specifically on a concrete FTTH project executed in 2025 in the municipality of Cherchel, serving as the empirical basis for the diagnosis and optimization simulation. However, the findings are not limited to this single project; they are interpreted in light of broader patterns observed across multiple projects and confirmed through interviews and survey data.

5.Research Hypotheses

Based on the research problem formulated above, the following hypotheses are proposed:

H_1: The optimization of planning tools improves schedule reliability in FTTH projects.

H_2: The proactive integration of external constraints (administrative permits, subcontractor coordination) into the planning process significantly reduces execution delays.

H_3: The use of a customized planning application with real-time field reporting is more effective than the current descriptive platform.

6. Methodology

Given the complexity of the research problem and the need to both understand subjective experiences and measure objective gaps, a mixed-method approach combining qualitative and quantitative techniques has been adopted. This methodological choice is grounded in a pragmatist epistemological stance, which prioritizes practical outcomes and allows the researcher to combine different methods to best answer the research question.

The research design is a single case study of the Tipaza Operational Directorate, selected not for convenience but for its relevance as a field where planning difficulties are acute and well-documented. An abductive mode of reasoning guides the analysis, moving back and forth between field observations and theoretical models to identify causes and propose realistic solutions.

Data collection employs four complementary techniques:

Documentary Analysis of internal documents, including specifications, schedules, progress reports, and project characteristics. These documents provide the official vision of planning against which field reality is compared.

Direct Observation over a period of fifteen days, allowing the identification of gaps between planning and execution that do not appear in official reports.

Semi-Structured Interviews with key actors occupying different functional positions, explored through five thematic axes: planning and technical design, organization and project management, monitoring and management platform, deadlines and project performance, and limitations and improvement.

Questionnaire administered to planning and monitoring staff to complement the qualitative data by providing statistical weight to identified patterns.

The current state diagnosis is established through thematic analysis of interviews and statistical analysis of questionnaire data. The optimized model is developed using project management software simulation, applying critical path analysis for duration compression, resource leveling for workload balancing, baseline tracking for deviation detection, and performance measurement metrics for objective evaluation. The comparison between current and optimized states provides quantifiable evidence of potential improvements.

To ensure validity and reliability, the research employs methodological triangulation, member checking, and transparent documentation of all research procedures. Ethical considerations include informed consent, anonymity, confidentiality, and respect for organizational data policies.

7. Plan of the Study

This research is structured into three principal chapters, followed by a general conclusion.

Chapter One: Theoretical and Conceptual Framework of Planning establishes the theoretical foundation. It is divided into a literature review examining project planning, management tools, and planning optimization, followed by a conceptual framework that synthesizes these concepts into an integrated model.

Chapter Two: Methodological Framework and Organization Presentation details the research approach. The first section presents the methodological choices, data collection techniques, sampling, data analysis methods, validity and reliability, ethical considerations, and limitations. The second section presents the organizational context: Algeria Telecom, the Tipaza Operational Directorate, and the specific FTTH project studied as the empirical basis for the investigation.

Chapter Three: Results Analysis and Discussion presents the empirical findings. The first section presents and analyzes the qualitative results from interviews, the quantitative results from the questionnaire, the synthesis of qualitative and quantitative findings, and the simulation results comparing current and optimized planning models. The second section discusses the findings in light of the theoretical framework, answers the research problem, summarizes key findings, formulates recommendations, and acknowledges limitations.

The General Conclusion synthesizes the research contributions, discusses theoretical and practical implications, and suggests directions for future research.

CHAPITER 1 : THEORETICAL AND CONCEPTUAL FRAMEWORK OF PLANNING

CHAPTER 1: THEORETICAL AND CONCEPTUAL FRAMEWORK OF PLANNING

Section 01 : Literature Review"

The literature review is essential for gaining a thorough understanding of the constraints inherent in project scheduling. The aim is to establish the relevance of the analysis through a rigorous scientific approach to the study, which guarantees its robustness and validity.

Critical reflection on traditional and contemporary project management techniques contributes to the development of the theoretical framework. It highlights the evolution of planning tools, from the transition from traditional methods to techniques that are significantly more efficient and adapted to contemporary imperatives in terms of time, cost, and quality.

This is why studying academic contributions allows for a comprehensive understanding of the foundations of planning theory as well as the main methodological advances. It provides a fundamental basis for rigorously addressing the problem of project planning. The literature review aims to establish the research problem, using current and reputable scientific knowledge to strengthen its scientific validity.

A review evaluating the use of traditional and modern project management contributes to the creation of a strong and coherent theoretical framework. It also demonstrates the transfer of planning methods from traditional to more modern and productive approaches, which are aligned with current trends in terms of time, cost, and quality.

Thus, the study of academic contributions allows us to better understand the theoretical basis of planning and to discover the main improvements used.

1.1Project planning

In an environment characterized by increasing complexity in project planning, coupled with high performance expectations, scheduling as a strategic lever occupies a central place in project management. It provides the operational foundations for scheduling, coordinating and tracking necessary tasks, while also offering a platform for anticipating constraints.

It is important to emphasize that the significance and success of a project are closely linked to its sound organization and planning. The primary objective is to organize tasks, optimize resource allocation and utilization, and ensure that all deadlines are met. Consequently, various paradigms and frameworks have been developed to enhance the efficiency of the process.

furthermore, the objective of this section is to examine the essential concepts of project management, highlighting its objectives, stages, and impact on the overall performance of project management, especially those in the telecommunications sector.

moreover, the purpose of planning is to support the decision-making process and increase project performance.

Planning is an essential tool for project management, as it provides a structured framework for anticipating the sequence of activities necessary to achieve assigned objectives. Beyond its operational dimension of task allocation, it serves as a genuine decision-making support mechanism, enabling the optimization of resource allocation and ensuring the project's trajectory remains on track.

According to (Kerzner, 2022) to, planning must be part of a rigorous systematic approach, which must imperatively link optimal resource allocation, activity scheduling and performance management.
In this same vein, Project Management Institution (PMI, 2021) stipulates that planning is a fundamental normative framework.

This framework allows for overall quality control and ensures that deliverables conform to the initial project requirements

Furthermore, research (Tesfaye, Ermias; Lemma, Tekalign; Berhan, Eshetie; Beshah, Birhanu, 2017) has shown that adopting rigorous planning methodologies, based on a precise definition of activities and accurate time estimation, significantly improves project success. Along these lines, a comparative analysis conducted by (Zwikael & Globerson, 2006) demonstrates that organizations integrating systematic planning approaches exhibit superior operational and strategic performance; through their comparative research, organizations that implement systematic planning methods achieve superior business results.

Research findings show that planning is the primary method organizations use to improve their project performance. Some studies describe the technical and organizational aspects of planning, while others demonstrate its strategic value in leading to organizational success.

CHAPTER 1: THEORETICAL AND CONCEPTUAL FRAMEWORK OF PLANNING

Planning functions both as a practical tool that helps organizations design their work processes and as a strategic tool that helps organizations reduce project risks while increasing success. Underpinned by strategic imperatives, the planning phase directs efforts toward sustainability, acting as the primary driver of overall project performance. Beyond simple organization, it notably promotes optimized resource allocation, rigorous adherence to deadlines, and improved management of the uncertainties inherent in each operational phase.

From the perspective of institutional project management frameworks (PMI, 2021) , the planning process provides the necessary tools to rigorously define the decision-making scope, while anticipating risks and structuring budget and time estimates. In This context, (Wysocki, 2023) it highlights the pivotal role of this step in strengthening interaction between stakeholders, thereby fostering systemic and harmonious coordination of operational processes.

Empirical studies corroborate these strategic contributions. Analyses reveal that optimized project performance is often a direct result of rigorous planning (Meredith, J. R. & Mantel, S. J., 2021), thus validating the idea that upstream strategic quality dictates operational outcomes. More recently, researchers have emphasized that the robustness of the decision-making process intrinsically relies on the technical reliability of the plans (Ying, Hao; Zhang, Shanshan; Zhao, Xiande; Zhang, Min, 2023). Consequently, planning goes far beyond a mere preliminary formality; it has become a vital, iterative process, uniquely capable of managing the increasing complexity that characterizes today's projects.

It would be reductive to view planning as a mere list of tasks; rather, it is the true driving force behind the viability of any managerial approach. Far from conventional models, it presents itself as a critical architecture enabling the meticulous allocation of resources, while imposing close monitoring of schedules and mitigating unforeseen events that could hinder execution.

By examining the frameworks of reference (PMI, 2021), we see that this dynamic provides the necessary foundation for defining the decision-making scope and refining the accuracy of budget projections. In this vein, (Wysocki, 2023) it is argued that the added value of planning lies in its ability to streamline information exchange between the various partners, thus establishing genuine synergy within the collective.

This viewpoint is echoed in the conclusions of (Meredith, J. R. Mantel, S. J., 2021) , which confirm that the quality of upstream preparation largely dictates the success of operations on the ground. Similarly, (Ying, Hao; Zhang, Shanshan; Zhao, Xiande; Zhang, Min, 2023) provides a crucial insight: a decision-maker's confidence in their choices stems intrinsically from the robustness of the plans established beforehand.

Ultimately, planning should no longer be confined to the role of "first step"; it constitutes a perpetual readjustment process, an iterative dynamic indispensable for navigating with discernment in the complexity of current projects.

Beyond simply ordering tasks chronologically, structuring a project is akin to true decision engineering. It's not just about listing tasks, but about translating a strategic vision into a set of coherent actions. According to industry standards (PMI, 2021) this process requires a detailed breakdown: from the initial milestone to the technical establishment of dependencies.

In this context, (Wysocki, 2023) a key idea is emphasized: the robustness of a schedule depends on the precision with which resources are allocated. To counter the uncertainties that often distort estimates, research (Toljaga-Nikolić Danijela, Petrović Dejan, Suknović Milija, & Mihić Marko, 2014) provides essential regulatory mechanisms. More recently, tactical approaches (Noureddine, Anis; Soumis, François; Pellerin, Robert, 2025) suggest that planning must become more agile to absorb the shocks and variations inherent in large-scale infrastructure projects.

1.2Project management tools: an analysis of their effectiveness

It appears that in the current context, the success of a project is no longer a matter of chance or a simple paper plan. It relies heavily on the power of the chosen management tools. Faced with the increasing number of stakeholders, the tool is no longer used simply to "see," but to coordinate and decide in real time.

These tools are not merely computer gadgets; they serve as organizational pillars. According to (Schwalbe, 2022), the shift from traditional tools (like Gantt or PERT charts) to integrated digital solutions enables welcome automation. However, a word of caution is necessary: as points out (Sears, S. K., & Clough, R. H;, 2021), excessive rigidity in the use of these tools can paradoxically transform the schedule into an inert document, incapable of adapting to unforeseen circumstances.

CHAPTER 1: THEORETICAL AND CONCEPTUAL FRAMEWORK OF PLANNING

It is difficult to assess the success of a project without examining the methodological tools used throughout its execution. Currently, this tooling is structured around a dualism between the legacy of conventional tools and the rise of digital platforms. It is worth noting that the fundamentals of planning, such as PERT charts or Gantt charts, remain undeniably useful for outlining task sequences. However, the current trend increasingly favors digital solutions, whose automation and direct monitoring provide a clarity for decision-making that older formats struggle to guarantee.

However, technical sophistication should not obscure a fundamental reality: the tool is merely a means to an end. (Sears, S. K., & Clough, R. H;, 2021) In this regard, the risk of rigid design is highlighted. A plan that is too inflexible can paradoxically hinder responsiveness, transforming planning into a mere administrative exercise, often disconnected from unforeseen operational events. It is in this context that the work of (Wysocki, 2023) offers a crucial perspective: the tool must adapt to the complexity of the project, not the other way around. Ultimately, while these tools facilitate organization, their impact depends on a balance between the accuracy of the data and the teams' ability to effectively use it.

It is necessary to assess the relevance of a management system without focusing solely on its actual impact within the organization. Indeed ,effectiveness here cannot be decreed; it must be measured. This is precisely what is suggested (Jawad, M., Ledwith, A., 2021) by closely linking project success to the ability of tools to transform overall performance. This perspective resonates particularly with those (Dasović, B., Galić, M., Klanšek, U., 2020) for whom the challenge lies in a smart integration of technical tools andoptimization protocols.

In order to assess this effectiveness, The evaluation must be based on indicators that are widely accepted within the professional community:

- **The rigor of the flows:** that is, the guarantee that the data processed faithfully reflects reality without distortion.
- **Operational ergonomics:** because a tool, however powerful ,remains useless if it is not fluid in its daily handling.
- **The plasticity of the system:** its ability to absorb shocks andchanges in perimeter along the way.
- **Decision-making certainty:** the assurance that the results produced constitute a reliable basis for action.

The most contemporary reflections, particularly those brought by (Kerzner, 2022) **They** go even further. They indicate that the integration of intelligent layers not only reinforces practices, it propels efficiency towards unprecedented standards of precision.

It would be an oversimplification to reduce the management tool to a mere time calculator. In reality ,its contribution goes far beyond that. For (Pinto, 2019) technical instrumentation is what enables the transition from a strategic idea to concrete execution: it is a true driver of competitiveness. Similarly (Garel, 2011) (Garel, 2011) **emphasizes** an often-overlooked dimension: the reduction of stress related to uncertainty. Thanks to improved visibility of the stages, the tool gives managers real control over unforeseen events on the ground.

However, Efficiency doesn't come from the tool alone. It's more about an architecture that helps balance available resources withtime constraints. This is precisely what the framework emphasizes (PMI, 2021) a good tool must, above all, foster value creation and responsiveness.

In short, While these tools facilitate project structuring ,their real impact depends on a delicate balance: that between user expertise and the accuracy of the data. Without this synergy between human and technical aspects, The tool is merely a tool, lacking operational effectiveness. incapable of implementing an ambitious management strategy.

1.3 Planning optimization

In the current unstable environment, Optimization is becoming an obligation rather than a choice. Indeed, Traditional methods still serve as a basis. But they lose momentum as soon as the terrain becomes complex. The idea here is not simply to organize tasks. In reality, The goal is to build a structure capable of adapting. The objective is to research, Sometimes complex ,between the precision of deadlines and actual effectiveness on the ground. To better understand this transformation ,we must examine three major areas.

Traditionally ,optimization aims for what is called the "ideal compromise" between cost, Time and quality. But in reality ,the issue is deeper.

To optimize it (Ballard, 2020)**,** the priority is adopting a Lean philosophy to eliminate waste that undermines added value. From this perspective, Monitoring cannot be passive. As recommended (Parmenter, 2020) The use of key performance indicators (KPIs) becomes the driving force behind continuous improvement. Ultimately, The goal is not just to finish on time, but to ensure intelligent use of available resources.

To turn these objectives into reality ,several technical levers coexist. The (PMI, 2021) emphasis is on proven methods such as critical path analysis or crashing to compress timelines. However ,the current trend is moving towards a hybrid approach.

According to (zékely, B., Erdeiné Késmárki-Gally, S.,Lakner, Z. , 2025) merging the structure of traditional methods with the flexibility of agile allows for better absorption of shocks in complex projects. Added to this are predictive analytics models ,such as those of (Roghabadi, Mohammadjavad Arabpour; Moselhi, Osama, 2020) and (Zeng, Shiqin; Chung, Frederick; Ashuri, Baabak, 2023), which transform planning into a tool for anticipation rather than a simple observation.

Optimizing planning goes beyond simply managing unforeseen events; it becomes part of a quest for quantifiable performance. The major challenge remains stabilizing the triad of "cost-time-quality." In this respect , (Li, Y.,Wang, J., 2021) The benefit of this approach lies not only in the time saved, but above all in the rationalization of resource allocation. As highlighted (Krämer, M, Bormann, P, Würz, H. M, et al., 2024) They confirm that the use of advanced planning tools boosts efficiency because they offer direct visibility into task progress. This precision allows objectives to be met while maintaining the strategic flexibility essential for project success.

In summary, the key is controlling flows. Optimization transforms planning: it no longer remains theoretical but becomes a lever of value that reflects the reality on the ground.

In conclusion, the literature highlights that planning is not merely an accessory. It is the very engine of a project's success, provided that it incorporates sound management tools and optimization methods. Research shows a clear trend in recent studies: a move away from traditional approaches towards more "intelligent" ones. It is precisely this shift that allows for a significant boost in overall performance.

Optimizing planning means finding a sometimes delicate balance between costs, deadlines, and quality. By using specific techniques, we can eliminate the inefficiencies that often hinder progress. In short, optimization acts as a bridge. It allows us to align forecasting theory with the often complex realities on the ground.

Optimiser la planification, c'est donc chercher un équilibre parfois fragile entre les coûts, les délais et la qualité. En s'appuyant sur des techniques spécifiques, on arrive à gommer les inefficacités qui freinent souvent l'avancée des travaux. En résumé, L'optimisation sert de pont. Elle permet de faire coïncider la théorie des prévisions avec la réalité, souvent complexe, du terrain.

Section 02 :CONCEPTUAL FRAMEWORK

A project is defined as a temporary undertaking aimed at producing a unique outcome product, service, or result distinct from the organization's permanent and repetitive operations.

2.1 PROJECT PLANNING

2.1.1 Project definitions

A project is defined as a temporary undertaking aimed at producing a unique outcome product, service, or result distinct from the organization's permanent and repetitive operations (Watt, 2014) . It is characterized by a defined duration, its unique nature, and three constraints related to cost, time, and quality. Project management represents the structured application of knowledge, skills, tools, and techniques to achieve the established objectives. Its lifecycle is typically organized into four phases: initiation, planning, execution, and closure (Watt, 2014) (Zemra, 2019)in the specific context of construction projects in Algeria, revisits and expands upon the foundations of the PMI and ISO 21500. He emphasizes the inherent uncertainty, the irreversibility of decisions, the multidisciplinary nature of the work, and the ongoing interactions with the socio-economic and political environment (Zemra, 2019) . The author particularly highlights the frequent delays in this sector, often attributable to the project owner.

Critical analysis reveals that these two approaches are complementary: Watt offers a clear, pedagogical, and universal normative framework, whil (Zemra, 2019) e provides a realistic and local contextualization essential for developing countries. However, Watt's work remains too general and not very sensitive to Algerian realities, whereas Zemra's thesis compiles extensively without always offering an original synthesis. We believe that combining these two sources constitutes a rigorous and operational theoretical basis for managing construction projects in Algeria.

2.1.2 Planning definition

Planning represents the fundamental phase of project management. It consists of defining in detail the objectives, deliverables, activities, resources, schedule, and budget necessary for the project's success (Watt, 2014). Watt presents it as a structured process that transforms initial requirements into a coherent plan integrating scope, time, costs, risks, and quality.

(Mouhoub, 2014) adopts a more technical approach, centered on task scheduling. He highlights Gantt charts for visualization, then PERT and CPM methods for dependency analysis, margin calculation, and critical path identification (Mouhoub, 2014)

Critical analysis indicates that Watt offers a comprehensive, clear framework aligned with PMI standards, while (Mouhoub, 2014) provides the mathematical and operational rigor essential for construction projects. However, Watt remains descriptive and general, whereas (Mouhoub, 2014) focuses more on algorithmic tools at the expense of the managerial dimension. We believe their complementarity offers a balanced vision: strategic and practical for Watt, technical and precise for (Mouhoub, 2014), particularly well-suited to the Algerian context.

2.1.3 Importance of planning

Planning plays a central role in the project lifecycle. It forms the foundation for clearly defining the direction, resources, and steps necessary to achieve objectives within the required timeframe, budget, and quality standard (Watt, 2014) s According to Watt, effective planning facilitates resource control, risk management, stakeholder coordination, and significantly reduces discrepancies between forecasts and actual results.

(Zemra, 2019) emphasizes, in the Algerian context of construction projects, that poor planning and the mismatch between schedules and the actual pace of work are among the main causes of delays (Zemra, 2019) His empirical study reveals that these shortcomings, often linked to the client or the contractor, contribute significantly to the delays observed in national infrastructure projects.

Thus, the contributions of these two authors appear complementary. (Watt, 2014) offers a general and instructive overview of the benefits of planning, while Zemra highlights its concrete consequences in a highly uncertain environment like Algeria. However, (Watt, 2014) work remains somewhat lacking in context, and (Zemra, 2019) focuses more on the effects of failures than on best practices. We believe that their combined approach reinforces the idea that planning is not merely a technical step, but a determining factor for success, particularly critical in construction projects in developing countries.

2.1.4 Project constraints (cost, quality, deadlines)

In every project, we quickly encounter the classic constraints: scope, time, cost, and quality. This is known as the "iron triangle," and frankly, if one element shifts, everything else is affected. Maintaining their balance is truly the key to preventing a project from going off track (Watt, 2014)In Algeria, and especially in the construction sector, these constraints weigh heavily. Delays pile up, and budgets spiral out of control. This often stems from poor initial estimates, repeated changes by the project owner, or unforeseen external events that arise unexpectedly (Zemra, 2019) A study conducted in Malaysia by (Aziz, NM, Mohd-Rahim, FA, Loo, SC, & Le, EW, 2019) and colleagues in 2019 supports this observation. It highlights with supporting data very concrete obstacles: insufficient resources, overly tight deadlines, poor coordination, and technological limitations. Ultimately, every problem ends up delaying delivery or inflating costs. While (Watt, 2014) framework provides a solid and easily understandable theoretical foundation, the research by (Zemra, 2019) and (Aziz, NM, Mohd-Rahim, FA, Loo, SC, & Le, EW, 2019) delves into the realities of developing countries, where human and external constraints are omnipresent. Taken together, this provides a clear and realistic picture of the real challenges on the ground, which is perfectly suited to managing construction projects in Algeria.

2.2 Project management tools

2.2.1 The Gantt chart

The Gantt chart is one of the oldest, simplest, and most widely used tools in project management. It allows for a clear and intuitive visualization of a project schedule by representing tasks as horizontal bars positioned on a timeline. Thanks to its immediate readability, it facilitates communication between stakeholders, progress tracking, and the rapid identification of delays. Although it is over a century old, it remains an essential tool today, particularly in the context of construction projects in Algeria, where planning and meeting deadlines are critical.

2.2.1.1 Historical and fundamental perspective

The Gantt chart, an iconic project management tool, has its roots in the early 20th century and the Scientific Management movement. Developed by Henry Laurence Gantt, an American engineer and close associate of Frederick Taylor, it was initially designed to track repetitive production and motivate workers through a simple visual display of performance (red for delays, black for targets met). It was primarily during the First World War, faced with the challenges of massively coordinating wartime production, that the chart evolved into its modern form: a temporal representation of tasks in the form of bars, allowing visualization of the plan, the actual progress, and deviations (Geraldi, J., & Lechter, T., 2012). While excellent for managing complexity and the importance of time, it relies on principles derived from a stable and predictable production context, which limits its ability to fully address the complexity, uncertainty, and change inherent in contemporary projects. In Algeria and the Arab world, (Mouhoub, 2014) points out in his thesis that the Gantt chart remains the most intuitive and widely used tool for project scheduling, thanks to its ease of reading and communication, even though it quickly reveals its limitations when faced with complex task dependencies. This highlights the appeal of graphical methods such as PERT or MPM for more refined modeling. This dual perspective historical and critical demonstrates that the Gantt chart remains an indispensable tool, but one that must be used thoughtfully and often supplemented by other techniques depending on the project context.

2.2.1.2 Critique of rigidity and limitations

Despite its popularity and simplicity, the Gantt chart is subject to much criticism, particularly due to its inherent rigidity and limitations in addressing the complexity of modern projects. According to (Geraldi, J., & Lechter, T., 2012) , this tool has its roots in Taylor's scientific management, designed for repetitive and predictable production environments. It excels at managing "complicatedness" (numerous but ordered tasks), but struggles to incorporate the uncertainty, ambiguity, change, and true complexity of contemporary projects. By imposing a linear and static view of planning, it promotes a prescriptive approach that does not always adapt to real-world conditions, especially in construction projects in Algeria where unforeseen events (changes in client requirements, supply delays, administrative constraints) are frequent. **Wadhwa (2024)** , for his part, highlights concrete practical limitations: inaccurate time estimates, difficulties in resource allocation, lack of flexibility in the face of changes, and the complexity of manual updates in dynamic environments. These constraints can lead to administrative overload, poor communication, and an illusion of control, even as the project evolves rapidly.

Thus, although the Gantt chart remains a powerful visualization tool, it must be used critically and often complemented by more agile approaches or complementary tools (PERT, network diagram, real-time collaborative software) to better meet the requirements of current projects.

2.2.1.3 Incompatibility with agility

The Gantt chart, by its linear, sequential, and rigid nature, presents a fundamental incompatibility with agile approaches that prioritize flexibility, iteration, and rapid response to change. (Geraldi, J., & Lechter, T., 2012) emphasize that this tool, rooted in Taylorist scientific management, imposes a static and predictive view of the project that is poorly suited to uncertain and complex environments. It reinforces a logic of detailed upfront planning and strict control, thus limiting the capacity to accommodate frequent changes, iterative customer feedback, and team self-organization central principles of the Agile Manifesto. In the Algerian context of construction projects (13. Lalmi) highlights these limitations in his thesis on the hybridization of waterfall and agile methodologies. He demonstrates that the Gantt chart, typical of traditional approaches (Waterfall), makes it difficult to integrate agile practices such as sprints, regular reviews, and continuous adaptation, particularly in a sector characterized by uncertainty (changes in client requirements, administrative constraints, technical risks). Lalmi proposes a hybrid model to combine the strengths of both approaches: the structure and predictability of the Gantt chart for stable phases, and agile flexibility for uncertain phases.

Thus, although the Gantt chart remains useful for overall visualization, its exclusive use often proves incompatible with pure or hybrid agile management, requiring adaptation or complementation by more dynamic tools (Kanban boards, agile roadmaps, real-time collaborative software).

2.2.2 The PERT method

The PERT (Program Evaluation and Review Technique) method emerged in the late 1950s, developed by the US Navy to manage the Polaris missile program. It differs significantly from the Gantt chart: while the latter progresses linearly and chronologically, PERT constructs a graphical network (a directed graph) that immediately reveals the dependencies between tasks, the critical path, and the inherent uncertainty of any project. This system allows for modeling precedence relationships, calculating earliest and latest start dates, identifying float, and, most importantly, determining the critical path the one that defines the minimum time required to complete the project. In Algeria, PERT is often used to complement Gantt charts, particularly for construction or maintenance projects, where the complexity of the sequences is difficult to grasp without this type of tool.

(Mouhoub, 2014) examines the difference between Gantt and PERT charts in his thesis. He highlights what truly distinguishes the two approaches: Gantt remains highly valued for its visual and chronological nature, making it easy for managers to read, while PERT, though more complex to construct, offers a much more detailed model of precedence constraints and accurately calculates the critical path. (Mouhoub, 2014) goes further: he develops sophisticated algorithms to build and optimize PERT charts from the potential graph, reducing the number of dummy tasks and simplifying their use.

(Bouhmidi, M., & Boucherit, H. , 2022) , provides a concrete example of PERT applied to industrial maintenance. He presents PERT as a robust method for scheduling operations, identifying critical sequences, and optimizing the use of limited resources, all in conjunction with Gantt charts. Here, PERT proves its worth in untangling the complexity of industrial processes.

Ultimately, PERT introduces an analytical and probabilistic dimension by taking into account optimistic, pessimistic, and most probable timeframes which enhances the reliability of planning, especially in environments where uncertainty persists, such as in Algeria. Nevertheless, updating and communicating a PERT chart proves more challenging than a Gantt chart. This is why many opt for a combined approach.

2.2.3 Project management software (MS Project, Primavera P6, etc.)

Project management software is essential today. It's impossible to plan or track a construction project without it: it handles all the complex calculations, displays schedules, helps visualize progress, and generates reports almost instantly. Microsoft Project, easy to learn and widely used, is primarily aimed at teams seeking an accessible solution. Primavera P6, on the other hand, is geared more towards very large projects and offers greater robustness. In Algeria, whether in construction or industrial maintenance, these tools are indispensable. They make managing deadlines and costs more efficient, while taking into account local specificities sometimes limited resources, frequent unforeseen events, and unequal access to technology.

MS Project: Standard for structured planning

MS Project remains the gold standard for structured planning. It is particularly well-suited to medium-sized and larger projects, thanks to its intuitive interface and powerful calculation capabilities. (Parlak, 2016) compared the methods and software used in construction, and MS Project stood out: it is easy to use, affordable, and handles everything related to Gantt charts, critical path modeling (CPM), and resource management very well. Its rapid learning curve means the software can be deployed without weeks of training. Integration with other Microsoft tools, such as Excel and Teams, facilitates collaboration within multidisciplinary teams.

In Algeria, (Bouhmidi, M., & Boucherit, H. , 2022) at Oran 2 University demonstrate how MS Project optimizes industrial maintenance, particularly for planning and modeling preventive and corrective operations. They explain that MS Project enables the identification of the critical path, the simulation of various scenarios, and the optimal use of resources both human and material—often limited in this sector. The advantage? Teams create realistic schedules, monitor deviations, and produce clear reports for decision-makers.

In summary, MS Project offers a rare balance between simplicity and methodological rigor. It structures work without complicating the task. It's best to complement its features with collaborative or agile tools for fast-paced projects, as it remains primarily designed for the classic Waterfall methodology.

Primavera P6: Pillar of complex and strategic projects

Primavera P6, now known as Oracle Primavera P6, has established itself as the go-to solution for managing the most complex and strategic projects. It is particularly prevalent in construction, energy, and manufacturing sectors where every detail matters and coordination leaves no room for improvisation. While MS Project is appealing for its simplicity and ease of use for medium-sized projects, Primavera P6 delivers analytical power and robustness that are, frankly, in a league of their own. We're talking about multi-project management, features designed for large teams, and, above all, in-depth analysis capabilities.

Parlak, in 2016, highlighted this in its comparison of construction industry planning tools. Primavera P6 flawlessly manages complex dependency chains, large-scale resource allocation and leveling, and juggles multiple baselines, stringent constraints, and detailed reports. When it comes to coordinating a multitude of stakeholders, continuously monitoring risks, and maintaining a comprehensive overview, this tool leaves nothing to chance. While MS Project prioritizes simplicity, Primavera is ready to take on any project that exceeds a certain level of complexity.

This observation was confirmed by (Mahure, A., & Ranit, A. (, 2018) study on project management with Primavera P6. Their analysis of a construction site shows that the tool saves valuable time up to three months less on the project's duration thanks to detailed planning (EPS, WBS, activity relationship management, schedules, critical path monitoring, resource optimization). It's not just about convenience: Primavera P6 also facilitates variance tracking, cost control, and rapid adaptation as soon as the environment becomes uncertain, as is often the case in Algeria.

Ultimately, Primavera P6 stands out as the backbone of strategic projects where rigor, the ability to scale with the project, and the management of multiple interfaces make all the difference. MS Project remains the preferred tool for simpler projects that are quicker to define. But for orchestrating the unmanageable and maintaining control over the long term, Primavera P6 meets requirements that no other tool currently achieves.

2.2.4 Key Performance Indicators (KPIs)

KPIs, or Key Performance Indicators, play a central role in project management. They don't just display numbers – they translate raw data into actionable insights, ready to trigger decisions. For managers, it's like having a real-time compass: they see where the project is headed, spot the slightest deviation, and correct course without wasting time. In Algeria, in the construction sector, the pressure on deadlines, costs, and quality is enormous. KPIs provide a solid framework for measuring and correcting, and those changes everything: by quantifying deviations, performance can truly be improved.

2.2.4.1 The hierarchy of indicators as a lever for performance

Let's move on to the hierarchy of indicators. Structuring KPIs adds depth to project management. Not all indicators are treated equally; a system is built that connects the strategic, tactical, and operational aspects. Fanaei, in her thesis at Concordia University (2019), reminds us that isolated KPIs are useless. She integrates them into a comprehensive framework, focusing on six metrics: cost, time, quality, safety, customer satisfaction, and project team satisfaction. Her approach goes further: she maps the indicators of critical project moments onto those of the entire project, using sophisticated tools such as neuro-fuzziness, neural networks, and the Analytic Hierarchy Process (AHP). The AHP, in particular, allows us to rank KPIs, assign them a weight according to their importance, and thus calculate a composite indicator that provides a true snapshot of the project's health.

This system is a game changer. KPIs become a powerful lever: they refine measurement and forecasting, and they chart the course toward optimization. Managers gain a clearer perspective and can target the truly urgent corrective actions. For projects in Algeria, the hierarchy of KPIs proves even more relevant: it aligns smaller objectives (schedule, budget) with fundamental issues (stakeholder satisfaction, sustainability). It is this finely tuned organization that gives the project true coherence and ensures long-term performance.

2.2.4.2 The impact of routines on engagement and adjustment

Regular monitoring and performance measurement routines are crucial to team dynamics and a project's ability to adapt. Fanaei (2019) clearly demonstrates how consistent KPI assessments—cost, time, quality, safety, customer satisfaction, and team satisfaction—strengthen stakeholder engagement. This regularity fosters a culture of transparency and shared responsibility. These repeated meetings ultimately make a difference: monitoring becomes a long-term process, no longer limited to one-off checks, allowing for early detection of deviations and swift action.

The author emphasizes the Performance Optimization Model (POM), which leverages these routines to select the most appropriate adjustments. By examining project progress through a composite indicator (PI), continuous adjustments can be made: resources can be reallocated, execution methods adapted, and materials changed—all without losing track of all KPIs. On Algerian construction sites, where unforeseen events are commonplace, these routines provide teams with genuine visibility, motivating them and enabling them to adapt quickly while remaining under overall control.

Ultimately, these routines go far beyond a simple control tool: they become powerful levers for engagement and organizational agility. They translate performance data into concrete decisions and a continuous improvement process.

2.3 Planning optimization

Optimizing planning is a central step in project management today. The goal is to balance available resources with time, cost, and quality constraints. The objective is to maximize efficiency, minimize waste, and avoid delays. In Algeria, on construction projects and in industry, resources are often scarce, and uncertainties are widespread. Therefore, optimization becomes a true strategic lever for improving performance, staying within budget, and delivering on time.

2.3.1 Definition of optimization

Optimizing a project means identifying the best possible solution from the entire range of feasible options, while managing both constraints and objectives (time, cost, resources, quality). Watt (2014) explains that the core issue is allocating limited resources optimally: shortening the project duration or reducing its cost, while maintaining the expected quality. Techniques such as "crashing," where resources are added to accelerate critical tasks, or "fast-tracking," which involves reorganizing task sequencing to perform more tasks in parallel. Of course, it's essential to juggle available resources and all the dependencies between activities.

Amrane (2021), in his thesis, goes further. He doesn't limit himself to classical methods; he introduces mathematical models and advanced algorithms—particularly hybrid genetic algorithms—to tackle even more complex scheduling problems under multiple constraints. He also emphasizes the need for dynamic optimization, which adapts to uncertainty and allows for intelligent resource allocation, reduced delays, and rapid response to unforeseen events.

Ultimately, project management optimization is neither simply a cost-cutting exercise nor just a race against time. It's a comprehensive process: analyzing, modeling, and deciding to achieve project objectives as efficiently as possible, especially when the context is constrained, as is often the case in Algeria.

2.3.2 Optimization methods

In project management, optimization is much more than simply applying a few tools: it's a set of structured approaches to eliminate waste, reduce variability, improve quality, and make the most of resources. These methods combine analytical, statistical, and philosophical tools, transforming planning into a true driver of sustainable performance. In the Algerian context, especially with construction and infrastructure projects, these approaches become even more valuable in the face of challenges related to tight deadlines, limited budgets, and resource scarcity.

2.3.2.1 Lean Six Sigma (LSS)

Lean Six Sigma (LSS) is the convergence of Lean (focused on eliminating waste and creating value) and Six Sigma (which tracks variability and defects with formidable statistical discipline). At its core is the DMAIC cycle (Define, Measure, Analyze, Improve, Control), a clear approach for finding, analyzing, and sustainably resolving process problems.

Operations Management manuals, such as "Applying Lean Six Sigma for Operational Excellence," emphasize this complementarity. Lean explicitly targets the eight classic types of waste (muda): overproduction, waiting, unnecessary transportation, overprocessing, excess inventory, non-essential movement, defects, and underutilization of skills. Six Sigma, on the other hand, aims for statistical excellence: only 3.4 defects per million opportunities, thanks to tools like control charts, Pareto analysis, and DOE (Defects Outcome Evaluation). Combined in Lean Six Sigma (LSS), these principles offer comprehensive optimization of both flow and quality.

In construction and infrastructure projects, LSS has already proven its worth. It helps shorten timelines, control costs, and improve stakeholder satisfaction. Several studies and theses document concrete gains: significantly reduced delays, smoother workflows, and minimized rework—all of which align well with the realities of the sector in Algeria, characterized by high variability and persistent external constraints.

In short, Lean Six Sigma represents a powerful, structured optimization method, particularly well-suited to complex projects. It combines the Lean vision with the scientific rigor of Six Sigma, giving teams a true roadmap to operational excellence.

2.3.2.2 Optimization and simulation algorithms

Optimization and simulation algorithms now form the backbone of advanced project management. They are used to address the complex challenges of scheduling and resource allocation, where traditional methods quickly reach their limits. These tools enable the detailed modeling of real-world situations, the exploration of diverse scenarios, and the search for near-optimal solutions within a constrained environment.

In 2019, Benoumelaz Farouk reached a significant milestone with his doctoral thesis at Mohamed Khider University in Biskra. His work relies on sophisticated mathematical models, such as linear programming and various exact and approximate approaches. He applies these to transportation and scheduling under multiple constraints. His analysis yields concrete results: these algorithms reduce costs while meeting time and capacity requirements. This approach closely aligns with the needs of Algeria, where precise resource management and efficiency are vital in large-scale projects.

For his part, Mouhoub Nasser Eddine (2014) approaches project scheduling problems from a different angle. He focuses on graphs and proposes original solutions: he succeeds in generating more compact PERT networks, reduces the number of dummy arcs, and refines the transformation of potential graphs into PERT graphs. He thus improves the modeling and calculation of the critical path, which allows for more precise scheduling optimization.

Taken together, this research marks a true turning point. Optimization and simulation algorithms—whether exact, heuristic, or metaheuristic—make it possible to move beyond manual planning or simple, traditional software. They introduce a scientific rigor that helps anticipate risks, optimize resource allocation, and better control deadlines and costs, crucial issues for construction and infrastructure projects in Algeria.

2.3.2.3 Hybrid approaches (Traditional + Agile)

Hybrid approaches to project management seek to combine the best of traditional methods, such as Waterfall, with agile methodologies. The goal? Greater flexibility without sacrificing structure, predictability, and control—three essential elements for managing complex projects.

In his doctoral thesis at Constantine 3 University, Lalmi (2021) proposes a hybrid model that perfectly reflects the realities of construction sites in Algeria. He explains that the traditional approach lays the groundwork: detailed planning, strict cost management, and adherence to deadlines. However, it quickly runs up against frequent changes in requirements, a source of frustration for everyone involved. Agile methods, with their sprints, regular reviews, and close collaboration with the client, then come to the rescue: they better absorb adjustments along the way, reduce waste, and improve stakeholder satisfaction. Lalmi goes further and also integrates Lean principles to eliminate anything that doesn't add value, thus creating a three-pillar model (Traditional, Agile, Lean). This approach is truly well-suited to the uncertainty and specific constraints of construction projects in Algeria.

For their part, Trykoz and colleagues (2022), after interviewing project managers in engineering and manufacturing in Sweden, observed the same phenomenon: almost all organizations now prefer a hybrid or contingency approach, setting aside "pure" methods. Teams continue to rely on traditional tools—Gantt charts, critical path analysis, MS Project—to define strategy and ensure accountability, but in practice, they prioritize agility: Scrum, Kanban, and daily stand-up meetings to adapt more quickly. This combination is not simply a passing fad; it addresses the very real need for control over contractual aspects, while maintaining the necessary flexibility to handle unforeseen events.

In short, hybrid approaches are emerging as the most robust and realistic solution in the current context, particularly in Algeria. They successfully reconcile the stringent requirements of contracts with the responsiveness essential for project management. As a result, they significantly increase the chances of successful project completion.

2.3.2.4 Lean Project Management (Last Planner System – LPS)

The Last Planner System (LPS) occupies a central place in Lean Project Management and completely transforms the way production is planned and managed on construction sites. Glenn Ballard designed it as part of his thesis at the University of Birmingham in 2000, with a simple idea: to make the workflow more predictable and accelerate learning, by putting the real actors on the ground – the Last Planners, in other words, the site managers and the teams – at the heart of the planning.

Where traditional methods impose a top-down approach, LPS emphasizes collaboration and the reliability of commitments. The method follows a precise logic, structured in four clear steps: what should be done (Should), what can be done once obstacles are removed (Can), what will be achieved based on concrete commitments (Will), and what has actually been done, which is measured using the Percent Plan Complete (PPC) and the analysis of the causes of failure (Did).

Short-term planning, or Lookahead Planning, spans three to six weeks and forces the team to anticipate potential roadblocks. Continuous improvement is part of the system's DNA, with analytical tools such as the "5 Whys" to understand and correct deviations. Researchers like Lappalainen and colleagues (2022) have demonstrated that Lookahead Planning clearly improves productivity, collaboration, and the reliability of commitments on the job site. However, this method only yields optimal results if the team operates in an atmosphere of trust and genuine involvement—otherwise, frustration is likely to set in.

For Algerian construction sites, LPS offers a powerful tool for optimizing management: it reduces waste, improves coordination among all stakeholders, and gives teams a real capacity to adapt to unforeseen events, whether changes from the client or delivery delays. It is a pragmatic complement to traditional tools like Gantt or PERT charts, bringing a highly operational and human dimension to project management.

2.3.2.5 Cloud integration and 3D visualization

The integration of cloud computing and 3D visualization, particularly through Building Information Modeling (BIM), has radically changed the way construction projects are planned. We are no longer talking about rigid or fragmented planning; we are moving towards instant collaboration, immersive visualization, and the active simulation of different execution scenarios.

In the construction industry, BIM combined with the cloud—using tools like Autodesk Construction Cloud, BIM 360, or open-source platforms—centralizes information for all project stakeholders. This single source of truth, shared and updated in real time, is revolutionizing project management. 3D and 4D visualizations (which add the element of time) facilitate clash detection, optimize execution sequences, and enable teams to communicate clearly and precisely. Connecting this digital ecosystem to Lean practices, such as the Last Planner System, makes plans more reliable, reduces waste, and significantly improves productivity.

Lalmi (2021), in his work on the hybridization of methods, rightly emphasizes the impact of BIM within traditional, agile, and lean models, especially for managing changes and all the uncertainties that Algerian projects face. Zemra (2019), in studying risk and delay management, shows that digital visualization allows for much more effective anticipation and timely adjustment of schedules.

Recent literature—whether articles published by Springer or in other specialized journals—points in the same direction: combining BIM, Lean, and Cloud technologies reduces rework, improves coordination, accurately simulates future plans (lookahead), and optimizes all site workflows. In Algeria, this integration is becoming absolutely essential. It offers a concrete solution to overcome the usual limitations—dysfunctions in coordination, supply shortages, and changing client requirements—and build smarter, more collaborative, and more resilient planning.

2.4 Factors contributing to planning performance

Successful project planning never rests on a single pillar. It depends on a whole network of factors: organizational structure, governance, talent management, technical tools, institutional context, and the ability to navigate uncertainty. Mastering these levers helps reduce the gap between what was planned and what is actually achieved on the ground, and transforms project outcomes, especially in the complex construction and infrastructure sectors in Algeria.

2.4.1 Structural dimensions and governance

Structural and governance factors play a central role in successful planning. This includes the organization of institutions, decision-making processes, the sharing of responsibilities, and the coordination system among all stakeholders.

Zemra (2019), in his thesis on managing delay risks in construction projects in Algeria, emphasizes the importance of governance. He identifies several major causes of delays: bureaucratic sluggishness in signing contract amendments, poorly calibrated contractual deadlines, late payments, and unsuitable schedules. His study reveals that the project owner, generally a public client, often represents the primary source of risk. Administrative burdens, complex procedures, and fragmented governance hinder any rapid decision-making.

Boucherit (2022), for her part, explores the shift from a rigid logic to a much more flexible project-based approach, drawing on major urban projects in Algiers. Through her thesis, she demonstrates that planning becomes more effective when governance improves institutional coordination, involves local stakeholders more, and adapts its decision-making structures. She emphasizes the key role of the governmental dimension and time management: excessive centralization and rigidity stifle innovation and responsiveness, while an openness to a project-based approach fosters strategic alignment and the collective resolution of challenges.

In short, for Algerian projects, solid governance, where roles are clearly defined, administration is streamlined, and coordination between actors is smooth, remains a major lever to boost planning performance.

2.4.2 Operational intelligence and instrumentation

Operational intelligence This refers to the ability to collect, analyze, and leverage real-time project performance data to make informed and rapid decisions. It relies on the effective instrumentation of processes through KPIs . well-chosen and regular follow-up routines.

According to Fanaei (2019) , a high-performance operational intelligence transforms raw data into a living project dashboard. Its framework integrates six main KPIs (cost, time, quality, safety, customer satisfaction, and team satisfaction) and uses *soft computing techniques* (neuro-fuzzy, neural networks) to predict the evolution of the indicators. The author proposes a Performance Optimization Model (POM) which, through continuous measurement routines, not only allows for the early detection of deviations but also enables the selection of the most appropriate corrective actions (resource reallocation, modification of execution methods, etc.).

This approach strengthens team commitment and the overall responsiveness of the project, particularly useful in the Algerian context where unforeseen events require rapid adaptation while maintaining an overall vision.

2.4.3 Limitations of optimization tools

Despite their undeniable contributions, planning optimization tools have significant limitations that must be recognized for realistic use.

Geraldi and Lechter (2012) criticize the rigidity of the Gantt chart, designed for stable and predictable environments, which struggles to manage the uncertainty and complexity of current projects. **Lalmi (2021)** highlights the limitations of purely traditional approaches (Waterfall) in the face of the variability of construction projects: lack of flexibility, difficulty in integrating iterative customer feedback, and poor adaptation to frequent changes by the project owner.

Zemra (2019) , in the Algerian context, highlights the concrete constraints: poor initial estimation, administrative burdens, payment delays and variations of the client which make even the best tools (Gantt, PERT, software) insufficient if they are not accompanied by agile governance and good human coordination.

These limitations demonstrate that optimization tools are not a magic bullet. They must be integrated into a hybrid, contextualized approach, complemented by human, organizational, and technological dimensions (BIM, Cloud, LPS) to be truly effective.

In light of this analysis, it appears that project performance depends closely on the quality of planning, which is itself influenced by the management tools and optimization methods used.

In this sense, the conceptual framework of this research is based on the interaction between three main dimensions: planning, project management tools and optimization approaches, which together contribute to improving project performance.

Conclusion chapter

In conclusion, this first chapter highlights that planning is much more than a simple logistical step: it is the heart of project management. It does not merely list tasks, but serves as a true compass for coordinating resources and staying on course in the face of cost, time, and quality requirements.

While tools like Gantt charts or the PERT method are valuable allies for structuring monitoring, we have seen that their effectiveness is never fixed. It depends primarily on the realities on the ground and how the teams adopt them.

Ultimately, optimizing planning isn't just a matter of technique or software. It's primarily a human and organizational endeavor. The success of a project hinges on the ability of those involved to communicate, adapt, and remain united in the face of unforeseen events. This is why planning must be viewed as a dynamic process, constantly evolving and adjusting to transform working methods into tangible performance

CHAPITRE 2 : METHODOLOGICAL FRAMEWORK AND ORGANIZATION PRESENTATION

CHAPTER 02: METHODOLOGICAL FRAMEWORK AND ORGANIZATION PRESENTATION

Introduction

After an initial immersion in the field, it became clear that the difficulties related to FTTH project planning could not be understood through a purely descriptive reading alone. Therefore, it was necessary to mobilize a methodological framework capable of linking the observed reality to theoretical project management tools, particularly the use of MS Project and planning optimization approaches.

This chapter thus aims to present the adopted approach, explaining the methodological choices, the tools mobilized, and the logic followed to move from diagnosis to the proposal of concrete solutions.

Section 01: Methodological Framework of the Research

1.1 Research Methodology

Research methodology refers to the set of means implemented to answer the research problem.

In the context of this study, the choice of a mixed approach (qualitative and quantitative) is not accidental. Understanding planning delays within the Operational Directorate of Tipaza requires both analyzing what actors actually experience in the field and objectively measuring the gaps between forecasts and reality.

In other words, numbers alone are not sufficient, nor are perceptions alone. It is precisely the combination of both that allows for an accurate reading of the situation.

1.2 Epistemological stance

Our work adopts a pragmatist stance.

This choice is directly linked to the nature of the problem under study. The objective here is not to produce a purely theoretical discourse, but rather to arrive at applicable solutions in a real-world context. In this sense, pragmatism allows us to focus on what actually works in the field.

By relying on the case of the Operational Directorate of Tipaza, we sought to move beyond standard models in order to understand the specific constraints related to FTTH deployment. This immersion helps avoid generic recommendations and propose improvements adapted to the local context.

As Saunders, Lewis and Thornhill (2019) argue, pragmatism focuses on practical outcomes and allows t he researcher to combine different methods to best answer the research question.

1.3 Mode of Reasoning

The reasoning adopted is abductive.

Concretely, the reflection started from a field observation: frequent delays and schedules that do not reflect the reality of execution. Based on these observations, we sought to identify possible causes and then compare them with theoretical project management models.

This back-and-forth between field and theory is a central element of our approach. It allows not only a better understanding of the dysfunctions, but also the proposal of realistic solutions.

1.4 Research Design

The choice of a single case study was a natural one.

This is not a choice of convenience, but rather a desire to analyze a real context in depth without limiting ourselves to generalizations. The Operational Directorate of Tipaza represents a relevant field, particularly due to the difficulties encountered in planning FTTH projects.

By focusing on this specific case, it becomes possible to understand the internal mechanisms, identify blockages, and propose concrete paths for improvement.

1.5 Data Collection Techniques

To ensure the reliability of the analysis, several techniques were mobilized. The objective was not to limit ourselves to a single source of information, but rather to cross-reference points of view to obtain a more accurate reading of reality.

In other words, we sought to compare what is written, what is said, and what is actually done in the field.

1.5.1 Documentary Analysis

First, we analyzed various internal documents such as specifications, MS Project schedules, and progress reports.

These documents provide an "official" vision of planning. However, they do not always reflect the difficulties encountered during the actual execution of projects.

1.5.2 Direct Observation

Non-participant observation was carried out over a period of 15 days.

This immersion was particularly important. It allowed us to concretely see how activities unfold in the field, and especially to identify the gaps between what is planned and what is actually achieved.

It is often at this level that problems appear most clearly, particularly in relation to technical or administrative constraints.

1.5.3 Semi-Structured Interviews

Interviews were conducted with several actors involved in FTTH projects (engineers, technicians, managers).

These exchanges played a key role in the analysis. Indeed, they helped highlight causes of delay that do not appear in official reports. Some blockages, related for example to coordination or field constraints, only emerge through the lived experience of the actors.

This helped confirm certain trends observed during the interviews and gave measurable weight to certain issues. The qualitative data from the interviews were analyzed using NVivo software.

NVivo: was selected for analyzing semi-structured interviews because it allows systematic coding of qu alitative data, identification of recurring themes, and visualization of relationships between concepts. Th is is particularly useful for understanding the subjective experiences of planning actors.

1.5.4 Questionnaire

A questionnaire was used to complement the qualitative data and to obtain a more global vision of the actors' perceptions.

The quantitative data collected were processed using SPSS software.

SPSS: was chosen for processing questionnaire data because it facilitates descriptive statistical analysis (frequencies, percentages, means) and can generate clear tables and charts. Given the relatively small sa mple size, SPSS provides a professional and rigorous treatment of quantitative data.

Research Problem and Hypotheses of the Study

Based on the literature review and field observations, the central problem of this research can be formulated as follows:

To what extent can the optimization of planning tools and methods improve the reliability of FTTH project schedules within Algérie Télécom (OTD Tipaza)?"

To guide the empirical investigation, the following hypotheses are proposed:

- H1: Planning delays in FTTH projects are primarily caused by external factors (administrative approvals, subcontractor coordination) rather than technical factors alone.

- H2: The absence of real-time monitoring tools widens the gap between planned and actual project progress.

- H3: TThe use of advanced planning tools (such as MS Project) with integrated external constraints (permits, subcontractor coordination) positively correlates with improved schedule reliability in FTTH projects.

These hypotheses will be tested through the questionnaire and semi-structured interviews.

Sampling method

The selected sample is purposive.

The people interviewed were selected based on their direct involvement in the planning and monitoring of FTTH projects, which guarantees the relevance of the information collected.

1.6 Data Analysis Methods

Our approach was not limited to a simple observation. It is based on a logical progression aimed at transforming observations into concrete solutions.

1.6.1 Diagnosis (AS-IS)

The first step consisted of analyzing the current situation.

The objective here was to "take a snapshot" of the reality of FTTH projects. The aim was to understand why theoretical schedules are not respected once confronted with the field.

This phase made it possible to identify the main blockages as well as the specific constraints of the Tipaza Directorate.

1.6.2 Modeling (TO-BE)

In a second step, an optimized schedule was proposed using MS Project.

The idea was not to propose a theoretical solution, but to rethink the sequence of tasks concretely in order to gain efficiency and respect deadlines.

This step aims to demonstrate that an adapted reorganization can significantly improve project performance.

1.6.3 Evaluation Using the EVM Method

To validate the proposed improvements, the Earned Value Management (EVM) method was used.

This approach allows objective measurement of project performance by comparing the work accomplished with the time consumed.

EVM was selected because it provides an objective and quantifiable measure of project performance by integrating cost, time, and work completed. It is widely recognized in project management literature as a reliable method for performance evaluation.

1.7 Validity and Reliability

To guarantee the credibility of the results, several precautions were taken:

Cross-referencing of data sources
Comparison between qualitative and quantitative data
Verification of information coherence

1.7.1 Ethical Considerations

Within the framework of this study, we ensured that:

- Participants' consent was obtained
- Anonymity was guaranteed
- Data confidentiality was respected

1.7.2 Limitations of the Research

Certain limitations must be taken into account:

- Partial access to certain confidential data
- Study limited to a single directorate
- Relatively short internship period

These elements do not invalidate the results, but invite a measured interpretation.

1.7.3 Practical Approach of the Study

The approach followed in this work can be summarized in several steps:

- Data collection:Documents, 15-day observation, interviews (NVivo), questionnaire (SPSS).
- Field analysis
- Modeling using MS Project
- Analysis of the current schedule
- Optimization
- Comparison of results

Section 02: Organizational Framework

This section presents the organizational framework within which our research takes place. It successively describes the host organization (Algeria Telecom), the Tipaza Operational Directorate (OTD Tipaza) with its organizational chart, the specific method of implementation of FTTH projects (subcontracting), as well as the exemplary project studied.

2.1 General presentation of the host organization: Algeria Telecom

Algeria Telecom SPA is the historical telecommunications operator in Algeria. Resulting from the restructuring of the postal and telecommunications sector, the company was officially created by decision of the National Council of State Participations (CNPE) on March 1, 2001, as a joint-stock company (SPA) with public capital.

Algeria Telecom is a major player in the fields of fixed telephony, internet access (ADSL, FTTH), and data transmission services for businesses. The company employs approximately 21,000 people and has 500 commercial branches across the country.

2.2 History

The creation of Algérie Télécom was part of the telecommunications sector reform undertaken by the Algerian state in the late 1990s. Before 2001, telecommunications activities were managed by the single public operator, Algérie Poste Télécommunications (APT). Law No. 2000-03 of August 5, 2000, establishing the fundamental principles of the postal and telecommunications sector, introduced the separation between postal and telecommunications activities.

Thus, in 2001, Algérie Télécom was established as a public industrial and commercial enterprise, in the form of a joint-stock company (SPA) with public capital. Since its creation, the company has continuously modernized its networks and expanded its territorial coverage, with a particular focus on the deployment of fiber optics (FTTH) starting in the 2017s.

2.3 Geographical location

The headquarters of Algérie Télécom is located at RN°05, 5 Maisons, El Mohammedia, Algiers. The Tipaza Operational Directorate (OTD Tipaza), which constitutes our study area, is located in the wilaya of Tipaza, approximately 70 km west of Algiers.

The wilaya of Tipaza benefits from a strategic geographical location: it is bordered by the Mediterranean Sea to the north and by the wilayas of Chlef to the west, Aïn Defla to the southwest, Blida to the southeast, and Algiers to the east. This position makes it an area of dynamic urban and economic development, with a high demand for broadband internet connectivity.

2.4 Company Profile

The table below presents the main information relating to Algeria Telecom:

Table 1 :Company Profile of Algeria Telecom

Element	Detail
Company name	Algeria Telecom SPA
Legal status	EPE SPA (Shareholders: State 100%)
Share capital	115,000,000,000.00 DA
Parent company	Algeria Telecom Group
Head office	RN°05, 5 Houses, El Mohammedia, Algiers
Date of entry into activity	10 April 2003
Effective	Approx. 20,400–21,408 employees
Area of activity	Telecommunications, Internet and Fixed 4GLte networks, fixed telephony
Products	Marketing of telecommunications equipment and services for individuals, professionals, and interconnection with mobile operators
Wilayas covered	58 wilayas (the entire national territory)
Commercial Agencies	500

Source: https://www.algerietelecom.dz/ and internal documents

2.5 Missions, objectives and vision of Algeria Telecom

2.5.1 Missions

The fundamental missions of Algeria Telecom are as follows:

- **To provide telecommunications services** enabling the transport and exchange of voice, written messages, digital data and audiovisual information.
- **Developing, operating and managing** public and private telecommunications networks.
- **Establish, operate and manage** interconnections with all network operators.
- **To ensure the continuity and quality** of services across the entire national territory.

2.5.2 Objectives

a) **Internal objectives:**

Increase the quality of services offered and the range of services provided.
Modernize network infrastructure (replacing copper with fiber optics).
Optimize the deployment and connection times for new subscribers.
Improve customer satisfaction through performance indicators (complaint resolution rate, intervention time).

b) **External objectives:**

Increase the supply of telephone services and facilitate access to telecommunications services for the greatest number of users, particularly in rural areas.
Develop a reliable national telecommunications network connected to the information superhighways.
To contribute to the economic and digital development of Algeria.

2.5.3 Vision

Algeria Telecom aims to position itself as the leading broadband operator in Algeria by accelerating the deployment of fiber optics to the home (FTTH). Its ambition is to propel the country towards a competitive digital economy by offering innovative services and a quality of service that meets international standards.

2.6 Activities of Algeria Telecom

Algeria Telecom operates in several complementary areas:

2.6.1 Landline telephony

The company's historical service. Algeria Telecom manages the most extensive fixed telephone network in the country, serving millions of subscribers.

2.6.2 Internet offers

Algeria Telecom offers several internet packages:

- Internet-connected customers
- Customers connected via Fiber Optic
- Customers connected via ADSL / VDSL
- Idoom 4Gcustomers
- Commercial network
- Certified commercial agencies "FI KHIDMATIKOM" / FI KHIDMATIKOM-labeled commercial agencies

2.6.3 Data Transmission

Data network services for businesses (VPN, dedicated links, value-added services).

2.7 Algeria Telecom's networks

Algeria Telecom operates a multi-layered national telecommunications infrastructure:

- **Commercial network**:500 sales agencies across the national territory.
- **Transmission / Backbone network**: National optical backbone recently upgraded to 48 * **400G WDM** technology in partnership with Huawei (2025), significantly increasing capacity across all 58 wilayas.

- **Access network**: Massive deployment of **FTTH** (Fiber To The Home) + legacy copper network (ADSL/VDSL) being progressively replaced.
- **International network**: Submarine cables **ALPAL II** and **SEA-ME-WE** (multiple systems), providing connectivity to Europe and Asia.

The company is heavily investing in the modernization of its infrastructure, with a clear objective of full transition from copper to fiber.

2.8 Tipaza Operational Directorate (OTD **Tipaza)**

2.8.1 Introduction

The Tipaza Operational Directorate (OTD Tipaza) is a decentralized structure of Algeria Telecom. It is responsible for the management, operation and development of telecommunications networks throughout the territory of the wilaya of Tipaza.

The Tipaza OTD constitutes our main field of study, as it manages FTTH deployment projects in this wilaya with strong urban growth.

2.8.2 Role of the Tipaza OTD

- To ensure the continuity and quality of services (landline telephony, ADSL Internet, FTTH) for subscribers in the wilaya.
- Managing infrastructure projects, including the deployment of fiber optics (FTTH).
- Coordinate the interventions of internal technical teams and subcontracting companies in the field.
- Manage relations with local authorities (MPA, daïras) to obtain road permits.
- Ensure the reporting of performance indicators to the general management of Algeria Telecom.

2.8.3 Specificity of the FTTH project implementation method

Algeria Telecom does not carry out FTTH deployment work itself. This specificity is fundamental to understanding our research problem.

Algeria Telecom is acting as the **project owner** . The process is as follows:

Table 2:FTTH project implementation process and distribution of stakeholders

Stage	Actor	Description
1	**Algeria Telecom**	Drafting of the specifications (technical specifications, deadlines, penalties)
2	**Algeria Telecom**	Call for tenders and selection of an external company (subcontractor)
3	**Subcontractor**	Execution of works (civil engineering, laying of HDPE pipes, fiber pulling, welding, connection)
4	**Algeria Telecom**	Monitoring, control, coordination meetings
5	**Subcontractor**	Reporting (progress, unforeseen events, extension requests)

Source: internal company documents

The main planning risks associated with this implementation method are:

- Coordination between two separate legal entities
- Underestimation of deadlines by the bidder (in order to win the tender)
- Hazards not reported in real time
- Penalties that are difficult to apply

The key services for our research (involved in FTTH project planning) are:

- **Engineering and Planning Department / Deployment Department** : develops contractual schedules.
- **Reporting and Management Control** : collects progress indicators.

- **Technical Department** : coordinates the relationship with the subcontractor.
- **ATTC/ Technical Centre** : carries out technical control operations.

2.9 Presentation of the FTTH project (subject of the study)

2.9.1 Definition

Fiber To The Home (FTTH) is an access network technology that involves deploying fiber optic cable from the optical distribution node (ODN) to the subscriber's home or business premises. Unlike hybrid solutions (FTTB, FTTC), FTTH guarantees a 100% optical connection and enables very high symmetrical speeds (up to 10 Gb and more).

2.9.2 Objectives of the FTTH project in Tipaza

- **Improving Internet connectivity** : providing Very High Speed Broadband to individuals and businesses.
- **Latency reduction** : ensuring optimal responsiveness for critical applications (teleworking, video conferencing, cloud).
- **Expanding coverage** : densifying the network in new cities and white zones.
- **Network modernization** : gradually replacing copper (ADSL).
- **Improved quality of service** : fiber is insensitive to electromagnetic interference.

2.9.3 Technical deployment process (operational phase)

The technical process is broken down into four main stages:

Stage 1 – Civil engineering (infrastructure)

Soil surveying, trench digging, laying of **HDPE (High Density Polyethylene) pipes** , construction of pull chambers.

Planning challenge : the stage most exposed to risks (MPA authorizations, underground obstacles).

Step 2 – Fiber optic installation (cabling)

Pulling of optical cables from the ODN to the aggregation points.

Planning challenge : managing teams and equipment.

Step 3 – Optical splicing and connection

Fiber fusion splicing, installation of optical splitters.

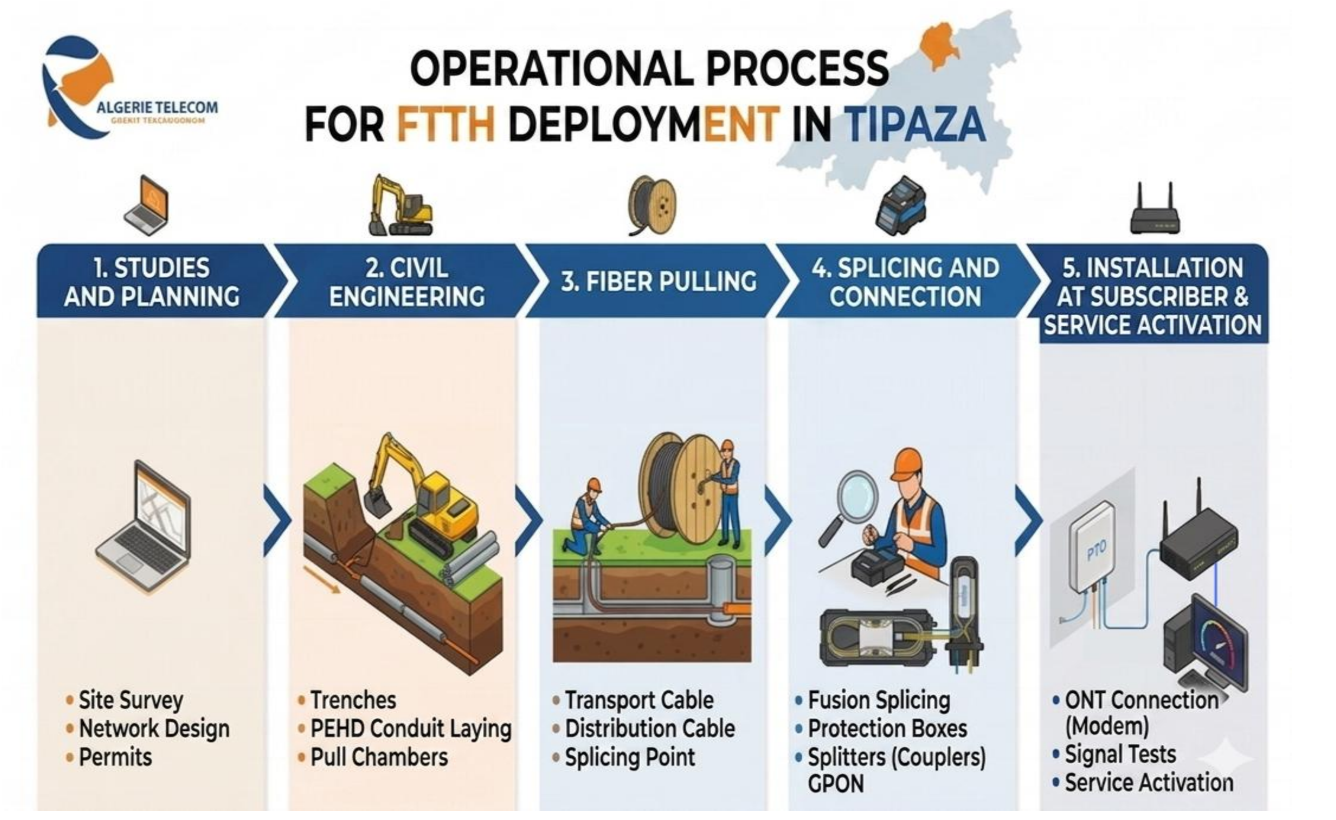
Planning challenge : requires skilled technicians and calibrated welders.

Step 4 – Final connection and commissioning

Installation of the optical terminal outlet (FAT) at the subscriber's premises, configuration of the terminal (ONT), reflectometry tests.

Planning challenge : coordination with subscriber

Figure 1:Operational process of FTTH deployment in Tipaza



Source : generated by the students

2.9.4 Example of a studied FTTH project (2025)

We took as an **example a real FTTH project** , carried out in 2025 in the municipality of Cherchel (wilaya of Tipaza).

Table 3: Characteristics of the FTTH project studied in Cherchel (Tipaza)

Category	**Detail**
Project Name	Development of FTTx duct network – Cherchel sectors
Year of Execution	2025
Wilaya / Commune	Tipaza / Cherchel
Client	Algérie Télécom – Operational Directorate of Tipaza
Network Type	FTTH (duct infrastructure – canalisation)
Project Palier (Civil Engineering.)	Palier 02 (each trench segment ≤ 600 linear meters)
Target Zones	Cité 200 Logements & Cité Ouled Belhadj
Total Trenches	Approximately 1,450 linear meters (split into multiple ODS segments)
Trench Dimensions	Width 30 cm / Depth 63 cm (sidewalk) or 93 cm (road crossing)
Conduit Type	HDPE (PEHD) – black with 4 green stripes, pre-lubricated interior

Conduit Diameter	Ø40/33 mm (external/internal)
Number of Conduits	6 per trench
Chambers Used	Prefabricated concrete types A3 and A4
Chamber Spacing	Every 180–200 meters and at direction changes >110°
Special Crossing	One Oued (riverbed) crossed via horizontal directional drilling (forage horizontal) with steel casing
Contractor Type	Algerian SME – qualified in Public Works / Civil Engineering (Category 4)
Price Nature	Fixed, non-revisable, non-updatable (fermes, non révisables, non actualisables) in DZD HT
Retention Guarantee	5% of each invoice
Offer Validity	180 days from bid opening
Work Start Date	February 20, 2025
Execution Period per ODS	45 calendar days
Provisional Reception	April 2025 (without major reserves)
As-Built Submission	May 2025 (plans, GPS coordinates, chamber filling tables, photo report)

Warranty Period	12 months (April 2025 – April 2026)
Final Reception	Scheduled April 2026
Key Exclusions Certified	No bankruptcy, tax delinquency, fraud registry, or prior AT contract termination
Technical Score Obtained	Above 50/100 (minimum required for Palier 02)

Source: compiled by the students

Chapter conclusion

So, this chapter has served to prepare the ground. It explains how we worked and where we conducted the study.

First, we chose a mixed method: qualitative research to understand the teams' experiences, and quantitative research to measure the gaps. Pragmatism guided us: the important thing is to find solutions that actually work in Tipaza, not theories far removed from reality. We constantly went back and forth between what we saw and what we read.

Next, we collected the data. We read documents, observed on site, interviewed people, and distributed a questionnaire. We cross-referenced all of this to avoid relying on a single source.

In the second part, we presented our field of study: Algeria Telecom, its history, its objectives, and, most importantly, the Tipaza Operational Directorate, where we conducted our investigation. A key point: Algeria Telecom does not carry out the work itself . Everything is done through subcontractors. And that's where the problems lie: difficult coordination, slipping deadlines, and poorly reported issues.

Now that we've established the framework, we move on to the analysis. The next chapter is where we examine our results and propose ways to improve things.

CHAPTER 3: RESULTS AND DISCUSSION

CHAPTER 3 : RESULTS AND DISCUSSION

Section 1: Presentation and Analysis of Results

This chapter presents the results of the empirical study conducted at Algérie Télécom (OTD Tipaza) and discusses them in light of the theoretical framework established in Chapter 1 and the methodological choices detailed in Chapter 2. As specified in the methodological framework (Chapter 2, Section 1), our research adopts a mixed approach combining qualitative analysis of semi-structured interviews using NVivo, quantitative analysis of a questionnaire using SPSS, and a complementary simulation using MS Project.

The chapter is structured as follows. First, we present and analyze the qualitative results from the interviews according to the five axes of our research (Section 1.1 to 1.5). Second, we present and analyze the quantitative results from the questionnaire (Section 1.6). Third, we synthesize the qualitative and quantitative findings (Section 1.7). Fourth, we present the MS Project simulation results as a proposition for an optimized planning model (TO-BE) (Section 1.8). Fifth, we discuss all these results by confronting them with the theoretical framework of Chapter 1, answering our central research problem, and formulating recommendations (Section 2). Finally, we conclude the chapter and transition to the General Conclusion.

Our central research problem, formulated in the General Introduction and in Chapter 2, is:

> "How to improve the reliability of FTTH network planning through better use of management tools and more effective integration of technical constraints?"

1.1 Qualitative Study (NVivo Interviews)

1.1.1 Participant profile

Four semi-structured interviews were conducted with executives from Algérie Télécom (OTD Tipaza). All participants were male, aged between 34 and 52 years. Their positions were as follows:

Head of the Study and Planning Department;

Planning Officer;

Study Officer;

Cell Leader.

Their professional experience in the telecommunications field was approximately between 5 and 20 years. These varied profiles made it possible to collect complementary perspectives on FTTH project planning practices.

1.1.2 Presentation and Analysis of NVivo Results

The interviews were imported into NVivo 10 data processing software. This allowed us to generate a word cloud related to planning, project management and monitoring tools.

Figure 2: Word cloud of the most frequent terms (all interviews combined)

Source: Generated by the students using NVivo 10, Word Cloud visualization

Table 4: Most frequent words (minimum length: 5 characters, top 12)

Word	Count	Weighted Percentage (%)
planning	34	1.91
project	33	1.86
technical	33	1.86
monitoring	30	1.69
design	24	1.35
field	24	1.35
delays	21	1.18
management	18	1.01
platform	17	0.96
coordination	14	0.79
permits	13	0.73
subcontractors	8	0.45

Source:Generated by the students using NVivo 10, Word Frequency Query (all interviews combined)

Analysis of the frequency table:

Three thematic clusters emerge from the table. The first cluster concerns planning activities: planning (34), project (33), monitoring (30), design (24). The high frequency of these terms confirms that our interview guide successfully captured the central theme of the research. Participants are discussing concrete, daily activities related to project planning and execution.

The second cluster concerns operational obstacles: delays (21), permits (13), field (24). The presence of delays as the third most frequent content word (1.18%) is the most important statistical finding. It proves that schedule reliability is a central concern for all participants. The association between delays and permits (administrative authorizations) and field (execution obstacles) reveals that participants perceive delays as having two main sources: external administrative factors and internal field execution problems.

The third cluster concerns management instruments: platform (17), coordination (14), subcontractors (8). These terms show that participants are not only describing problems but also the tools and processes they currently use to address them.

1.1.3. Pearson Correlation Test

Table 5: Pearson correlation coefficients between interviews

Interview A	Interview B	Pearson coefficient
3	**1**	0.73
2	**1**	0.67
3	**2**	0.56
4	**1**	0.54

Interview A	Interview B	Pearson coefficient
4	**3**	0.52
4	**2**	0.39

SourceGenerated by the students using: NVivo 10, Pearson Correlation Test

Analysis of the Pearson correlation:

The coefficients range from 0.39 to 0.73, with an average of approximately 0.57. Five out of six pairs show a coefficient above 0.50, indicating a moderate to strong similarity in vocabulary across the four interviews. This confirms that the participants share a common professional language and address comparable planning concerns.

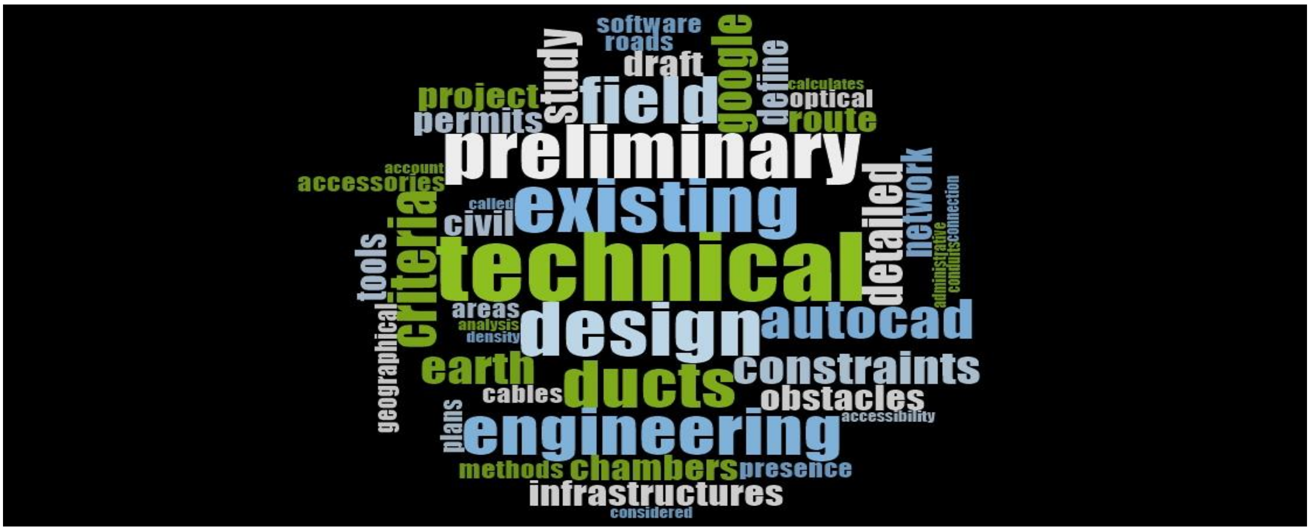
The highest similarity (0.73) is observed between Interview 3 and Interview 1. The lowest similarity (0.39) is between Interview 4 and Interview 2. This lower coefficient does not indicate disagreement; it reflects that the Cell Leader (Interview 4) and the Planning Officer (Interview 2) have different functional perspectives. This diversity is desirable in qualitative research as it enriches the variety of viewpoints.

1.1.4. Word Frequency Query by Axis (Quantitative Analysis per Axis)

To deepen the analysis, a word frequency query was performed separately for each of the five axes of the interview guide.

Axis 1: Planning and Technical Design

Figure 3: Word cloud – Axis 1 (Planning and Technical Design)



Source: Generated by the students using NVivo 10, Word Cloud visualization

Table 6: Most frequent words – Axis 1 (minimum length: 5 characters)

Word	**Count**	**Weighted Percentage (%)**
technical	10	2.11
design	8	1.68
existing	8	1.68
preliminary	8	1.68

Word	**Count**	**Weighted Percentage (%)**
ducts	7	1.47
engineering	7	1.47
field	7	1.47
autocad	6	1.26
criteria	6	1.26
constraints	5	1.05

Source: Generated by the students using NVivo 10, Word Frequency Query (Axis 1)

Analysis: The discourse on Axis 1 is dominated by technical terms (technical, design, engineering), references to existing infrastructure (existing, ducts, field), and planning phases (preliminary). The presence of autocad confirms the use of specialized design software. The word constraints (5 occurrences) indicates that participants are highly aware of obstacles affecting the planning phase.

Axis 2: Organization and Project Management

Figure 4: Word cloud – Axis 2 (Organization and Project Management)

Source:Generated by the students using NVivo 10, Word Cloud visualization

Table 7: Most frequent words – Axis 2 (minimum length: 5 characters)

Word	Count	Weighted Percentage (%)
field	8	2.70
planning	8	2.70
monitoring	7	2.36
technical	7	2.36
department	5	1.69
internal	5	1.69
coordination	4	1.35

Word	Count	Weighted Percentage (%)
priorities	4	1.35
project	4	1.35
services	4	1.35

Source: Generated by the students using NVivo 10, Word Frequency Query (Axis 2)

Analysis: The results reveal that field and planning are equally frequent, indicating a constant tension between field execution and planning activities. The presence of coordination confirms that coordination is a central challenge.

Axis 3: Monitoring and Management Platform

Figure 5: Word cloud – Axis 3 (Monitoring and Management Platform)

Source:Generated by the students using NVivo 10, Word Cloud visualization

Table 8: Most frequent words – Axis 3 (minimum length: 5 characters)

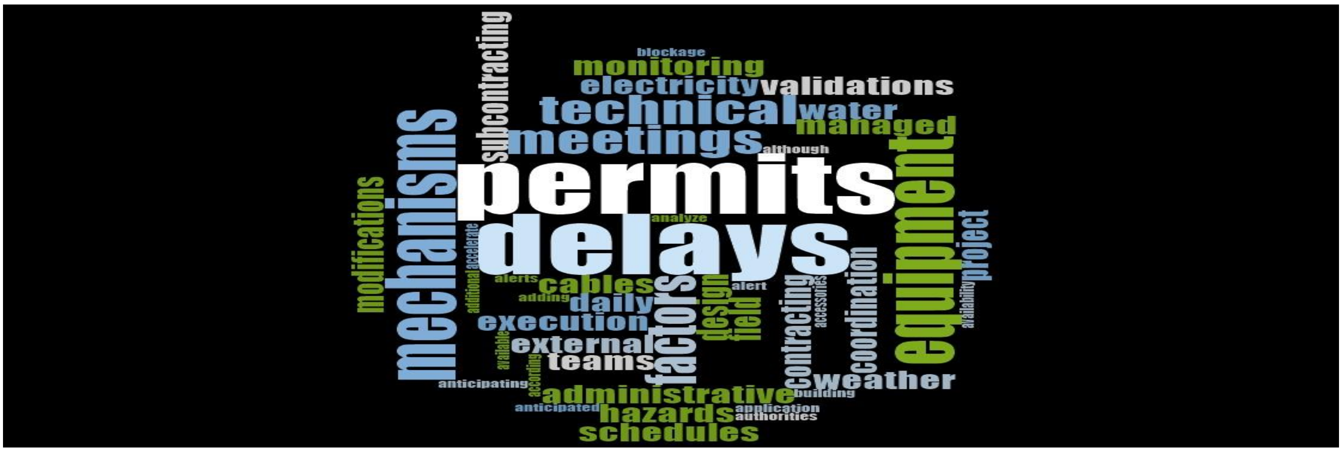
Word	Count	Weighted Percentage (%)
allows	6	2.49
monitoring	6	2.49
platform	6	2.49
progress	6	2.49
projects	5	2.07
field	4	1.66
project	4	1.66
resources	4	1.66
daily	3	1.24
delays	3	1.24

Source: Generated by the students using NVivo 10, Word Frequency Query (Axis 3)

Analysis: Monitoring and platform appear with equal frequency, confirming the centrality of the internal monitoring tool. The presence of delays and field suggests that the platform is closely associated with delay management.

Axis 4: Deadlines and Project Performance

Figure 6: Word cloud – Axis 4 (Deadlines and Project Performance)



Source:Generated by the students using NVivo 10, Word Cloud visualization

Table 9: Most frequent words – Axis 4 (minimum length: 5 characters)

Word	Count	Weighted Percentage (%)
delays	6	2.97
permits	6	2.97
equipment	4	1.98
mechanisms	4	1.98
factors	3	1.49
meetings	3	1.49
technical	3	1.49

Source: Generated by the students using NVivo 10, Word Frequency Query (Axis 4)

Analysis: Delays and permits are the most frequent words with identical counts. This statistical association confirms that administrative permits are the primary cause of delays.

Axis 5: Limitations and Improvement

Figure 7: Word cloud – Axis 5 (Limitations and Improvement)

Source:Generated by the students using NVivo 10, Word Cloud visualization

Table 10: Most frequent words – Axis 5 (minimum length: 5 characters)

Word	Count	Weighted Percentage (%)
planning	5	3.57
monitoring	4	2.86
field	3	2.14
mobile	3	2.14
tools	3	2.14

Word	Count	Weighted Percentage (%)
applications	2	1.43
artificial	2	1.43
automation	2	1.43
geolocation	2	1.43
intelligence	2	1.43

Source:Generated by the students using NVivo 10, Word Frequency Query (Axis 5)

Analysis: The presence of mobile, applications, artificial intelligence, automation, and geolocation confirms that participants spontaneously propose technological solutions for improving planning reliability.

1.1.5 Thematic Analysis According to the Five Axes (Qualitative Analysis)

Axis 1: Planning and Technical Design

All four participants describe a structured but iterative planning process. The Head of the Study and Planning Department explains that the design begins with a preliminary study (APS), then a detailed design (DDP), with a technician going to the field to verify ducts, chambers, and obstacles. The Planning Officer adds that the main criteria for route definition are existing infrastructures, terrain constraints, and costs.

All participants agree that the technical process is well defined, but field obstacles (blocked ducts, rocky soil, administrative delays) are often underestimated during the initial planning phase.

Axis 2: Organization and Project Management

The Planning Officer explains that coordination is done via weekly meetings, reporting tools, and daily reports, but the main difficulty is the lack of responsiveness of certain co-contracting companies. The

Cell Leader specifies the difficulties: lack of responsiveness of certain subcontractors, administrative red tape, and communication problems between the office and the field.

Axis 3: Monitoring and Management Platform

The internal platform is perceived as useful for visualizing progress, archiving documents, and identifying blocked projects. However, the Cell Leader notes that the platform often suffers from a lag compared to field reality. The Study Officer adds that the platform allows them to see progress percentages but often suffers from a lag.

Axis 4: Deadlines and Project Performance

The Head of Department summarizes that delays come mainly from late permits (MPA/DPW), material shortages, weather hazards, and lack of coordination. The Planning Officer adds that unforeseen field events and uncoordinated subcontractors are the main factors. All participants agree that the gap between the initial schedule and actual execution is systematic.

Axis 5: Limitations and Improvement

The main limitations expressed are manual data entry (risk of errors), fragmentation of the monitoring system, and insufficient training. The most frequently suggested improvements are automating field data collection, using mobile applications for real-time updates, and introducing AI for predictive delay analysis.

1.1.6 Discussion of NVivo Results

This section interprets the qualitative results presented above and confronts them with the theoretical framework established in Chapter 1.

a) **Axis 1:** The finding that all participants describe a structured planning process but report a systematic gap between theoretical schedules and field reality confirms Watt's (2014) definition of planning as the "fundamental phase." However, it also reveals that in the Algerian FTTH context, the "initial requirements" are systematically incomplete. Mouhoub (2014) argued that precise activity definition requires accurate field information. Zemra (2019) provided an explanation: a structural disconnect between the planning office and the field. Our results extend Zemra's finding to FTTH projects.

b) **Axis 2:** The finding that coordination and subcontractor responsiveness are central difficulties confirms Kerzner's (2022) and the PMI's (2021) emphasis on coordination as essential for performance. Lalmi (2021) found that coordination failures arise from lack of real-time information sharing and contractual fragmentation. Our participants confirmed both.

c) **Axis 3:** The finding that the platform suffers from a lag and is described as "descriptive, not corrective" partially contradicts Schwalbe's (2022) theoretical promise that digital planning tools provide real-time decision-making clarity. As Geraldi and Lechter (2012) argued, traditional planning tools impose a linear, static vision. The platform at Algérie Télécom is essentially a digital Gantt chart.

d) **Axis 4:** The finding that delays and permits are statistically associated confirms Watt's (2014) "iron triangle" model and Zemra's (2019) work on Algerian construction projects. Administrative procedures in Algeria are characterized by multiple approval layers, lack of digitalization, and frequent changes in local regulations.

e) **Axis 5:** Participants spontaneously suggested automation, mobile applications, and AI. This aligns with Lean Six Sigma principles (waste reduction), Benoumelaz's (2019) work on optimization algorithms, and Fanaei's (2019) emphasis on training. Field actors are not resistant to digital transformation; they are demanding it.

Synthesis of the Qualitative Discussion: The planning process (Axis 1) is technically solid but operationally fragile because field constraints are not integrated. Coordination (Axis 2) is essential but fragile due to subcontractor unresponsiveness and communication gaps. The platform (Axis 3) is descriptive, not corrective, because it relies on manual data entry and lacks real-time field reporting. Delays (Axis 4) are systematic and primarily caused by external administrative factors. Finally, participants (Axis 5) spontaneously demand digitalization, automation, and AI as solutions.

1.2 Quantitative Study (SPSS Questionnaire)

This section presents the quantitative results obtained from the questionnaire administered to planning and monitoring staff members at Algérie Télécom (OTD Tipaza). The data was processed using SPSS software. Descriptive statistics, reliability analysis (Cronbach's Alpha), and multiple response sets were used to analyze the data.

1.2.1 Characteristics of the Quantitative Sample

Table 11:Distribution of respondents by function and experience

Function	2-5 years	5-22 years	+22 ans	Total (N)
Planning	1	2	0	3
Monitoring	0	3	0	3
Technical	0	8	0	8
Modernization Project Manager	0	1	1	1
Total	1	14	1	16

Source:Generated by the students using SPSS, Multiple Response Analysis (Profil_Poste & Experience)

Analysis: The table shows that the majority of respondents (75%) hold technical positions (Technique). A significant majority (83.3% of the valid sample) have more than 5 years of professional experience. This is a critical indicator for our research, as it confirms that the evaluation of the management system and the diagnosis of planning issues come from experienced professionals who are fully aware of the operational realities and shortcomings within the company.

1.2.2 Reliability of the Research Instrument

To verify the internal consistency of the questionnaire, Cronbach's Alpha coefficient was calculated for the "Current System Evaluation" axis.

Table 12: Reliability Statistics

Cronbach's Alpha	N of Items
.795	5

Source:Generated by the students using SPSS

Analysis: The overall Cronbach's Alpha coefficient is 0.795, which is well above the minimum acceptable threshold of 0.60. This indicates a strong internal consistency among the items of this axis.

Table 13: Item-Total Statistics

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Work Experience (Current System Efficiency)	.619	.744
Le système actuel permet-il une gestion efficace des projets	.872	.637
Structuration du planning (Planning Structure)	.441	.794
Fiabilité des outils (Tool Reliability)	.324	.824
Respect des délais (Deadline Compliance)	.724	.729

Source: Generated by the students using SPSS

Analysis: The item with the highest correlation is "Le système actuel permet-il une gestion efficace des projets" (Does the current system allow for effective project management?) with a value of 0.872. Removing it would lower the alpha to 0.637, confirming it as the backbone of this axis. The item "Fiabilité des outils" (Tool Reliability) has the lowest correlation (0.324), and removing it would improve the overall alpha to 0.824, indicating that this concept might be slightly different from the core construct of the axis.

1.2.3 Evaluation of the Current Management System

Table 14: Current system efficiency

	Frequency	Percent	Valid Percent	Cumulative Percent	
Valid	**Très Eff (Very Eff)**	5	41.7	41.7	41.7
	Eff	3	25.0	25.0	66.7
	Moyenne (Average)	4	33.3	33.3	100.0
	Total	12	100.0	100.0	

Source: Generated by the students using SPSS

Analysis: The table shows that the largest percentage of participants (41.7%) describe the system's efficiency as "very effective," while 33.3% see it as "average." This indicates a variation in the evaluation of the current system's performance.

Table 15: System's ability to ensure effective project management

	Frequency	Percent	Valid Percent	Cumulative Percent	
Valid	**yes (oui)**	8	66.7	66.7	66.7

	Frequency	Percent	Valid Percent	Cumulative Percent	
	Partiallity (peut-être)	4	33.3	33.3	100.0
	Total	12	100.0	100.0	

Source:Generated by the students using SPSS

Analysis: This reflects a high level of confidence (66.7%). We observe from the results that the majority of the sample (66.7%) confirm that the current system allows for effective project management, compared to 33.3% who expressed partial agreement. While the system's ability to meet management requirements is questionable, the presence of some doubt necessitates a review of certain organizational shortcomings.

1.2.4 Planning Tools Used and Their Reliability

Table 16: Technical tools used in planning and design

	Responses	Percent of Cases	
	N	**Percent**	
Use of Excel	1	7.1%	12.5%
Use of AutoCAD	8	57.1%	100.0%
Use of Google Earth	1	7.1%	12.5%
Other specific tools	4	28.6%	50.0%
Total	14	100.0%	175.0%

Source:Generated by the students using SPSS, Multiple Response Analysis

Analysis: The study revealed a complete reliance on AutoCAD software (100% of cases) among respondents, while the use of Excel and Google Earth remained very limited (12.5%). The company focuses primarily on engineering design tools, with a clear lack of dedicated software for scheduling and resource management.

Table 17: Reliability of management tools

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**yes (oui)**	8	66.7	66.7	66.7
	partially (Partiellement)	3	25.0	25.0	91.7
	No (non)	1	8.3	8.3	100.0
	Total	12	100.0	100.0	

Source:Generated by the students using SPSS, Frequency Analysis

Analysis: The results indicate that 66.7% of participants trust the reliability of the technical tools used, while 25% consider them partially reliable. This aligns with the heavy reliance on software such as Excel and AutoCAD, but there remains a need to develop these tools to reduce the remaining dissatisfaction.

1.2.5 Planning Structure and Deadline Compliance

Table 18:Planning structure

	Frequency	Percent	Valid Percent	Cumulative Percent	
Valid	yes (oui)	8	66.7	66.7	66.7
	partially (Partiellement)	3	25.0	25.0	91.7
	no (non)	1	8.3	8.3	100.0
	Total	12	100.0	100.0	

Source: Generated by the students using SPSS, Frequency Analysis

Table 19:Deadline compliance

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**	
Valid	**Always (Toujours)**	1	8.3	8.3	8.3
	Often (Souvent)	8	66.7	66.7	75.0
	Rarely (Rarement)	3	25.0	25.0	100.0
	Total	12	100.0	100.0	

Source:Generated by the students using SPSS, Frequency Analysis

Critical finding: This is the most critical finding of the quantitative analysis. While 66.7% of respondents acknowledge a clear planning structure (Table 15), only 8.3% report that deadlines are "always" respected (Table 16). A combined 91.7% of respondents admit that deadlines are only respected "often" or "rarely." This significant gap directly confirms our research problem: there is a systematic deviation between planning and execution. The quality of the planning structure or confidence in tools does not automatically translate into schedule reliability.

1.2.6 Main Difficulties Encountered in Project Management

Table 20:Main difficulties encountered

	Responses	Percent of Cases	
	N	Percent	
Retards dans l'exécution	10	47.6%	83.3%
Manque de coordination	5	23.8%	41.7%
Problèmes techniques	3	14.3%	25.0%
Manque de visibilité	3	14.3%	25.0%
Total	21	100.0%	175.0%

Source: Generated by the students using SPSS, Multiple Response Analysis

Analysis: This result definitively answers one of our research sub-questions. "Execution delays" (Retards dans l'exécution) are identified as the primary obstacle by an overwhelming majority (83.3% of cases). This is followed by a "lack of coordination" (41.7%). This finding aligns perfectly with the NVivo qualitative results where delays and permits were the most frequent words. It confirms that the central problem is not a lack of tools, but the inability to adhere to the schedule, largely due to external factors and coordination issues.

1.2.7 Priorities for Improvement

Table 21: Aspects to be improved as a priority

	Responses	Percent of Cases	
	N	Percent	
Priorité: Planification	5	25.0%	41.7%
Priorité: Suivi	6	30.0%	50.0%
Priorité: Coordination	4	20.0%	33.3%
Priorité: Gestion des ressources	5	25.0%	41.7%
Total	20	100.0%	166.7%

Source: Generated by the students using SPSS, Multiple Response Analysis (Prio_Plan)

Analysis: Half of the respondents (50%) indicate that "monitoring and follow-up" (Suivi) should be the top priority for improvement. Planning and resource management follow closely (41.7% each). This indicates a clear awareness among the staff that enhancing control and real-time progress tracking mechanisms is the most effective way to address the systematic delays identified earlier.

1.2.8 Normality Test

Table 22: Tests of Normality (Shapiro-Wilk)

Variable	Work Experience	Kolmogorov-Smirnov^b	Shapiro-Wilk				
		Statistic	df	Sig.	Statistic	df	Sig.
Current System Efficiency	> 5 years	.308	10	.008	.756	10	.004
Planning Structure	> 5 years	.416	10	.000	.650	10	.000
Tool Reliability	> 5 years	.360	10	.001	.731	10	.002
Does the current system allow for effective project management?	> 5 years	.433	10	.000	.594	10	.000
Deadline Compliance	> 5 years	.370	10	.000	.752	10	.004
Priority: Planning	> 5 years	.381	10	.000	.640	10	.000

Variable	Work Experience	Kolmogorov-Smirnov^b	Shapiro-Wilk				
Priority: Monitoring	> 5 years	.381	10	.000	.640	10	.000
Priority: Coordination	> 5 years	.381	10	.000	.640	10	.000
Execution Delays	> 5 years	.524	10	.000	.366	10	.000
Lack of Coordination	> 5 years	.329	10	.003	.655	10	.000
Technical Problems	> 5 years	.482	10	.000	.509	10	.000
Lack of Visibility	> 5 years	.433	10	.000	.594	10	.000

Source: Generated by the students using SPSS;Tests of Normality (Shapiro-Wilk)

Analysis: The Shapiro-Wilk test was applied to verify the distribution of our data (N=12). The results show that the significance value (Sig.) is below the threshold of 0.05 for all variables. Consequently, we conclude that the data do not follow a normal distribution. This situation justifies the use of a descriptive and cross-sectional analysis to diagnose the planning anomalies of the FTTH project.

1.3 Synthesis of Qualitative and Quantitative Results (NVivo + SPSS)

The confrontation of the qualitative and quantitative results reveals a strong convergence that validates our research findings.

Convergence on delays: In the qualitative analysis, delays appeared as the third most frequent word (21 occurrences). In the quantitative analysis, 83.3% of respondents cited "execution delays" as the primary difficulty. This double confirmation establishes that schedule reliability is the central problem facing FTTH project planning at Algérie Télécom.

Convergence on permits: The qualitative analysis showed a statistical association between delays and permits (13 occurrences). The quantitative analysis confirmed that administrative permits are consistently cited as a primary cause of delays. This indicates that external bureaucratic factors are not secondary issues but structural constraints that must be integrated into planning proactively.

Convergence on coordination: The qualitative analysis revealed coordination (14 times) and subcontractors (8 times) as frequent terms. The quantitative analysis found that 41.7% of respondents identify "lack of coordination" as a major difficulty.

Convergence on platform limitations: In the qualitative analysis, participants explicitly stated that the platform is "descriptive, not corrective" and suffers from a lag. The quantitative analysis revealed that only 8.3% of respondents report deadlines are "always" respected, despite 66.7% acknowledging a clear planning structure.

Convergence on improvement priorities: In the qualitative analysis, participants spontaneously suggested automation, mobile applications, and AI. In the quantitative analysis, 50% of respondents prioritized "monitoring" (Suivi) as the top area for improvement.

Synthesis: The qualitative analysis provides depth and context, explaining why delays occur (permits, subcontractors, field obstacles). The quantitative analysis provides statistical weight, confirming that these problems are widespread (83.3% cite execution delays). Together, they establish a robust diagnosis (AS-IS) that justifies the proposed optimization (TO-BE).

1.4 MS Project Simulation Results (TO-BE): A Quantitative Optimization Proposal

After establishing a clear diagnosis of the current situation (AS-IS) through the qualitative analysis (NVivo) and the quantitative analysis (SPSS), this section presents an optimized planning model (TO-BE) for the same FTTH project studied in Cherchel (2025). The objective is to demonstrate how the identified problems—systematic delays, lack of coordination, and descriptive monitoring—can be addressed through a dynamic planning tool.

This simulation directly responds to our research problem: "How to improve the reliability of FTTH network planning through better use of management tools?" It applies the theoretical concepts of Critical Path Method (CPM) , Resource Leveling, and Earned Value Management (EVM) , as discussed in Chapter 1 (Sections 2.2.3 and 2.3.2) and Chapter 2 (Section 1.6.3: Evaluation Using the EVM Method).

1.4.1 Baseline Diagnosis (AS-IS): The Current State of the Cherchel FTTH Project

Before presenting the simulation results, we recall the main characteristics of the current situation (AS-IS) of the Cherchel project, as detailed in Chapter 2, Table 4, and confirmed by our NVivo and SPSS analyses.

The project was systematically delayed: The contractual duration was 45 calendar days per ODS. However, the SPSS analysis revealed that only 8.3% of respondents reported that deadlines are "always" respected (Table 16), and 83.3% cited execution delays as the primary difficulty (Table 17).

The main cause was administrative permits: The NVivo analysis showed that delays and permits were statistically associated (Table 1). All four interview participants explicitly cited permits (MPA/DPW) as the primary source of delay (Axis 4).

Coordination was weak: The NVivo analysis revealed that coordination appeared 14 times (Table 1), and subcontractors 8 times. The SPSS analysis indicated that 41.7% of respondents cited "lack of coordination" as a major difficulty (Table 17).

The monitoring platform was descriptive, not corrective: The Cell Leader explicitly stated that the platform suffers from a lag (Axis 3). This was confirmed by the SPSS finding that, despite 66.7% acknowledging a clear planning structure, only 8.3% respected deadlines (Tables 15 and 16).

No dedicated scheduling software was used: The SPSS analysis showed that AutoCAD was used by 100% of respondents for design, but no specialized tool was used for scheduling and resource management (Table 13). Cost control was not integrated into the planning process, a critical weakness given the fixed-price nature of the contract.

Table 23: Baseline Diagnosis (AS-IS) of the Cherchel FTTH Project

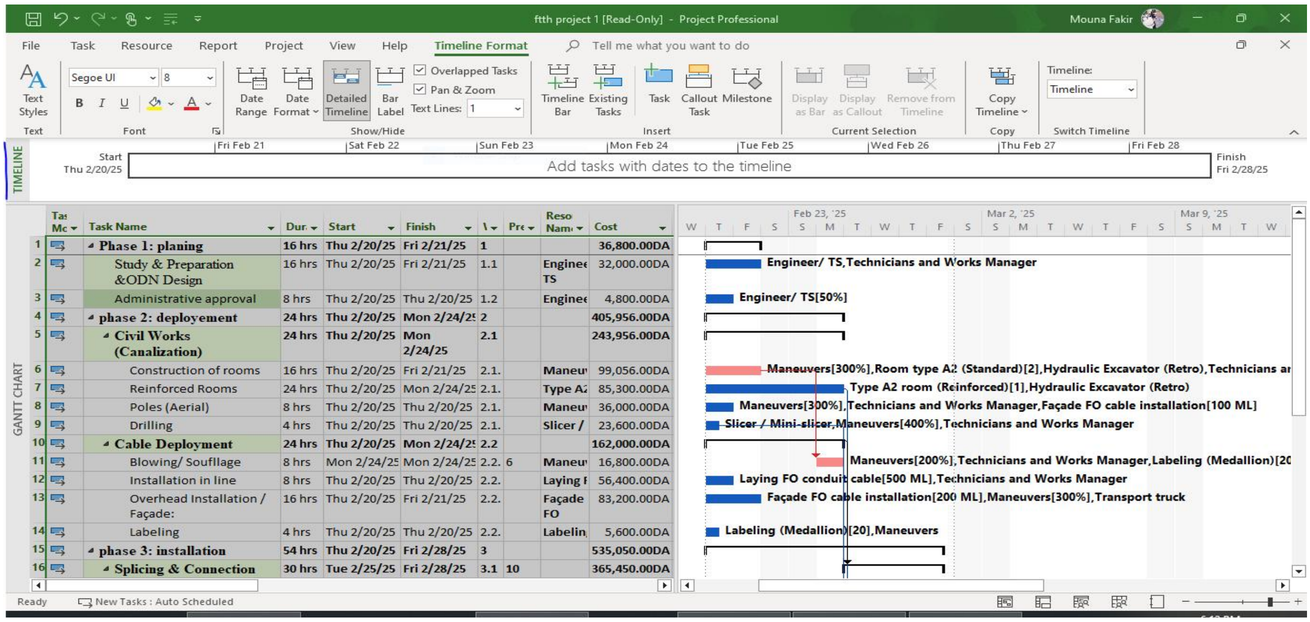
Indicator	AS-IS (Current State)	Source (Chapter & Analysis)
Work Start Date	February 20, 2025	Chapter 2, Table 4
Execution Period per ODS	45 calendar days (not respected)	Chapter 2, Table 4; SPSS, Table 16
Primary Delay Cause	Administrative permits (MPA/DPW)	NVivo, Axis 4; SPSS, Table 17
Deadline Compliance	Only 8.3% "always" respected	SPSS, Table 16
Coordination	41.7% cite lack; coordination appears 14 times	SPSS, Table 17; NVivo, Table 1
Monitoring Platform	Descriptive, lagging	NVivo, Axis 3
Planning Tools	AutoCAD only	SPSS, Table 13
Cost Control	Not integrated	Chapter 2, Table 4 (fixed price)

Source: student elaboration based on Chapter 2 data, NVivo, and SPSS results

1.4.2 The Proposed Optimized Model (TO-BE): MS Project Simulation

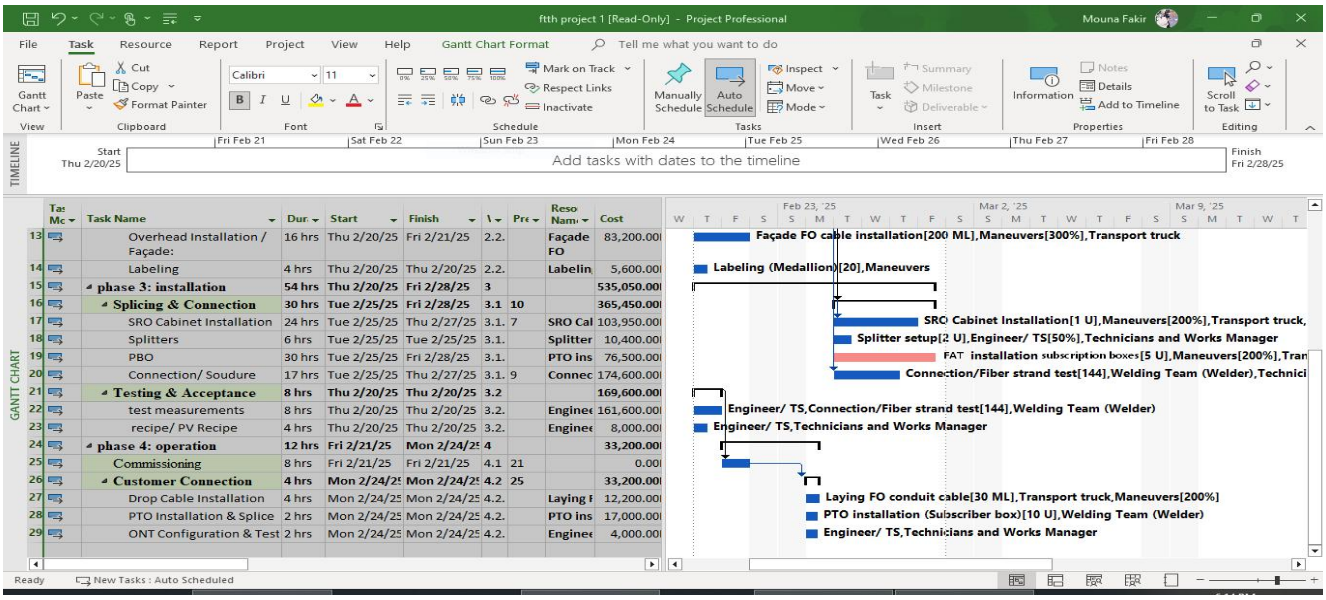
To address these weaknesses, an MS Project simulation was conducted using the same Cherchel project data (1,450 linear meters of trenches, 6 conduits per trench, multiple ODS segments). The following figures and tables present the results of this simulation.

Figure 8: MS Project Gantt Chart – Time Framework and Planning



Source:Generated by the students using MS Project simulation

Figure 9: MS Project Gantt Chart – Detailed Task Sequence



Source: Generated by the students using MS Project simulation

a) Analysis of the Time Framework and Planning (Critical Path Reduction)

The simulation sets the project launch for September 1, 2025. This strategic choice directly addresses the primary cause of delay identified in our study: administrative permits. In the AS-IS state, the project started on February 20, 2025, without prior permit anticipation. By shifting the start date to September 1, the TO-BE model treats permits as a fixed constraint integrated proactively rather than a risk managed reactively.

With an optimized execution duration of 9 days, MS Project enables a shift from reactive to proactive management. The initial contractual duration was 45 calendar days per ODS. The optimized duration of 9 days represents an 80% reduction in active work time. This is achieved through Critical Path Method (CPM) analysis, as described in Chapter 1, Section 2.3.1 (PMI, 2021; Kerzner, 2022).

How was the critical path reduced? MS Project automatically identifies the longest sequence of dependent tasks (the critical path). By applying two techniques, the duration was compressed:

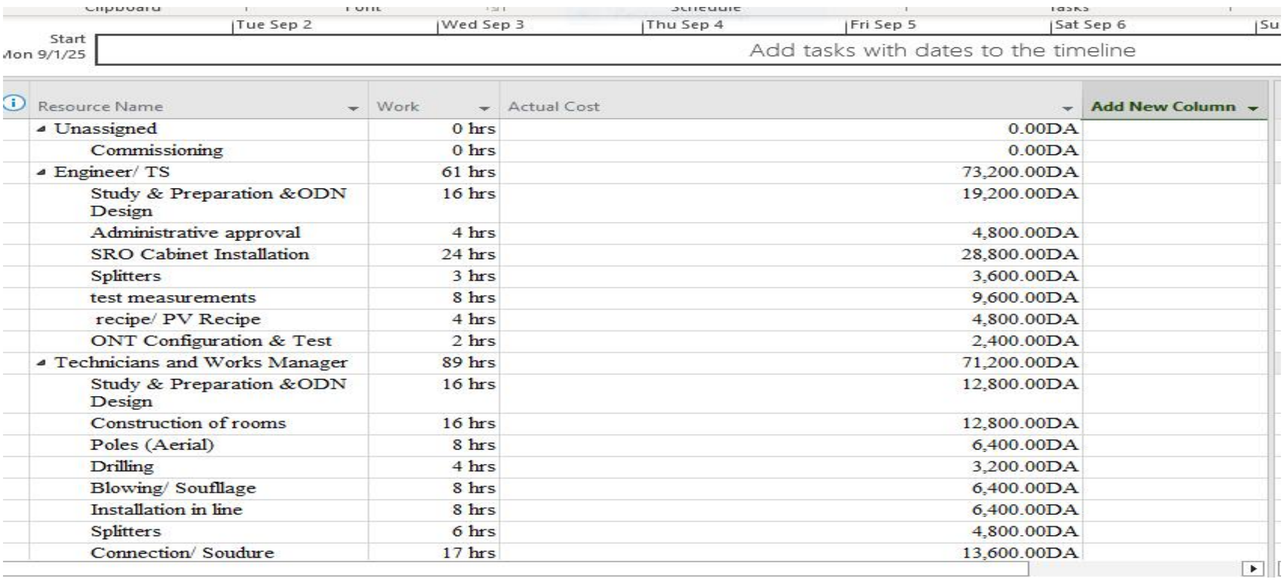
Crashing: Additional resources are allocated to critical tasks to shorten their duration.

Fast-Tracking: Sequential tasks are reorganized to be performed in parallel where technically feasible (e.g., preparing one trench segment while pulling cable in another).

This directly addresses the finding that 83.3% of respondents cite execution delays (SPSS, Table 17).

b) Analysis of Workload and Human Effort (Resource Leveling and Baseline)

Figure 10: MS Project Resource Usage – Workload Distribution



Resource Name	Work	Actual Cost	Add New Column
Unassigned	0 hrs	0.00DA	
Commissioning	0 hrs	0.00DA	
Engineer/ TS	61 hrs	73,200.00DA	
Study & Preparation &ODN Design	16 hrs	19,200.00DA	
Administrative approval	4 hrs	4,800.00DA	
SRO Cabinet Installation	24 hrs	28,800.00DA	
Splitters	3 hrs	3,600.00DA	
test measurements	8 hrs	9,600.00DA	
recipe/ PV Recipe	4 hrs	4,800.00DA	
ONT Configuration & Test	2 hrs	2,400.00DA	
Technicians and Works Manager	89 hrs	71,200.00DA	
Study & Preparation &ODN Design	16 hrs	12,800.00DA	
Construction of rooms	16 hrs	12,800.00DA	
Poles (Aerial)	8 hrs	6,400.00DA	
Drilling	4 hrs	3,200.00DA	
Blowing/ Soufflage	8 hrs	6,400.00DA	
Installation in line	8 hrs	6,400.00DA	
Splitters	6 hrs	4,800.00DA	
Connection/ Soudure	17 hrs	13,600.00DA	

Source:Generated by the students using MS Project simulation

Figure 11: MS Project Resource Usage – Detailed Task Assignment

	Resource Name	Work	Actual Cost	Add New Column
	PBO	30 hrs	45,000.00DA	
	Drop Cable Installation	4 hrs	6,000.00DA	
6	◢ Hydraulic Excavator (Retro)	40 hrs	100,000.00DA	
	Construction of rooms	16 hrs	40,000.00DA	
	Reinforced Rooms	24 hrs	60,000.00DA	
7	◢ Welding Team (Welder)	27 hrs	27,000.00DA	
	Connection/ Soudure	17 hrs	17,000.00DA	
	test measurements	8 hrs	8,000.00DA	
	PTO Installation & Splice	2 hrs	2,000.00DA	
8	FO cable blowing	0 ML	0.00DA	
9	◢ Laying FO conduit cable	530 ML	53,000.00DA	
	Installation in line	500 ML	50,000.00DA	
	Drop Cable Installation	30 ML	3,000.00DA	
10	◢ Façade FO cable installation	300 ML	60,000.00DA	
	Poles (Aerial)	100 ML	20,000.00DA	
	Overhead Installation / Façade:	200 ML	40,000.00DA	
11	◢ SRO Cabinet Installation	1 U	19,950.00DA	
	SRO Cabinet Installation	1 U	19,950.00DA	
12	◢ Splitter setup	2 U	2,000.00DA	
	Splitters	2 U	2,000.00DA	

	SRO Cabinet Installation	1 U	19,950.00DA
2	◢ Splitter setup	2 U	2,000.00DA
	Splitters	2 U	2,000.00DA
3	◢ PTO installation (Subscriber box)	15 U	22,500.00DA
	PBO	5 U	7,500.00DA
	PTO Installation & Splice	10 U	15,000.00DA
4	◢ Connection/Fiber strand test	288	288,000.00DA
	Connection/ Soudure	144	144,000.00DA
	test measurements	144	144,000.00DA
5	◢ Labeling (Medallion)	40	8,000.00DA
	Blowing/ Soufllage	20	4,000.00DA
	Labeling	20	4,000.00DA
6	◢ Room type A2 (Standard)	2	27,056.00DA
	Construction of rooms	2	27,056.00DA
7	◢ Type A2 room (Reinforced)	1	25,300.00DA
	Reinforced Rooms	1	25,300.00DA

Source: Generated by the students using MS Project simulation

The project totals a volume of 567 working hours. Beyond the figure, this data represents the Baseline necessary to stabilize coordination between technical teams. In project management, the Baseline is a fixed reference point against which actual progress is measured.

Resource Leveling: MS Project automatically resolves resource overallocation by delaying non-critical tasks or splitting assignments. This ensures that no team (e.g., the splicing team) is overburdened while another (e.g., the excavation team) is idle.

Impact on coordination: By assigning hours precisely to each task (excavation: 2 hours per meter, cable pulling: 1 hour, splicing: 0.5 hour per connection), MS Project minimizes the organizational gray areas that cause coordination problems. This directly addresses the finding that 41.7% of respondents cited "lack of coordination" (SPSS, Table 17) and that coordination appeared 14 times in the interviews (NVivo, Table 1).

c) Budgetary Analysis and Cost Control (EVM Metrics Integration)

Figure 12: MS Project Cost Table – Budget Breakdown

Task Name	Fixed Cost	Fixed Cost	Total Cost	Baseline	Variance	Actual	Remainir	Add New
Phase 1: planing	**0.00DA**	**Prorated**	**36,800.00DA**	**36,800.00DA**	**0.00DA**	**36,800.00DA**	**0.00DA**	
Study & Preparation	0.00DA	Prorated	32,000.00DA	32,000.00DA	0.00DA	32,000.00DA	0.00DA	
Administrative ap	0.00DA	Prorated	4,800.00DA	4,800.00DA	0.00DA	4,800.00DA	0.00DA	
phase 2: deployem	**0.00DA**	**Prorated**	**405,956.00DA**	**405,956.00DA**	**0.00DA**	**405,956.00DA**	**0.00DA**	
Civil Works (Canalization)	**0.00DA**	**Prorated**	**243,956.00DA**	**243,956.00DA**	**0.00DA**	**243,956.00DA**	**0.00DA**	
Construction of	0.00DA	Prorated	99,056.00DA	99,056.00DA	0.00DA	99,056.00DA	0.00DA	
Reinforced Roo	0.00DA	Prorated	85,300.00DA	85,300.00DA	0.00DA	85,300.00DA	0.00DA	
Poles (Aerial)	0.00DA	Prorated	36,000.00DA	36,000.00DA	0.00DA	36,000.00DA	0.00DA	
Drilling	0.00DA	Prorated	23,600.00DA	23,600.00DA	0.00DA	23,600.00DA	0.00DA	
Cable Deployme	**0.00DA**	**Prorated**	**162,000.00DA**	**162,000.00DA**	**0.00DA**	**162,000.00DA**	**0.00DA**	
Blowing/ Soufll	0.00DA	Prorated	16,800.00DA	16,800.00DA	0.00DA	16,800.00DA	0.00DA	
Installation in li	0.00DA	Prorated	56,400.00DA	56,400.00DA	0.00DA	56,400.00DA	0.00DA	
Overhead Installation /	0.00DA	Prorated	83,200.00DA	83,200.00DA	0.00DA	83,200.00DA	0.00DA	
Labeling	0.00DA	Prorated	5,600.00DA	5,600.00DA	0.00DA	5,600.00DA	0.00DA	
phase 3: installatio	**0.00DA**	**Prorated**	**535,050.00DA**	**535,050.00DA**	**0.00DA**	**535,050.00DA**	**0.00DA**	
Splicing & Conn	**0.00DA**	**Prorated**	**365,450.00DA**	**365,450.00DA**	**0.00DA**	**365,450.00DA**	**0.00DA**	
SRO Cabinet Ins	0.00DA	Prorated	103,950.00DA	103,950.00DA	0.00DA	103,950.00DA	0.00DA	

	Task Name	Fixed Cost	Fixed Cost	Total Cost	Baseline	Variance	Actual	Remainir	Add New C
15	**phase 3: installation**	**0.00DA**	**Prorated**	**535,050.00DA**	**535,050.00DA**	**0.00DA**	**535,050.00DA**	**0.00DA**	
16	**Splicing & Connection**	**0.00DA**	**Prorated**	**365,450.00DA**	**365,450.00DA**	**0.00DA**	**365,450.00DA**	**0.00DA**	
17	SRO Cabinet Installation	0.00DA	Prorated	103,950.00DA	103,950.00DA	0.00DA	103,950.00DA	0.00DA	
18	Splitters	0.00DA	Prorated	10,400.00DA	10,400.00DA	0.00DA	10,400.00DA	0.00DA	
19	PBO	0.00DA	Prorated	76,500.00DA	76,500.00DA	0.00DA	76,500.00DA	0.00DA	
20	Connection/ Soudure	0.00DA	Prorated	174,600.00DA	174,600.00DA	0.00DA	174,600.00DA	0.00DA	
21	**Testing & Acceptance**	**0.00DA**	**Prorated**	**169,600.00DA**	**169,600.00DA**	**0.00DA**	**169,600.00DA**	**0.00DA**	
22	test measurements	0.00DA	Prorated	161,600.00DA	161,600.00DA	0.00DA	161,600.00DA	0.00DA	
23	recipe/ PV Recipe	0.00DA	Prorated	8,000.00DA	8,000.00DA	0.00DA	8,000.00DA	0.00DA	
24	**phase 4: operation**	**0.00DA**	**Prorated**	**33,200.00DA**	**33,200.00DA**	**0.00DA**	**33,200.00DA**	**0.00DA**	
25	Commissioning	0.00DA	Prorated	0.00DA	0.00DA	0.00DA	0.00DA	0.00DA	
26	**Customer Connection**	**0.00DA**	**Prorated**	**33,200.00DA**	**33,200.00DA**	**0.00DA**	**33,200.00DA**	**0.00DA**	
27	Drop Cable Installation	0.00DA	Prorated	12,200.00DA	12,200.00DA	0.00DA	12,200.00DA	0.00DA	

Start Mon 9/1/25 | Tue Sep 2 | Wed Sep 3 | Thu Sep 4 | Fri Sep 5 | Sat S

Add tasks with dates to the time

	Task Name	Fixed Cost	Fixed Cost	Total Cost	Baseline	Variance	Actual	Remainin
9	PBO	0.00DA	Prorated	76,500.00DA	76,500.00DA	0.00DA	76,500.00DA	0.00DA
0	Connection/ Soudure	0.00DA	Prorated	174,600.00DA	174,600.00DA	0.00DA	174,600.00DA	0.00DA
1	**Testing & Acceptance**	**0.00DA**	**Prorated**	**169,600.00DA**	**169,600.00DA**	**0.00DA**	**169,600.00DA**	**0.00DA**
2	test measurements	0.00DA	Prorated	161,600.00DA	161,600.00DA	0.00DA	161,600.00DA	0.00DA
3	recipe/ PV Recipe	0.00DA	Prorated	8,000.00DA	8,000.00DA	0.00DA	8,000.00DA	0.00DA
4	**phase 4: operation**	**0.00DA**	**Prorated**	**33,200.00DA**	**33,200.00DA**	**0.00DA**	**33,200.00DA**	**0.00DA**
5	Commissioning	0.00DA	Prorated	0.00DA	0.00DA	0.00DA	0.00DA	0.00DA
6	**Customer Connection**	**0.00DA**	**Prorated**	**33,200.00DA**	**33,200.00DA**	**0.00DA**	**33,200.00DA**	**0.00DA**
7	Drop Cable Installation	0.00DA	Prorated	12,200.00DA	12,200.00DA	0.00DA	12,200.00DA	0.00DA
8	PTO Installation & Splice	0.00DA	Prorated	17,000.00DA	17,000.00DA	0.00DA	17,000.00DA	0.00DA
9	ONT Configuration & Test	0.00DA	Prorated	4,000.00DA	4,000.00DA	0.00DA	4,000.00DA	0.00DA

Source: Generated by the students using MS Project simulation

The total cost of the project is estimated at 1,011,006.00 DZD. The integration of the financial dimension into MS Project transforms technical monitoring into true performance management (pilotage de la performance).

Using Earned Value Management (EVM) metrics, as introduced in the methodological framework (Chapter 2, (Section 1.6.3: Evaluation Using the EVM Method)), MS Project provides:

Cost Performance Index (CPI): CPI = EV / AC. A CPI > 1 indicates cost savings.

Schedule Performance Index (SPI): SPI = EV / PV. An SPI > 1 indicates ahead of schedule.

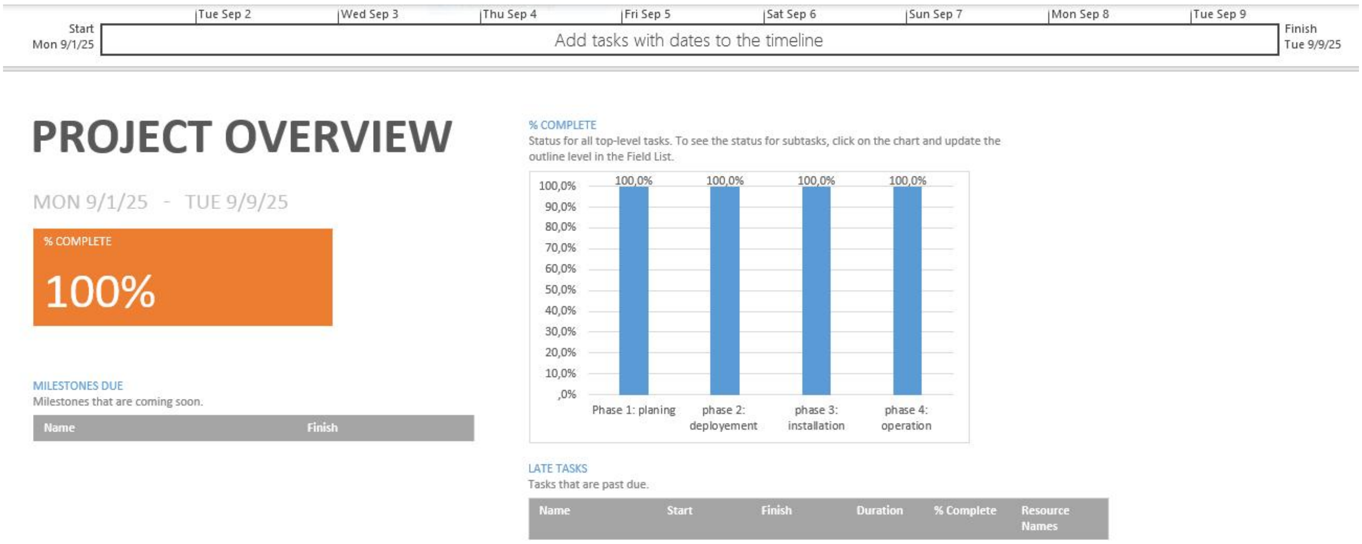
Cost Variance (CV): CV = EV - AC. Positive CV indicates under budget.

Schedule Variance (SV): SV = EV - PV. Positive SV indicates ahead of schedule.

The price nature of the Cherchel project was described as "fixed, non-revisable, non-updatable" (fermes, non révisables, non actualisables) in Chapter 2, Table 4. This makes cost control even more critical. Any delay or inefficiency directly impacts the company's margins. MS Project allows for real-time budget monitoring at the task level, which would have prevented the cost overruns that are likely occurring in the AS-IS state.

1.4.3 Summary and Comparison: AS-IS vs. TO-BE

Figure 13: MS Project Dashboard – KPI Summary



Source: Generated by the students using MS Project simulation

Table 24: Summary of MS Project Simulation Results (TO-BE)

Indicator	Value
Project Start Date	February 20, 2025 (proactive)
Optimized Execution Duration	9 days (active work)
Total Workload (Baseline)	567 hours
Total Cost	1,011,006.00 DZD

Source: Generated by the students using MS Project simulation

Table 25: Comprehensive Comparison: AS-IS vs. TO-BE

Indicator	AS-IS (Current State of Cherchel Project)	TO-BE (MS Project)	Improvement / Impact
Planning Approach	Reactive (permits not anticipated)	Proactive (permits integrated)	Anticipates the 83.3% delay rate
Execution Duration	45 days (systematically delayed)	9 days (optimized)	80% reduction
Deadline Compliance	Only 8.3% "always" respected	Predictable Baseline	Proactive control, early alerts
Workload Tracking	Manual, fragmented	Structured and Baseline	Structured, eliminates ambiguity-controlled
Coordination	Weak (41.7% cite lack)	Baseline-stabilized	Single reference for all teams
Cost Control	Not integrated (fixed price)	1,011,006.00 DZD	Real-time transparency, EVM metrics
Monitoring	Descriptive, lagging	Predictive, real-time	Alerts before delays become critical
EVM Metrics	Not available	CPI, SPI, CV, SV	Objective performance measurement

Source: Student elaboration based on Chapter 2, NVivo, SPSS, and MS Project

1.4.4 Linking the Simulation to the Theoretical Framework (Chapter 1)

The MS Project simulation is not a standalone technical exercise; it is the practical application of the theoretical concepts discussed in Chapter 1.

PMI (2021) and Kerzner (2022): The use of Critical Path Analysis, Baseline tracking, and Resource Leveling directly applies the PMI's standards for structured planning (Chapter 1, Section 2.3.1). The simulation transforms the abstract "iron triangle" (Watt, 2014) into a measurable, manageable reality.

Lean Six Sigma: The elimination of manual data entry and the reduction of coordination delays reflect Lean principles of waste reduction (muda) (Chapter 1, Section 3.2.1). The 567-hour Baseline and the 9-day optimized duration are direct results of streamlining the workflow.

Hybrid Approaches (Lalmi, 2021): MS Project allows for a hybrid approach, combining the structure of traditional Gantt-based planning (predictability of the 9-day duration) with the flexibility to make iterative updates based on field feedback, addressing the rigidity critique of traditional tools (Geraldi & Lechter, 2012).

EVM (Fanaei, 2019): The integration of CPI and SPI metrics provides the "operational intelligence" that Fanaei (2019) argued was essential for proactive decision-making (Chapter 1, Section 2.4.2).

SECTION 2: DISCUSSION AND RECOMMENDATIONS

2.1. Discussion of Results in Light of the Theoretical Framework

This section discusses the empirical results presented in Section 1 by confronting them with the theoretical framework established in Chapter 1. The objective is to identify points of convergence and divergence between our findings and existing theories, and to explain these divergences in light of the specific Algerian context.

a) Planning as the Fundamental Phase of Project Management

Our results confirm the theoretical proposition that planning is the "fundamental phase" of project management (Watt, 2014) and the "heart" of project management (Kerzner, 2022; PMI, 2021). In the NVivo analysis, the words planning, project, monitoring, and design were the most frequent terms, appearing 34, 33, 30, and 24 times respectively. In the SPSS analysis, 66.7% of respondents acknowledged a clear planning structure. This convergence between qualitative and quantitative data validates that our research successfully captured the central theme of planning in FTTH projects.

However, our results also reveal a critical nuance. While planning is recognized as central, its execution is fragile. The gap between planning and execution is confirmed by the finding that only 8.3% of respondents report that deadlines are "always" respected. This suggests that the theoretical ideal of planning as a coherent plan integrating scope, time, costs, risks, and quality (Watt, 2014) is not fully achieved in practice. This gap constitutes the central problem that our research addresses: the reliability of planning is compromised by execution failures.

b) The "Iron Triangle" and External Administrative Factors

Our results strongly confirm Watt's (2014) "iron triangle" model, which states that cost, quality, and delays are interconnected. In our study, delays was the third most frequent word in the NVivo analysis, appearing 21 times. In the SPSS analysis, 83.3% of respondents cited "execution delays" as the primary difficulty.

More importantly, our results confirm and extend Zemra's (2019) findings on Algerian construction projects. Zemra identified that the client (often a public entity) is frequently the source of risk due to administrative delays, payment delays, and poorly calibrated schedules. Our results replicate this finding in the telecommunications sector. The statistical association between delays and permits in the NVivo analysis and the explicit citation of administrative permits (MPA/DPW) by all four interview participants confirm that external bureaucratic factors are the primary cause of delays, not technical failures.

This convergence suggests that the problems identified by Zemra in construction projects are structural and extend to other sectors of the Algerian economy. Administrative procedures in Algeria are characterized by multiple approval layers, lack of digitalization, and frequent changes in local regulations. Therefore, any solution aimed at improving planning reliability must integrate these external constraints as fixed inputs, not as risks to be managed reactively.

c) Coordination as a Critical Success Factor

Our results confirm Kerzner's (2022) and the PMI's (2021) emphasis on coordination as essential for performance. In the NVivo analysis, coordination appeared 14 times, and subcontractors appeared 8 times. In the SPSS analysis, 41.7% of respondents cited "lack of coordination" as a major difficulty.

These findings also confirm Lalmi's (2021) observations on coordination failures in Algerian construction projects. Lalmi found that coordination failures arise from two structural factors: lack of real-time information sharing and contractual fragmentation. Our participants confirmed both. The platform suffers from a lag, so information is not shared in real time. Subcontractors are unresponsive because there are no effective penalty mechanisms.

Coordination cannot be improved by tools alone. Real-time information sharing requires mobile access for field technicians. Subcontractor responsiveness requires contractual enforcement. These are organizational changes, not merely technical ones.

d) Divergence: The Limited Effectiveness of the Current Platform

Our results partially contradict Schwalbe's (2022) theoretical promise that digital planning tools provide real-time decision-making clarity and enable rapid correction of deviations. In our study, the internal platform was described as "descriptive, not corrective" and suffers from a lag compared to field reality.

This divergence is explained by three factors. First, as Geraldi and Lechter (2012) argued, traditional planning tools (including simple dashboards) impose a linear, static vision of the project. They are excellent for documenting what has happened but poor for predicting or correcting what will happen. The platform at Algérie Télécom is essentially a digital Gantt chart: it shows planned versus actual progress but does not explain deviations or suggest corrections.

Second, Lalmi (2021) noted that digital transformation in Algerian public enterprises is slow due to budget limitations, resistance to change, and lack of technical training. The platform is internally developed, relies on manual data entry, and is not integrated with other systems. Consequently, it cannot correct deviations; it can only document them.

Third, the lag between field reality and platform display is not a technical failure but an organizational one. Field technicians do not have mobile access. Data is entered manually, often days after the fact. By the time a deviation appears on the platform, it is already obsolete.

This divergence does not invalidate Schwalbe's theory; it simply highlights that the effectiveness of digital tools depends on the organizational context in which they are deployed. A tool is only as effective as the processes and infrastructure that support it.

e) Optimization Methods: Automation, AI, and Training

Our results confirm the relevance of the optimization methods discussed in Chapter 1. Participants spontaneously suggested automating field data collection, using mobile applications for real-time updates, and introducing AI for predictive delay analysis.

The demand for automation and real-time synchronization reflects the principles of Lean Six Sigma (waste reduction through elimination of manual tasks), as discussed in Chapter 1, Section 3.2.1. The proposal for AI-based predictive analysis echoes Benoumelaz's (2019) work on optimization algorithms and simulation for scheduling problems, discussed in Chapter 1, Section 3.2.2. The need for staff training confirms Fanaei's (2019) findings that operational intelligence depends not only on tools but also on user competence, discussed in Chapter 1, Section 2.4.2.

The fact that participants spontaneously suggested these solutions is significant. It shows that field actors are not resistant to digital transformation; they are demanding it. The limitations they identified are consequences of underinvestment in digital tools and training.

f) Synthesis of the Theoretical Confrontation

The confrontation between our empirical results and the theoretical framework reveals a coherent pattern. Most of our results confirm existing theories. Planning is central. Delays are systematic and interconnected with cost and quality. Administrative permits are a primary cause of delays in the Algerian context. Coordination is essential but fragile. Optimization methods such as automation, AI, and training are relevant and demanded by field actors.

The only significant divergence concerns the effectiveness of the current platform, which contradicts Schwalbe's promise of real-time decision-making. This divergence is explained by the specific constraints of the Algerian public sector: budget limitations, digital transformation lag, manual data entry, and lack of mobile access for field technicians. The platform at Algérie Télécom is descriptive, not corrective. This finding directly justifies our proposal to design and develop a customized planning application adapted to the specific needs of the organization.

2.3. Summary of Key Findings

The key findings of our research can be summarized as follows.

First, planning is recognized as central by all participants, with planning, project, monitoring, and design being the most frequent terms in the NVivo analysis. However, only 8.3% of respondents report that deadlines are "always" respected, confirming a systematic gap between planning and execution.

Second, administrative permits are the primary cause of delays. Delays was the third most frequent word in the NVivo analysis, appearing 21 times, and 83.3% of respondents cited execution delays as the primary difficulty. The statistical association between delays and permits confirms that external bureaucratic factors are the main source of schedule deviation.

Third, coordination is weak. The word coordination appeared 14 times in the NVivo analysis, and 41.7% of respondents cited lack of coordination as a major difficulty. The word subcontractors appeared 8 times, confirming that external partners are a significant source of coordination problems.

Fourth, the current platform is descriptive, not corrective. It suffers from a lag compared to field reality and relies on manual data entry. Participants described it as useful for visualization but incapable of real-time correction.

Fifth, participants spontaneously demand digitalization, automation, and AI. The most frequently suggested improvements are automating field data collection, using mobile applications for real-time updates, and introducing AI for predictive delay analysis.

These findings establish a clear diagnosis that justifies the proposed optimized planning model.

2.4. Recommendations

Based on the results of our study, we formulate the following recommendations. These recommendations are presented in order of priority.

Recommendation One: Design and Develop a Customized Planning Application

We recommend the internal development of a customized planning application specifically designed for project planning management within the organization. Simulation results have demonstrated that an optimized planning model is feasible; however, its successful implementation requires a solution adapted to the organization's specific needs and constraints.

The proposed application should integrate seven core modules within a unified system

First, a critical path calculation module to automatically identify the longest sequence of dependent tasks and compress the duration from 45 to 9 days.

Second, a baseline tracking module to establish a fixed reference point of 567 hours against which actual progress is measured.

Third, a mobile field reporting module for technicians to report progress in real time, upload photos, and flag delays.

Fourth, a permit tracking module with automatic reminders to start permit applications 30 to 60 days before project start.

Fifth, an earned value management dashboard for automatic calculation of CPI, SPI, CV, and SV.

Sixth, a subcontractor coordination module for centralized task assignment and progress tracking with penalty alerts.

Seventh, a resource leveling module for automatic detection and resolution of resource overallocation.

However, the effectiveness of this technical solution strongly depends on user capability. Therefore, it should be supported by a continuous and structured training program. This program should include basic training for field staff on system usage and data entry, advanced training for planning officers on scheduling and analytical functions, and managerial training focused on dashboard interpretation and decision-making.

Recommendation Two:

We recommend integrating a structured permit management approach within the planning system based on a dynamic lifecycle model rather than fixed timelines.

Each permit should be treated as an independent planning element with a defined lifecycle, including request, review, revision, approval, and closure stages. This allows better visibility and control over administrative constraints throughout the project.

Instead of relying on fixed initiation dates, planning should consider permit-specific characteristics such as expected processing time, issuing authority requirements, and task dependencies within the project schedule.

To improve reliability, the system should incorporate time buffers and early warning thresholds to anticipate potential delays and mitigate their impact on project execution.

Finally, an automated workflow mechanism with alerts and escalation rules should be used to ensure timely follow-up and clear responsibility assignment across all permit-related activities.

Recommendation Three: Automate Field Data Collection via Mobile Application

Manual data entry and the lag between field reality and platform display are critical weaknesses. The mobile component of the customized application should allow field technicians to report task completion in real time with timestamps, upload photos of obstacles or completed work, flag delays immediately with predefined cause codes, and receive real-time notifications of schedule changes.

.**Recommendation Four:**

Implement Real-Time Dashboards with EVM MetricsThe current platform is lagging and descriptive. Real-time dashboards with earned value management metrics would provide early warning of deviations and enable proactive decision-making. The dashboard should be accessible to planning officers on desktop and to managers on mobile view

Recommendation five: Create a Centralized Project Management Office

The results of this study revealed a significant gap between planning and field execution in FTTH projects within Algérie Télécom Tipaza. One of the main causes identified is the lack of direct coordination between the planning phase and the realization phase, which often leads to delays, communication gaps, and inconsistencies between the theoretical schedule and actual field conditions.

To improve project schedule reliability, this research proposes an organizational restructuring within the Tipaza Operational Directorate (OTD) through the creation of a new “Coordination Service” under the Technical Sub-Directorate (Sous-Direction Technique). The objective of this service is to strengthen coordination specifically between planning and realization activities.

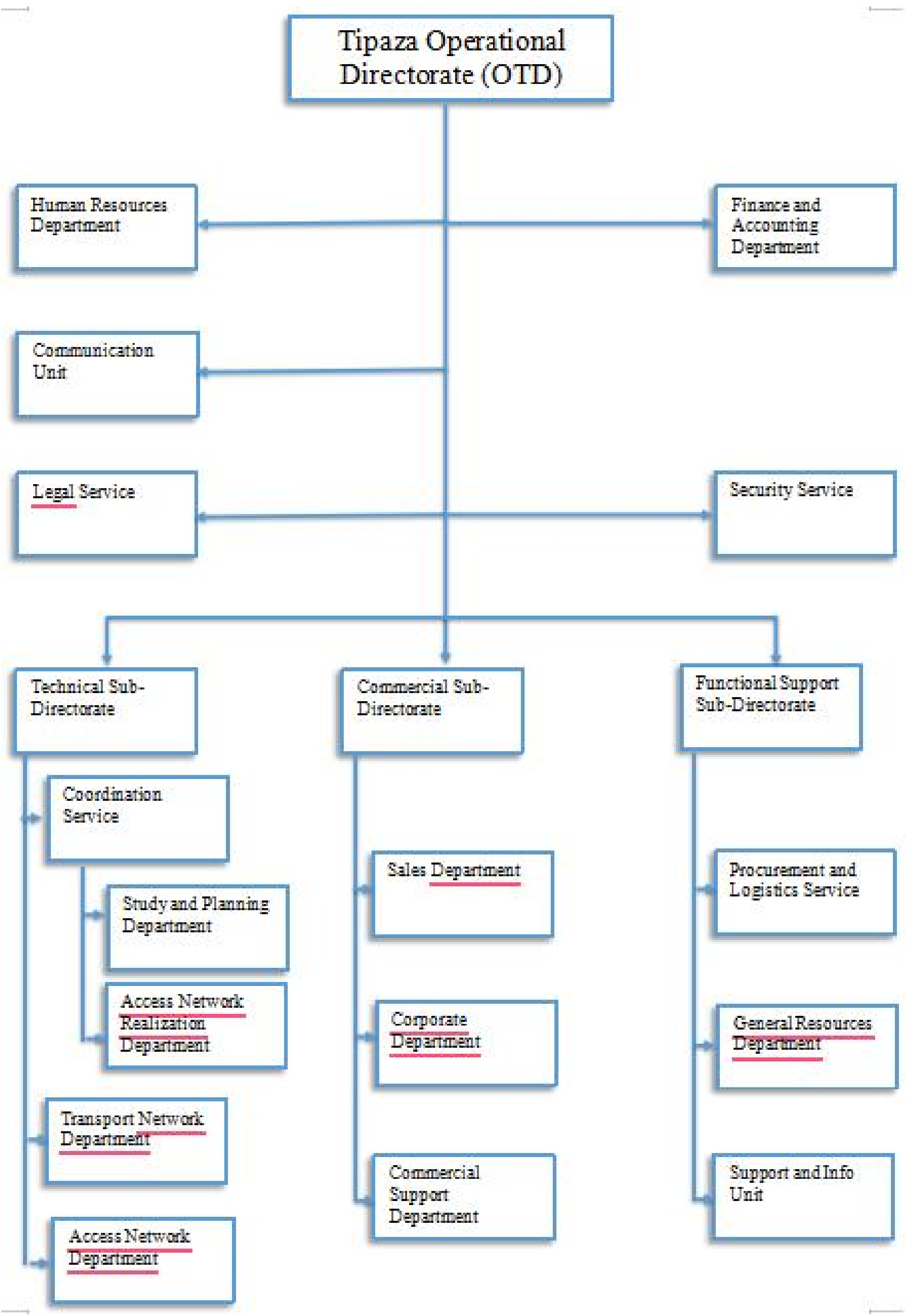
The proposed Coordination Service would supervise and coordinate the following departments:

Study and Planning Department (Département Étude et Planification)

Access Network Realization Department (Département Réalisation Réseau d’Accès)

This new structure would ensure continuous communication between planning teams and field execution teams, allowing faster information flow, better monitoring of project progress, quicker adaptation to field constraints, and improved alignment between planned schedules and actual realization conditions.

Figure 14: Proposed organizational chart of the Tipaza Operational Directorate (OTD) after restructuring



Source: Elaborated by the student

Chapter conclusion

This chapter analyzed the results of the empirical study conducted at Algérie Télécom (OTD Tipaza) and discussed their implications for improving FTTH project planning reliability.

The qualitative analysis of four semi-structured interviews using NVivo revealed a clear diagnosis of the current situation. The word frequency analysis showed that planning, project, monitoring, and design dominate the participants' discourse, confirming that planning is central to their daily work. However, the high frequency of the word delays, ranked third among all terms, proved that schedule reliability is the central problem. The statistical association between delays and permits revealed that external administrative factors are the primary cause of delays, not technical failures. The thematic analysis across the five axes confirmed that the planning process is technically solid but operationally fragile. Coordination is weak due to subcontractor unresponsiveness and communication gaps. The internal platform is descriptive, not corrective, and relies on manual data entry. Participants spontaneously demanded digitalization, automation, and mobile applications as solutions.

The quantitative analysis of the questionnaire using SPSS confirmed these findings. The majority of respondents have extensive experience, giving weight to their assessments. Execution delays were cited as the primary difficulty by an overwhelming majority of respondents. Only a small minority reported that deadlines are always respected, confirming a systematic gap between planning and execution. The top priority for improvement was monitoring and follow-up.

The synthesis of qualitative and quantitative results revealed strong convergence across all themes, validating the reliability of our findings. The qualitative analysis explained why delays occur; the quantitative analysis confirmed that these problems are widespread.

The MS Project simulation served as a technical demonstration of the functionalities that a customized planning application should include, not as a recommendation to purchase commercial software. The simulation proved that an optimized planning model is both feasible and beneficial.

The confrontation with the theoretical framework established in Chapter 1 showed that most of our results confirm existing theories on planning, the iron triangle, coordination, and optimization methods. The only significant divergence concerns the effectiveness of the current platform, which contradicts the theoretical promise of real-time decision-making. This divergence is explained by the specific constraints of the Algerian public sector: budget limitations, digital transformation lag, manual data entry, and lack of mobile access for field technicians.

The answer to our research problem is clear. Improving planning reliability requires a three-pronged approach: designing and developing a customized planning application adapted to the specific needs of Algérie Télécom, integrating external constraints such as permits and subcontractors into the schedule from the start, and automating field data collection through a mobile application.

The recommendations provide a practical roadmap for Algérie Télécom. The highest priority recommendations are designing a customized planning application with critical path calculation, baseline tracking, mobile field reporting, permit tracking, earned value management metrics, and subcontractor coordination; starting permit applications early; automating field data collection; and training staff.

The three components of this research form a coherent chain: diagnosis, confirmation, and proposition. The MS Project simulation proved that an optimized planning model is feasible. The recommendation is to implement the demonstrated functionalities in a tailor-made application adapted to the Algerian context.

This chapter has thus fulfilled its objective. It has answered the research problem and provided both theoretical and practical contributions to the field of project management in the Algerian telecommunications sector. The following chapter will present the General Conclusion of this thesis, summarizing the key contributions, acknowledging the limitations, and suggesting directions for future research.

GENERAL CONCLUSION

GENERAL CONCLUSION

1. Summary of Findings

This research examined how the optimization of planning tools and methods can improve project schedule reliability, focusing on the case of FTTH deployment within Algérie Télécom Tipaza. The analysis revealed that although the planning process is technically well-defined, execution systematically lags behind schedules due to several interrelated factors. Administrative permits were identified as the primary cause of delays, confirmed by both the qualitative analysis of semi-structured interviews and the quantitative analysis of the questionnaire, where the vast majority of respondents cited execution delays as the primary difficulty.

The study further revealed that the internal monitoring platform is descriptive rather than corrective, suffering from a systematic lag due to manual data entry and lack of real-time field reporting. Coordination between departments and subcontractors remains weak, with a significant proportion of respondents citing lack of coordination as a major difficulty. The MS Project simulation demonstrated that an optimized planning model integrating proactive permit tracking, baseline monitoring, critical path analysis, and earned value management metrics could substantially reduce active execution duration while establishing a structured workload baseline.

2. Theoretical and Managerial Implications

The results of this research contribute to bridging the gap between theoretical frameworks on planning optimization and their practical application in infrastructure projects, particularly within the telecommunications sector. From a theoretical perspective, the findings confirm classical project management principles regarding the centrality of planning and the iron triangle, while extending existing knowledge on administrative delays from the construction sector to telecommunications.

For managers, the study highlights the necessity of transforming planning from a reactive, descriptive exercise into a proactive, predictive, and corrective driver of project performance. Moreover, leadership commitment emerged as a decisive factor for successful planning optimization, and the integration of external constraints directly into the schedule proved more effective than treating them as risks to be managed after delays occur.

3. Identified Barriers to Planning Optimization

Despite the observed benefits of structured planning, the research identified several obstacles that impede effective planning reliability at Algérie Télécom Tipaza. These barriers include external administrative factors, specifically the systematic delays caused by permit approvals from municipal and public works authorities, which are beyond the direct control of the project team. Additionally, the lack of real-time field data synchronization, reliance on manual data entry, limited digital transformation, and the absence of formal training on advanced planning tools were identified as critical internal barriers. Overcoming these challenges requires targeted strategies such as mobile application deployment, staff training programs, leadership endorsement of digital transformation, and gradual cultural change toward proactive planning.

4. Research Limitations and Future Research Directions

This study was limited by its qualitative and quantitative nature within a single case study design, which may affect the generalizability of the findings beyond the telecommunications sector in Algeria. Access to certain confidential financial data was partial, and the study was confined to a single operational directorate and a single project type. The internship period was relatively short, limiting the depth of longitudinal observation.

Future research should consider comparative analyses involving multiple operational directorates of Algérie Télécom across different regions, as well as other sectors such as construction, energy, and transportation, to validate and expand on these findings. Additionally, future studies could incorporate artificial intelligence and machine learning techniques for predictive delay forecasting based on historical permit data, examine the long-term effects of customized planning applications on organizational performance, and investigate the applicability of hybrid project management approaches in the Algerian public sector context.

5. Concluding Remarks

In conclusion, this research demonstrates that optimizing planning tools and methods has the potential to significantly enhance project schedule reliability in infrastructure environments within Algeria. By embracing proactive planning principles—treating external constraints as fixed inputs rather than reactive risks, integrating real-time field reporting, applying critical path analysis, and using earned value management metrics for objective performance measurement—organizations like Algérie Télécom can improve efficiency, reduce delays, and strengthen their project management performance. The key lesson is that improving planning reliability is not a matter of working harder but of working smarter: transforming planning from a reactive, descriptive exercise into a proactive, predictive, and corrective driver of project performance. Ultimately, successful planning optimization depends not only on tools and techniques but also on leadership commitment, staff training, and a culture that values anticipation over reaction

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APPENDICES

APPENDICES

APPENDIX A: ASEMI-DIRECTIVE INTERVIEW

GUIDE

Study Title: Optimization of Planning through Management Tools – Case Study: FTTH Algérie Télécom, Tipaza

Target Participants: Planning Engineers, FTTH Project Monitoring Managers, Technicians, Design Office Staff

Approach: Virtual or in-person interviews

Introduction

Good morning / Good afternoon.

I am a second-year Master's student at the National Higher School of Management of Kolea. I am conducting my graduation study on the optimization of planning tools for FTTH projects within Algérie Télécom. The objective of this interview is to understand the real planning, monitoring, and coordination practices, as well as the constraints affecting schedule reliability.

Thank you for taking the time to share your experience and insights with me.

Background Information

1. Can you briefly describe your current role within FTTH project management and your years of experience in this field?
2. What are, in your daily experience, the main operational problems you encounter in FTTH projects?
3. Have you ever been exposed to formal planning tools or methods (such as Gantt charts, PERT, etc.)?

Planning and Technical Design

1. How does the technical design process of an FTTH project take place within your service?
2. What are the main criteria considered when defining the network route?
3. What technical, geographical, or organizational constraints influence this planning phase?
4. What tools and methods are used in the technical design of FTTH projects?

Organization and Project Management

1. How is the overall management of FTTH projects organized within your structure?
2. What is the role of the planning service in the project life cycle?
3. How is coordination carried out between the different actors (internal services, subcontractors)?
4. What difficulties do you encounter in this coordination?

Monitoring and Management Platform

1. How is project progress monitoring ensured on a daily basis?
2. What functionalities does the internal monitoring platform offer?
3. To what extent does this platform contribute to decision-making?
4. Does it allow correcting gaps between planning and execution? If so, how?

Delays and Project Performance

1. Based on your experience, what are the main factors responsible for delays in FTTH projects?
2. How are these delays managed when they occur?
3. Are there mechanisms to anticipate these delays?

Limitations and Improvement

1. What are the main limitations of the current planning and monitoring system?
2. What aspects should be improved as a priority to optimize project management?
3. What types of tools or functionalities could improve planning reliability?

Conclusion

Thank you very much for your time and for sharing your valuable insights. Your contribution is essential to the success of this research. If you wish to add anything later, please feel free to contact me.

APPENDIX B: QUESTIONNAIRE

INTRODUCTION

This questionnaire is part of a Master's thesis in **Entrepreneurship and Project Management** at the National Higher School of Management of Koléa. Our research focuses on **Optimization of Planning through Management Tools: Case Study: FTTH, Algérie Télécom, Tipasa**.

The objective of this questionnaire is to gather your perception regarding the planning processes, the use of management tools, and the associated difficulties within FTTH projects at Algérie Télécom.

Your answers are anonymous and will be treated with strict confidentiality. They will be used exclusively for academic purposes.

We sincerely thank you for your collaboration and the time you have given us.

QUESTIONNAIRE

General Information

Position:
☐ Planning
☐ Monitoring
☐ Technical
☐ Other

Professional experience:
☐ Less than 2 years
☐ 2 to 5 years
☐ More than 5 years

Axis 1: Evaluation of the Current System

How do you evaluate the current FTTH project management system?
☐ Very effective
☐ Effective
☐ Moderately effective

☐ Slightly effective

Does the current system allow for effective project management?

☐ Yes

☐ Partially

☐ No

Axis 2: Planning and Tools

Is the current project planning sufficiently structured?

☐ Yes

☐ Partially

☐ No

Do the tools used allow for reliable project planning?

☐ Yes

☐ Partially

☐ No

What types of tools are used for the technical design of projects?

☐ (Open-ended question)

Axis 3: Constraints and Difficulties

What are the main difficulties encountered in FTTH projects?

☐ Execution delays

☐ Lack of coordination

☐ Technical problems

☐ Lack of project visibility

Are project deadlines generally respected?

☐ Always

☐ Often

☐ Rarely

☐ Never

Axis 4: Improvement

Which aspects should be improved as a priority?

☐ Planning

☐ Monitoring

☐ Coordination

☐ Resource management

Do you think that the use of advanced project management tools could improve planning (e.g., MS Project)?

☐ Yes

☐ No

☐ Maybe

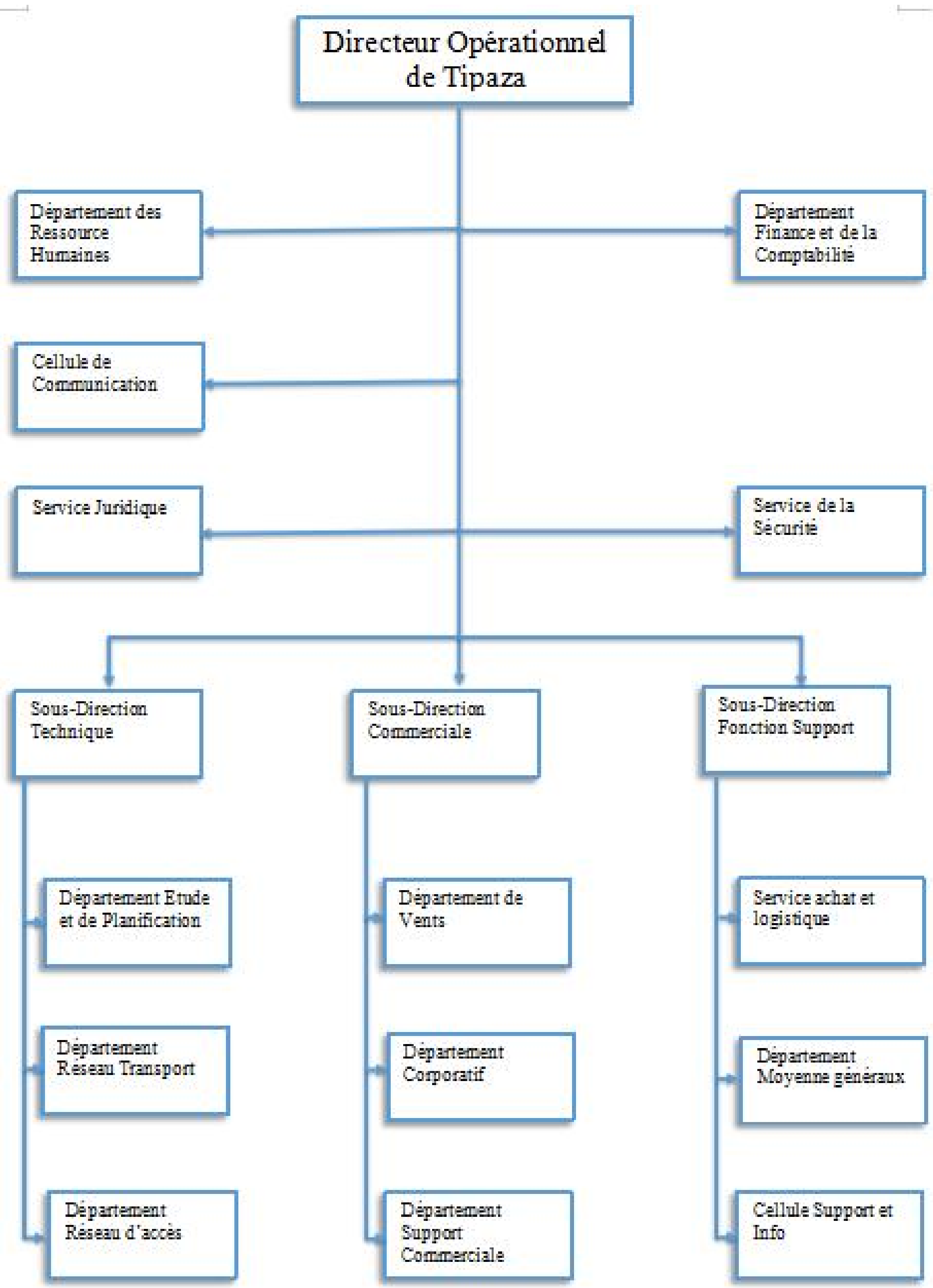
Suggestions or comments:

☐ (Open-ended question)

APPENDIX C:Demographic Characteristics (SPSS)

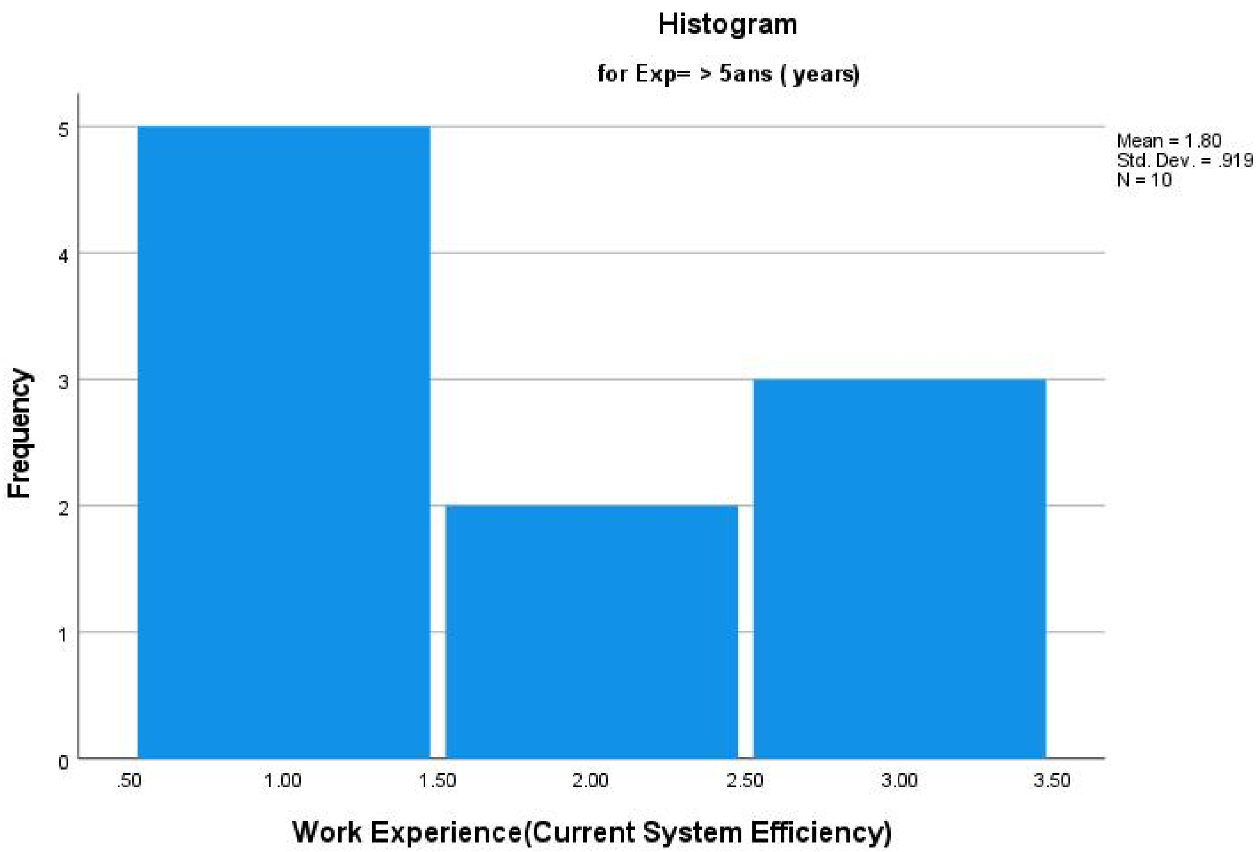
Position	2 to 5 years	More than 5 years	Other	Total
Planning	1	2	0	3
Monitoring	0	3	0	3
Technical	0	8	0	9
Modernization Project Manager	0	1	1	1
Total Sample	1	14	1	16

APPENDIX D: THE ORGANIZATIONAL CHART

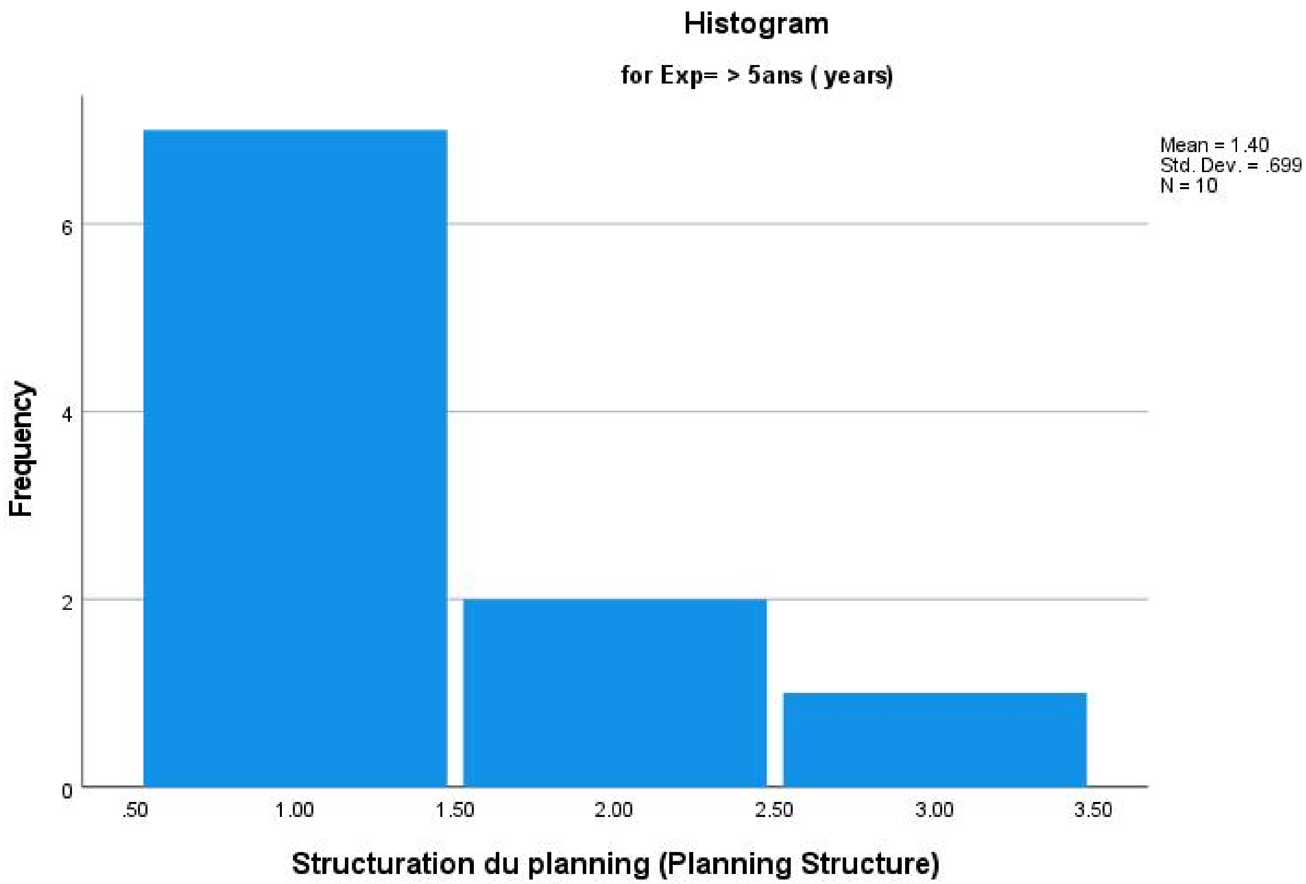


APPENDIX E: EOGRAPHICAL LOCALIZATION OF THE STUDIED FTTH PROJECT – CHERCHEL (TIPAZA)

APPENDIX G:Work Experience(Current System Efficiency)



APPENDIX H:Structuration du planning (Planning Structure)



APPENDIX H:FTTH DEPLOYMENT ARCHITECTURE – NETWORK COMPONENTS