2025

Contract Attribute Analysis for Optimal Contract Type Selection in Asset Management: An fsQCA Study

Commissioned by University of Twente regarding the Master Business Administration with a specialization in Digit Business & Analytics (DB).

IJSSEL technology services

Name: Jens Welles
Student Number: 2621843
University: University of Twente
Degree Program: Master of Business Administration
Specialization: Digital Business & Analytics

Company Supervisor IJssel Technology Servies:
Mats Boeve

University of Twente Supervisor:
Remco Siebelink

IJssel Technology Services
10-2-2025

Title page

Author:
Jens Welles
j.m.welles@student.utwente.nl

Company supervisor:
Mats Boeve

University of Twente supervisor:
Remco Siebelink

Company:
IJssel Technology Services
Trawlerweg 3
8042 PZ Zwolle
038-4256256

University:
University of Twente
Drienerlolaan 5
7522 NB Enschede

Abstract

Purpose

This research addresses IJssel Technology Services' challenge in selecting optimal contract types following their 2023 strategic shift toward service-oriented operations. The study aims to identify which combinations of contract attributes lead to successful outcomes and develop a data-driven model for contract type selection to maximize profitability.

Design/Methodology

The study employs a mixed-methods approach combining Fuzzy-set Qualitative Comparative Analysis (fsQCA) of 33 contracts, analysis of historical contract data, expert interviews with key stakeholders, and literature review on contract theory and risk management. The collected results and findings are used in a recommendation tool to select the most suitable contract type for IJssels' future projects.

Findings

The fsQCA analysis revealed three pathways to successful contract outcomes. First, complex projects succeed with well-defined scope and mature client characteristics. Second, high-risk projects achieve success through well-defined scope and mature clients. Third, non-complex projects succeed with less mature clients when scope is well-defined and risks are low. A practical contract recommendation tool was developed based on five key attributes: total risk, client characteristics, improvement potential, project complexity, and risk-taking willingness.

Practical Implications

The study provides IJssel with a systematic, data-driven approach to contract selection through a decision-support tool for contract type recommendations. It offers guidelines for transitioning from Cost-Plus to Performance-Based contracts as client maturity increases, along with a framework for evaluating project contexts and risk factors. The research establishes a structured approach for scope definition and client assessment.

Originality/Value

This research fills a gap in asset management literature by providing empirical evidence for successful contract attribute combinations and developing a practical framework for contract selection. The study's unique contribution lies in its integration of fsQCA analysis with operational decision-making tools, offering both theoretical insights and practical applications for service-oriented asset management organizations.

Foreword

Contracts are at the crucial of successful collaborations, particularly in industries like asset management, where complexity, risk, and client expectations meet. As IJssel Technology Services aims to maximize profitability and enhance contract outcome, the ability to select the most suitable contract forms has become a crucial factor in achieving these objectives. IJssel Technology Services is mentioned as IJssel in future text.

This research explores which combinations of contract attributes lead to positive contract outcomes and examines how the most suitable contract types can be selected based on project-specific attributes. By employing a Fuzzy-set Qualitative Comparative Analysis (fsQCA) approach, this study uncovers the configurations of attributes that influence contract success within IJssels' asset management division. The findings are grounded in both academic literature and practical insights, providing a comprehensive framework for contract selection.

I want to thank my academic supervisors, Remco Siebelink and Matthias de Visser, my company supervisor, Mats Boeve, Niels Meerdink, Manager Consultancy, and other stakeholders within IJssel and the University for their valuable guidance and support throughout this project.

During the preparation of this work, I used Chat GPT, Grammarly, and Scopus AI to summarize, brainstorm, and improve grammar. After using this tool/service, I thoroughly reviewed and edited the content as needed, taking full responsibility for the final outcome.

Jens Welles
University of Twente
Zwolle February 2025

Table of Content

1. Introduction

Problem Context

In 2023, IJssel made a strategic shift towards becoming a more service-oriented organization. This transformation has rendered some previously effective contract types less suitable for their current operations, as different contract structures could better support their service-oriented approach. Despite IJssels' broad expertise and client base, they now face challenges in aligning their contract types with the specific characteristics of each project, particularly regarding client maturity levels and project complexity.

Two key problems need to be addressed. First, IJssel lacks understanding of which combinations of contract attributes consistently contribute to successful project outcomes in asset management. Second, they require a structured approach to select the most suitable contract type based on specific project contexts. The current approach relies heavily on intuition and past experiences, lacking a systematic, data-driven methodology for contract selection, which results in suboptimal financial outcomes and increased project risks.

To bridge these gaps, a data-driven approach is necessary to determine how contract attributes influence project success. This method is essential because it enables decision-makers to move beyond intuition and anecdotal evidence, ensuring that contract selection is based on empirical insights (Luca & Bazerman, 2021). By analyzing historical project data and relevant literature, patterns between contract attributes and project outcomes can be identified. This provides a more objective and reliable basis for selecting contract types that align with specific project characteristics, such as client maturity, risk tolerance, and project complexity.

Literature Context

The choice of the contract form directly influences how risks are allocated between involved parties, including financial, legal, and operational risks. Less suitable contract can lead to substantial project failures, loss of profitability, and an increase in risks (Murdoch & Hughes, 2002; Turner, 2009). There are various contracts forms discussed in the literature which will be elaborated in Chapter 2. Different contract forms offer different advantages and disadvantages in terms of cost, risk allocation, and flexibility. The choice of a contract form is often dependent on factors such as project complexity, resources availability, and the level of uncertainty in the project (Turner J. R., 2017).

The literature suggests that projects often fail because the contract forms are not adequately matched to the specific project or client (Turner J. R., 2017). Misaligned contracts can lead to disputes, delays, cost overruns, and in some cases, legal conflicts. In particular, long-term projects in asset management, where asset performance and lifecycle costs need to be optimized over time, require a sophisticated approach to contracting to mitigate such risks (Murdoch & Hughes, 2002)

Based on current literature, studies suggest that contract selection in asset management should be informed by key parameters, primarily grounded in contract theory and risk management (Turner J. R., 2017). But none have a robust framework where the project context and parameters are used for selecting the most suitable contract and which combination of contract attributes lead to successful project outcomes. Contract theory provides the basis for understanding the different forms of contracts in this regard, and how the risks and responsibilities will be distributed between the parties concerned. In practices like asset management, projects may span over a number of years or involve long-term service provision. Therefore, such dynamic conditions must be managed through the adaptation of contract theory (Turner, 2014; Ke, 2024). Traditional contract frameworks may not fit in these contexts since they are developed for bounded and limited-duration projects.

Risk management theory provides techniques for examining how different contract forms deal with various risk types—financial, legal, and operational—within the context of asset management projects. According to Murdoch & Hughes (2002), understanding how risks are allocated and managed is essential for choosing the most appropriate contract form, especially in long-term projects where asset performance and lifecycle costs are critical considerations. Improper contract choice and therefore the allocation of risks can lead to project failures, delays, or cost overruns. In contrast, a well-structured contract ensures a balanced distribution of risk among stakeholders, reducing the overall project risk.

The choice of a contract type is influenced by a combination of external and internal attributes that shape the overall risk distribution, adaptability and the success of the projects outcome (Rahman & Kumaraswamy, 2002). The choice of a contract is influenced by a combination of external and internal attributes that shape the overall risk distribution, adaptability, and the success of the projects' outcome. External attributes, such as project complexity, client characteristics, trust in the client-contractor relationship, market conditions, and risk allocation, play a critical role in determining contract preferences by influencing the alignment of contract type with project outcomes. These attributes reflect factors outside the organization's direct control, requiring contracts to adapt to external uncertainties (Murdoch & Hughes, 2002; Turner, 2009). In contrast, internal attributes, including resource availability, alignment with organizational strategy, operational flexibility, and profitability considerations, dictate the degree of control and customization needed within the contract to meet the organization's goals and constraints. Together, these external and internal attributes underscore the importance of a tailored approach to contract type selection, ensuring alignment between project-specific demands and contract structures that facilitate effective risk management and successful outcomes (Rahman & Kumaraswamy, 2002; Love, Edwards, & Irani, 2016).

Model choice

Fuzzy-set Qualitative Comparative Analysis (fsQCA) is used in this research because it enables an analysis of combinations of contract attributes that collectively contribute to successful contract outcomes, rather than focusing on single, isolated factors. Other potential models, such as regression analysis or traditional statistical methods, were considered but ultimately not chosen. Regression analysis, for instance, is well-suited for understanding linear relationships between variables but lacks the capability to explore complex, configurational causation, which is crucial for this study. Rooted in set theory and configurational analysis, fsQCA is well-suited for identifying multiple pathways to success, making it ideal for examining complex, real-world contexts (Ragin, 2008). This method also works effectively with small to medium sample sizes, allowing for meaningful insights even with limited historical project data from IJssel. By using fsQCA, this research can uncover context-specific combinations of attributes that optimize contract selection, providing a nuanced understanding of the interdependent factors that lead to enhanced project outcomes. A configurational perspective, as emphasized by Hofman, Faems, and Schleimer (2017), underscores that governance mechanisms such as contracts are not standalone features but bundles of functions interacting in complex ways. This perspective aligns with fsQCA's capacity to capture conjunction, equifinality, and causal asymmetry (Hofman, Faems, & Schleimer, 2017).

1.1 IJssel Technology Services

IJssel provides services to optimize production processes across various industries, including manufacturing, processing, and the food industry. Their expertise spans maintenance, production line optimization, customized factory design, lean working, and automation. IJssel collaborates with notable clients such as Heineken, Nedmag, Gazelle, Scania, and TATA Steel to enhance production efficiency through standardization, optimization, and innovation (IJssel Technology Services, 2024).

IJssels' core activities are organized around three main pillars:

- **Maintenance**: Ensuring that machinery and production lines remain operational with minimal downtime through preventive and predictive maintenance strategies.
- **Machine Building**: Custom design and construction of machinery tailored to client needs, focused on innovation and efficiency in production processes.
- **Production Optimization**: Lean working methodologies and automation technologies to optimize production lines, reduce waste, and increase overall efficiency.

The company aims to make production companies competitive by helping them increase efficiency, reduce waste, and integrate innovative technologies. With a workforce of 500 employees spread across five locations, including technicians, engineers, and business consultants, IJssel serves the manufacturing, food, and process industries by offering services to realize, maintain, and improve smart factories. IJssel' combination of new technology, craftsmanship, and business management positions them as a leading player in the market (IJssel Technology Services, 2024).

1.2 Research Question and Objective

This research consist of two parts. First, based on historical data an fsQCA model is built to analyze which combination of contract attributes are leading to successful contract outcomes. Second, this study explores the relationship between contextual factors (e.g., client characteristics, project complexity, or risk) and the type of contract that best fits those contexts. The goal is to determine which contract types deliver optimal performance in particular situations, a practical model is developed for IJssel to apply in future projects.

The fsQCA model will first be constructed based on a literature review of contract attributes that influence contract outcomes. This initial model will then be examined and refined within IJssels' context, allowing for the identification of additional relevant contract attributes that influence both contract selection and project outcomes.

The key challenge lies in identifying which contract forms perform best in various scenarios and under which conditions they lead to optimal outcomes. This requires a thorough understanding of contract attributes.

This has led to the first research question:

What combinations of contract attributes contribute to successful contract outcome at IJssel Technology Services?

The second phase focuses on the future, aiming to develop a practical model that enables IJssel to offer more suitable contract types to specific project contexts. This model will guide in aligning contract forms with the characteristics of asset management projects, enhancing both profitability and risk allocation.

The second research question is:

How can the most suitable contract type been selected based on project context to maximize profitability at IJssel Technology Services?

The objective of this research is to address two key aspects. First, it aims to identify and analyze which combinations of contract attributes contribute to successful contract outcomes through historical data analysis and a literature review. This will involve the development of an fsQCA model to uncover these combinations. Second, the research will focus on creating a practical model based on project context, enabling IJssel to select the most suitable contract type in a specific context.

1.3 Research Gap

While contract selection has been explored in various industries, including construction, IT, and project management (Rahman & Kumaraswamy, 2002; Murdoch & Hughes, 2002; Turner, 2014). There is a notable gap in the literature concerning how contract forms are selected in asset management projects within service-oriented companies. Specifically, existing studies often fail to adopt a data-driven approach that examines the unique combinations of contract attributes, that influence both contract choice and successful project outcomes. This lack of focus on the interplay between these attributes highlights the need for further research to develop frameworks for contract selection in this context.

This gap presents an opportunity to develop an integrated contract selection model that uses fsQCA to identify combinations of internal and external contract attributes that contribute to optimal outcomes in asset management projects. By building an empirical, data-driven decision-support framework, this research will provide IJssel with a systematic way to optimize contract selection based on both theoretical and real-world insights. Although studies emphasize individual factors like project complexity, client characteristics, and risk tolerance as essential to contract choice (Turner J. R., 2014; Luu & Chen, 2003), there is limited focus on how these factors interrelate and influence contract selection in asset management.

Theoretical Contribution

This research addresses a gap in the literature concerning contract selection in asset management, where limited studies explore the impact of various contract attributes on project success. While existing literature examines how contracts manage risk, allocate responsibilities, and optimize performance, there has been minimal exploration of how combinations of contract attributes affect contract selection and outcomes in the context of asset management. The theoretical contribution of this research lies in developing a context-specific, data-driven model using fsQCA to analyze how specific combinations of contract attributes influence the selection of contract types that lead to successful project outcomes.

Practical Contribution

The practical contribution of this research is the development of a decision-support tool based on an fsQCA model that will assist IJssel in optimizing contract selection for their asset management projects. This tool will be grounded in historical project data, insights from the literature, and specific project context allowing it to evaluate and integrate specific combinations of contract attributes. By analyzing these attribute combinations, the tool will recommend the most suitable contract type for a specific project contexts, supporting IJssel in maximizing profitability and minimizing associated risks.

1.4 Outline of the Research

This thesis is structured as follows: Chapter 2 reviews the relevant literature on contract forms, the different types of contracts, and contract attributes that influence to choice of the most suitable contract. Chapter 3 outlines the research methodology used to analyze and calibrate contract attributes and describes how the recommendation tool is built. Chapter 4 presents the findings based on historical project data and discusses the implications for IJssel using fsQCA. Chapter 5 provides insights into future contract selection and the development of a recommendation tool. Chapter 6 concludes the research by summarizing key findings, outlining limitations, and elaborating on the practical implications of the study.

2. Literature Review Contracts

Contracts are the foundation of business agreements, providing a legal structure that defines the roles, responsibilities, and expectations of the involved parties. A contract is essentially a binding agreement that outlines the rights and obligations of the parties involved, and its enforceability ensures that the agreed-upon terms are adhered to, or that remedies are available in case of a breach ((Murdoch & Hughes, 2002). Contracts are particularly significant in asset management and project-based industries, where the clear delineation of responsibilities is critical for both parties to manage risks and ensure successful outcomes.

2.1 Contracts

A contract serves as a formalized understanding between two or more parties, detailing the scope of work, payment terms, deliverables, timelines, and the allocation of risks. Contracts are not only legal documents but also management tools that ensure the proper execution of projects by setting expectations and obligations. In asset management, contracts define the service levels and the responsibilities of maintaining and improving physical assets over time (Murdoch & Hughes, 2002).

According to Turner (2014) contracts help in reducing uncertainty and managing the complexities of delivering services or completing projects. They formalize expectations about performance, payment and responsibilities, which makes them vital in industries such as construction, IT, and asset management. These industries often require long-term service delivery or project execution, where the risks of delays, cost overruns or performance failures are high.

Parameters in Contracts

Contracts must contain specific parameters that clearly define the nature of the agreement. The inclusion of these parameters ensure that the contract serves as a guide for managing the project or service. Key parameters typically found in contracts include:

- **Scope of Work:** The scope of work defines the exact work or services to be performed, ensuring clarity on what the contractor or service provider is expected to deliver. A well-defined scope helps in preventing disputes over expectations and deliverables (Murdoch & Hughes, 2002).
- **Payment Terms:** Contracts specify how and when payments will be made, whether based on milestones, deliverables, or a fixed schedule. Payments terms also outline how cost overruns or additional work will be handled (Love, Edwards, & Irani, 2016).
- **Timeframe and Deadlines:** Clear deadlines for deliverables or project completion must be included to ensure that both parties have mutual understanding regarding timelines (Murdoch & Hughes, 2002).
- **Risk Allocation:** A critical component is the allocation of risks, whether financial, operational, or legal. Contracts outline who bears the risk if something goes wrong, such as delays, cost increases, or failures to meet performances standards (Smith & Bohn, 2009).
- **Performance Criteria:** Specific criteria must be met for the contractor to receive full compensation. This can include service-level agreements (SLAs) or key performance indicator (KPIs) that measure the success of the project or service (Rahman & Kumaraswamy, 2002).
- **Dispute resolution:** contracts typically include clauses for dispute resolution. Specifying how disagreement will be handled, whether through arbitration, mediation or litigation (Murdoch & Hughes, 2002).

- **Termination Clauses:** Contracts also include condition under which the agreement can be terminated by either parties, specifying the process of doing so and any penalties that may apply (Murdoch & Hughes, 2002).

Types of Contracts

Based on literature there are multiple type of contracts that can be used in different situations. The contracts forms are listed below with their key characteristics.

- **Fixed-Price / Unit Rate:** These contracts have a predetermined cost for delivering a specified service or completing a project, either as a lump sum (fixed-price) or based on predefined unit rates (unit rate). This contract type is most suitable for well-defined projects where the scope, deliverables, and timelines are clearly established. Contractors bear the risk of cost overruns, while clients benefit from cost certainty. Fixed-price contracts offer budget predictability but limited flexibility, whereas unit rate contracts provide some adaptability in adjusting quantities based on actual work performed. These contracts are widely used when the scope is clear and the work can be accurately estimated (Murdoch & Hughes, 2002; Bower, 2003).
- **Cost-Plus or Cost Reimbursable:** These contracts compensate the contractor for actual costs incurred during the project, plus an additional fee or profit margin. This is mostly used when the scope is uncertain or likely to change, as they provide flexibility in covering unforeseen expenses. Clients assume more financial risk since they are responsible for all costs. This contract is useful in uncertain project, where the scope might evolve over time and flexibility is required (Turner J. R., 2014).
- **Performance-Based:** performance-based contracts tie contractor compensation to the achievement of the specific performance outcomes or key performance indicators (KPI's). These contracts are used to meet or exceed performance benchmarks. This type of contract can put risk to contractors if targets are too ambitious or influenced by external factors (Rahman & Kumaraswamy, 2002; Selviaridis & Wynstra, 2015).

Performance-Based Contracts

Performance-based contracting represents a significant evolution in asset management contracting, shifting focus from input-based to outcome-focused agreements. Performance-based contracting fundamentally changes how service providers and clients align their interests by linking compensation directly to achieved performance outcomes rather than time and materials used (Selviaridis & Wynstra, 2015).

The core principles of Performance-based contracting include outcome-based compensation structures, where payment mechanisms directly tie to specific performance indicators, and balanced risk-reward distribution between parties. This approach requires mature asset management systems, clear performance metrics, and robust data management capabilities from both service providers and clients. The contract structure typically combines base payments with performance incentives.

Successful implementation of Performance-based contracting demands a strong collaborative relationship between provider and client, moving beyond traditional transactional approaches to establish long-term partnerships. This collaboration necessitates open communication, data sharing, and aligned incentives. While Performance-based contracting can lead to improved asset performance and better alignment of interests organizations must carefully consider the increased complexity in contract design and management, as well as the need for sophisticated performance measurement capabilities.

2.2 Contract Attributes

Based on academic literature, contract selection is often guided by project-specific factors such as complexity and scope, risk allocation, client characteristics, the nature of the relationship between the contractor and the client, external environmental factors. Rahman and Kumaraswamy (2002) emphasize that contract selection should be based on a careful assessment of risk, project scope, and the client's expectations. High level of uncertainty also play a big factor in the contract selection process. To provide a structured approach, this chapter distinguishes between external attributes, which relate to project and client conditions, and internal attributes, which reflect the company's strategic priorities and operational capabilities. These attributes are discussed below.

External Contract Attributes

Project Complexity

Project complexity reflects the difficulty of executing a contract, influenced by factors such as the nature of activities performed, the level of expertise required, and the involvement of multiple disciplines. Higher complexity levels typically involve predictive maintenance on multiple assets, integration of advanced diagnostics, and cross-functional coordination, while lower complexity levels involve routine corrective or preventive maintenance.

When complexity is low, such as in projects involving standardized tasks or routine maintenance, fixed-price/unit rate contracts are the preferred option. These contracts ensure cost certainty and budget predictability, as the scope, deliverables, and timelines are clearly defined (Turner, 2014). However, in more complex projects, where work involves advanced technical expertise, unpredictable risks, or evolving project demands, a more flexible contract structure is required (Murdoch & Hughes, 2002).

As complexity increases, cost-plus contracts become more suitable because they provide the flexibility to accommodate evolving project requirements without the need for constant renegotiation (Rahman & Kumaraswamy, 2002). In long-term projects requiring adaptive maintenance strategies, performance-based contracts can be applied, ensuring that compensation is tied to achieving specific operational improvements or efficiency targets over time

Scope

Scope defines the extent to which a contract clearly outlines deliverables, responsibilities, and performance metrics (KPIs). A well-defined scope reduces ambiguity and enhances contract execution, while an unclear or evolving scope increases the likelihood of disputes, inefficiencies, and unforeseen costs.

When the scope is well-defined, meaning specific deliverables, key milestones, and performance indicators are explicitly stated in the contract. Fixed price / unit rate price contracts provide financial stability and ensure that both parties operate within a clearly structured agreement (Turner, 2014).

However, when the scope is uncertain or likely to evolve, cost-plus contracts are preferred. Cost-plus contracts allow for scope flexibility, ensuring that work can be adjusted without requiring contract renegotiation (Murdoch & Hughes, 2002). In cases where outcome-based incentives can drive efficiency, performance-based contracts can be applied, ensuring that payments align with achieving defined performance improvements over the contract duration (Selviaridis & Wynstra, 2015).

Risk Allocation
Risk Allocation is according to Smith and Bohn (2009) a major determinant in contract selection. Contracts must clearly define how risks, financial-, operational- or legal-risk are distributed between the parties. Poor risk allocation can lead to disputes, cost overrun, and even project failure. Fixed-price contracts shift most of the risk to the contractor, as they must absorb any cost overruns or delays, making them more suitable for projects with low uncertainty and clearly defined deliverables. On the other hand, cost-plus contracts allocate the financial risk to the client, ensuring that the contractor is compensated for actual costs incurred, regardless of any overruns.

Performance-based contracts incentivize contractors to meet specific performance benchmarks, which reduces the client's risk and increase the risks for the contractor and places greater pressure on the contractor to meet performance targets that may be influenced by external factors (Turner J. R., 2014). The choice of contract is thus heavily influenced by the level of risk each party is willing to assume and how effectively that risk is managed throughout the project.

Incorporating warranties and penalties into contracts further refines risk allocation. Warranties serve as assurances from the contractor regarding the quality and performance of the work delivered. They provide the client with recourse if the work fails to meet specified standards, transferring the risk of defects or subpar performance back to the contractor. Contracts may also include provisions holding the contractor responsible for damages caused by negligence or failure to meet project requirements (Rahman & Kumaraswamy, 2002).

Client Characteristics
Client characteristics play a significant role in in contract selection. Client characteristics include maturity of the client, risk tolerance and the financial capacity. According to Luu and Chen (2003), Procurement Selection parameters (PSPs) that are tailored to the client's attributes can lead to better decision-making. mature clients with experience in managing complex projects may prefer performance-based contracts, where collaboration and flexibility are critical. These contracts allow for ongoing adjustments based on project performance, making them suitable for clients who are comfortable with dynamic and evolving project scopes.

Less experienced clients or those with limited financial resources may prefer fixed-price / unit rate contracts, where cost is prioritized. Such clients typically seek contracts that provide clear terms and limited financial risk, even if it means sacrificing some flexibility in project execution and therefore potentially come at a higher costs.

Client maturity can be divided into multiple stages which indicate their level of maturity based on how they handle their assets (International Organization for Standardization, 2024):

- **Reactive**: Focuses on fixing problems as they occur. Least efficient.
- **Standardized**: Establishes basic preventive measures but lacks full coordination.
- **Learning**: Uses past data to inform preventive measures.
- **Dynamic**: Real-time monitoring and condition-based maintenance.
- **Predictive**: Utilizes AI and advanced analytics for predictive maintenance and continuous improvement.

Market Conditions

Market conditions, including economic cycles, supply chain stability, and industry-specific demand fluctuations, play a crucial role in contract selection. In a seller's market, where demand exceeds supply, contractors may prefer cost-plus contracts, allowing them to pass fluctuating material and labor costs onto the client (Love, Edwards, & Irani, 2016). In contrast, in a buyer's market, where clients have greater negotiating power and competition among contractors is high, fixed-price/unit rate contracts are often favored, as they provide cost certainty and help clients secure the most competitive pricing.

Economic fluctuations, such as high or low conjuncture, further impact contract selection. During periods of economic expansion, where inflationary pressures may drive up costs, cost-plus contracts provide flexibility for managing uncertainties. Conversely, in periods of economic downturn, clients may prioritize fixed-price/unit rate contracts to maintain budget control and minimize financial risks.

Regulatory Rules

Regulatory requirements influence contract selection by dictating safety, environmental, and operational compliance standards. Contracts in industries with strict regulatory oversight, such as infrastructure, healthcare, or energy, often require performance-based contracts to ensure compliance with key performance indicators (KPIs) and legal mandates. These contracts may include penalties for non-compliance to enforce adherence to safety, environmental, or quality standards (Smith & Bohn, 2009).

The regulatory environment in which the client operates also affects contract structuring. Clients subject to stringent industry regulations may require contracts that specify detailed reporting, auditing, and compliance mechanisms. In contrast, clients with minimal regulatory constraints may prefer simpler contract structures, such as fixed-price/unit rate contracts, where compliance is less complex.

Environmental considerations, such as sustainability goals and ecological impact, further shape contract preferences. Contracts may incorporate clauses mandating sustainable practices, such as reduced emissions, waste management, and resource efficiency, aligning with organizational and regulatory sustainability objectives (Smith & Bohn, 2009). Performance-based contracts are often preferred in these cases, as they incentivize compliance with environmental targets by linking compensation to sustainable outcomes.

Relational Factors and Trust

The relationship between the contractor and the client plays a crucial role in contract selection, particularly in long-term and complex projects that require continuous collaboration. Contracts that foster trust and cooperation help ensure successful project execution by promoting mutual adaptability rather than rigidly adhering to predefined terms (Rahman & Kumaraswamy, 2002).

In projects where long-term engagement and adaptability are essential, performance-based contracts are often preferred. These contracts incentivize ongoing improvements and collaboration by linking contractor compensation to measurable outcomes, such as efficiency gains, reduced downtime, or enhanced service levels. Cost-plus contracts may also be used when trust between parties allows for transparent cost reporting and shared risk management, ensuring that both client and contractor remain aligned despite project uncertainties.

Internal Contract Attributes

While external factors largely shape contract selection based on client needs and environmental conditions, internal attributes within the contractor organization—such as resource availability, internal strategic priorities, and organizational goals—also play a critical role. These internal factors help define how effectively a contractor can meet project demands and determine which contract forms align best with the organization's capabilities and objectives.

Resource Availability

The availability of essential resources, including personnel, machinery, and materials, significantly impacts a contractor's ability to fulfill specific contract requirements. Turner (Turner J. R., 2017) emphasize that resource availability is crucial for deciding between cost-plus or fixed contract types, as resource constraints may limit the contractor's adaptability. When resources are stable and predictable, contractors often prefer fixed-price / unit rate price contracts, as these offer cost certainty and efficiency. However, in contexts where resource availability is variable or limited cost-plus contracts may be more suitable, as they provide the flexibility to adjust resource costs in line with project needs. By matching contract types with resource constraints, contractors can allocate labor, machinery, and materials more effectively to fulfill project requirements (Osipova & Eriksson, 2013).

Internal Priorities and Organizational Strategy

Internal priorities, such as a contractor's focus on long-term growth versus short-term profitability, also influence contract form selection. In the Strategic Management of Large Engineering Projects, Miller and Lessard (2001) discuss how contractors with long-term strategic goals may prioritize performance-based contracts that foster sustained partnerships and collaboration. These contracts are compatible with organizational strategies that emphasize continuous improvement and knowledge-sharing within project partnerships (Miller, Lessard, Michaud, & Floricel, 2001). Conversely, contractors focused on short-term profitability may prefer fixed-price contracts due to their budget predictability and controlled risk exposure, aligning with immediate financial objectives. Aligning contract forms with organizational priorities allows contractors to manage project complexities while supporting broader strategic goals.

Contract Outcome

In this study, contract outcome is a key variable that is examined to determine how various combinations of contract attributes contribute to either positive or negative outcomes. A contract outcome is defined as successful when the revenue exceeds the costs of the project, meaning that the project has been profitable. On the other hand, break-even occurs when the costs equal the revenue, and when the costs surpass the revenue, the project outcome is considered negative.

Recent studies underline the critical role of understanding these interactions to select the appropriate contract type, which maximizes the potential for positive outcomes. Proper alignment of contract attributes is crucial for ensuring profitability and minimizing inefficiencies. The research by Turner (2014) and Selviaridis & Wynstra (2015) further supports the notion that contract success is closely tied to the careful selection of attributes tailored to the specific project needs.

2.3 Fuzzy-set Qualitative Comparative Analysis (fsQCA)

FsQCA is a methodological approach developed by Charles Ragin to understand causally complex phenomena, where multiple factors work together to produce outcomes. Unlike traditional statistical methods, fsQCA is rooted in set theory and Boolean algebra, offering a unique framework for analyzing combinations of conditions rather than isolating individual variables. This configurational approach reveals not only which factors are present in successful outcomes but also how they interact, making fsQCA invaluable for fields where complex interdependencies influence results, such as contract selection in project management (Ragin, 2008).

The fsQCA model is based on configurational causation. This principle suggests that outcomes often result from specific combinations of conditions rather than from individual factors acting independently. For example, a successful project outcome may emerge not solely from high client maturity or strong risk tolerance, but from a unique combination of these and other attributes. This concept, known as equifinality, allows fsQCA to reveal that there may be multiple paths to the same outcome, enabling a nuanced understanding of success in real-world contexts (Rihoux & Ragin, 2009).

FsQCA captures three key dimensions of complex causality: conjunction, equifinality, and causal asymmetry (Rihoux & Ragin, 2009). Conjunction refers to the interplay of multiple factors that collectively produce an outcome, emphasizing that no single attribute alone determines success. Equifinality highlights that there are multiple pathways to achieving the same successful outcome; for example, both high client maturity combined with moderate flexibility and strong risk allocation might lead to contract success. Causal asymmetry recognizes that the conditions leading to success may not simply be the inverse of those causing failure, providing a nuanced understanding of both successful and unsuccessful outcomes.

FsQCA is suitable for this research because it aligns with the study's objective of determining how combinations of contract attributes influence successful outcomes. Its configurational lens provides insights by identifying the critical combinations of conditions that drive success and revealing multiple pathways to optimal outcomes. Moreover, its adaptability to medium-sized datasets ensures that conclusions can be drawn from IJssel' historical contract data. By applying fsQCA, this study offers IJssel practical tools for aligning contract forms with project-specific contexts, enhancing profitability and minimizing risks.

FsQCA Model

The presented model in figure 1. illustrates the application of fsQCA for contract attributes and selection. It begins with Internal and External Contract Attributes, categorized to reflect key influences on contract type and contract success. External attributes include project complexity, risk allocation, client characteristics, environmental factors, and relational trust, while Internal attributes focus on resource availability and organizational strategy. Based on the literature review, the following contract attributes were identified as critical for contract selection. These attributes were used to develop the first theoretical model (Model-1).

The model emphasizes configurational causation, where various combinations (or configurations) of these attributes interact, represented by "Multiple Pathways." These pathways indicate that different attribute combinations can lead to the selection of specific Contract Types (e.g., fixed-price, cost-plus), aligning with the fsQCA principle of equifinality, multiple configurations can yield the same successful outcome.

Finally, the selected Contract Type impacts the Project Outcome, showing how tailored contract forms based on empirical attribute configurations enhance project success. This model provides a structured, data-driven approach for identifying optimal contract types, aligning project requirements with contract attributes to achieve desirable project outcomes.

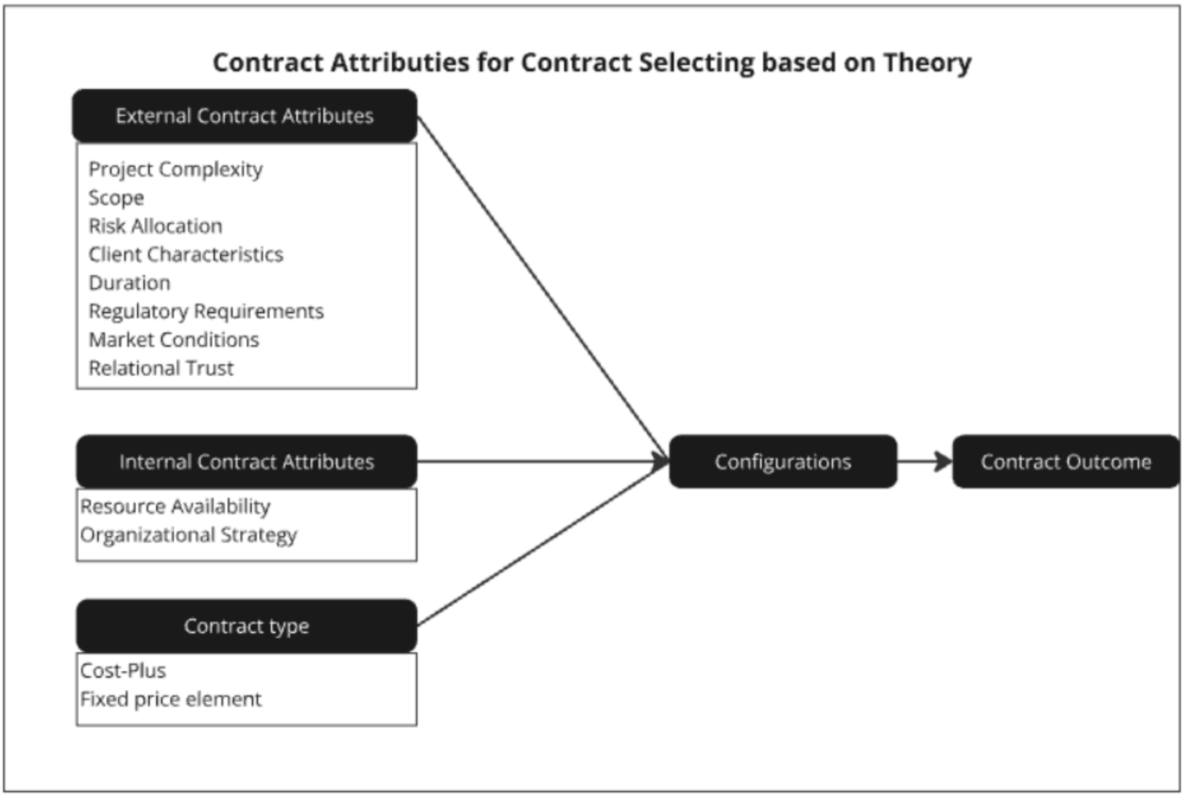


Figure 1: Model-1 Literature Based

3. Research Method

This chapter details the methodology used to structure the research and develop the four models that guide the analysis. The research follows an empirical approach, using real-world data from IJssels' projects to identify key patterns in contract selection and performance. The study is structured around the two main research questions:

- What combinations of contract attributes contribute to successful contract outcome at IJssel Technology Services?
- How can the most suitable contract type been selected based on project context to maximize profitability at IJssel Technology Services?

These research questions provide the foundation for the development and refinement of four models, each iteratively improving the understanding of contract attributes and their impact on project success. The chapter begins with a justification for the configurational approach, explaining why fsQCA is used as the central analytical method. It then describes the data collection process, data calibration procedures, and fsQCA analysis process, detailing how contract attributes are assessed and structured. The chapter also introduces the contract selection model, explaining its evolution through multiple iterations. Finally, it outlines validation measures, ethical considerations, and the approach to planning and reporting.

3.1 Research Design and Justification

This study adopts a mixed-methods empirical design that combines qualitative insights from experts, historical contract data, quantitative analysis using fsQCA, literature review and a case study. The mixed-methods approach allows for a comprehensive understanding of contract selection by integrating three sources: numerical patterns in historical data, contextual insights from key stakeholders, and theoretical frameworks from established literature. This triangulation ensures that the analysis is grounded in both empirical data and theoretical perspectives, enhancing the robustness of the findings (Kern, 2018).

The use of fsQCA is justified by its ability to analyze equifinality, the concept that multiple configurations of attributes can lead to the same successful outcomes. This approach is particularly appropriate for contract selection, where varying internal and external project conditions require different contract forms to achieve optimal results (Prentice, 2019). By applying fsQCA, this research identifies pathways to contract success, uncovering how diverse combinations of attributes influence contract performance. This configurational causation model aligns with existing literature, which has shown fsQCA's effectiveness in fields requiring nuanced, combinatorial analyses, such as lean manufacturing and competitive advantage studies (Galeazzo & Furlan, 2018).

3.2 Sample Size

The study focuses on contracts that meet specific criteria to ensure relevance to the research questions. The following selection criteria were applied:

- Client Classification: Only contracts with A+, A, and B clients were included. This classification is based on turnover per client, ensuring the study targets clients with varying levels of financial impact on the company. With this selection, a large portion of the revenue is represented by a small group of clients, applying the 80-20 rule.

- Contract Period: The analysis focuses on contracts structured over the past four years to ensure relevance to current business conditions. Contracts older than four years are excluded, as they may not be representative due to external factors such as COVID-19-related disruptions and regulatory changes. Additionally, IJssels' acquisition by private equity in 2023 introduced a strategic shift in contract selection, further reinforcing the need to analyze recent contracts that align with the company's evolving priorities.
- Availability of Data: Contracts with sufficient structured data on key attributes, including financial records, project scope, and client relationships, were included.

Applying these criteria resulted in a final dataset of 33 contracts.

3.3 Model Development

This research began with a literature review to identify the most influential contract attributes. Based on this review, **Model-1** was developed as an initial framework for analyzing contracts in the database. This model served as the foundation for further refinement. Through a detailed examination of contract documents and expert insights, **Model-2** was created as an optimized version, focusing solely on contract attributes while excluding contract type. Model-2 was used to determine which attributes contribute to positive or negative contract outcomes. Model-2 is optimized to four attributes whereas one attribute is a combined score of three attributes.

Following the fsQCA analysis of Model-2, **Model-3** was introduced. This version retained the attributes of Model-2 but incorporated contract type as a binary variable, where 1 represents the presence of a Fixed-Price element and 0 represents the absence of a Fixed-Price element, corresponding to a Cost-Plus contract. By integrating contract type, Model-3 allowed for a deeper understanding of how specific contract structures influence outcomes.

After analyzing the results from Model-3, **Model-4** was developed in Chapter 5. This final model builds upon the insights gained from Model-3 but is designed to be future-proof, ensuring that contract selection is optimized for different project contexts. Model-4 refines the decision-making process by integrating additional contract attributes and strategic considerations, enabling IJssel to make more informed contract choices beyond current industry practices.

3.4 Contract Attributes Optimization

The initial contract attribute model, Model-1, was developed purely based on literature and identified ten contract attributes, see Chapter 2, that were considered influential in contract selection and outcome. However, as the research progressed, it became evident that a direct application of theoretical attributes without empirical refinement introduced limitations in both practical usability and analytical clarity. To enhance the models robustness and ensure that the attributes used accurately reflect contract outcomes within IJssels' specific operational context, an optimization process was undertaken.

In Chapter 2, ten attributes were identified. These attributes are summarized in discussed in section 3.4 However, two key factors necessitated a optimization and refinement of these attributes. First, the relatively small sample size of the dataset limited the feasibility of effectively analyzing ten attributes simultaneously while maintaining statistical and configurational validity in fsQCA. Given that fsQCA relies on pattern recognition across multiple conditions, a highly granular attribute set would lead to an excessive number of configurations, reducing the interpretability and reliability of results. Second, expert insights with Niels Meerdink and Mats Boeve (Meerdink & Boeve, 2024) indicated that certain attributes were conceptually interrelated and could be merged without sacrificing analytical depth. This aligns with established research in contract theory, where attribute interdependencies often determine contract effectiveness rather than individual attributes in isolation (Turner, 2014).

To address these concerns, multiple attributes were consolidated into two composite variables:

- **Total Risk:** which integrates Market Conditions, Regulatory Requirements, and Relation and Trust. This decision was guided by the fact that these three elements collectively shape the external uncertainty surrounding contract execution, a key determinant in contract selection (Williamson, 1985).
- **Internal Alignment:** which merges Resource Availability and Organizational Strategy. This variable initially aimed to capture how well the contract aligned with internal strategic priorities and operational feasibility.

During further analysis, Internal Alignment was excluded from the final fsQCA model due to its lack of variability across contracts. Since all contracts in the dataset demonstrated adequate resource availability and alignment with IJssels' strategic goals, retaining this variable would not provide meaningful differentiation in the analysis. This decision aligns with empirical best practices in fsQCA, where attributes that exhibit minimal variance offer little explanatory power and can distort results (Ragin, 2008). Additionally, Duration was initially treated as an independent attribute in Model-1. However, expert interviews with Niels Meerdink and Mats Boeve revealed that project duration was inherently linked to project complexity, with longer durations typically required for more complex projects. This correlation aligns with Turner's (2014) framework, which suggests that complexity is a primary driver of project timeline requirements rather than an independent decision variable. Given this strong theoretical and empirical relationship, duration is removed as single attribute.

Model-2 used for the first fsQCA analysis thus prioritized the attributes with the most significant impact on contract outcomes: Project Complexity, Scope, Client Characteristics, and Total Risk. By balancing analytical rigor with interpretability, this approach ensures that the model effectively captures the most influential contract determinants while remaining adaptable to real-world decision-making. Figure 2 illustrates the refined model. Model-3 is the identical but introduces contract type as addental attribute.

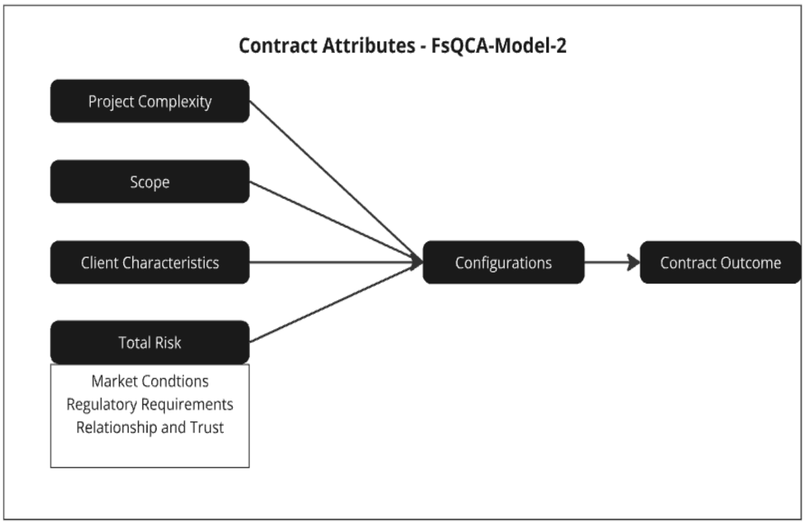


Figure 2: Model-2 Contract Attributes - fsQCA-Model

3.5 Data Collection

This section describes the key attributes used in Model-2 and Model-3, explaining their role in contract selection and how they were measured. The attributes were selected based on literature review, expert input, and historical project data. They represent critical factors influencing contract outcomes, grouped into individual attributes and combined attributes.

The data used in this study was collected from multiple internal and external sources to ensure accuracy and reliability. The primary sources of data include:

- **Contract Documentation**: Official agreements were reviewed to extract information on contract type, project complexity, scope, and regulatory requirements. These documents provide objective, verifiable insights into contractual terms, conditions, and project-specific attributes, leaving no room for subjective interpretation. As Lumineau and Malhotra (2016) emphasize, contract documents serve as primary data sources, providing factual evidence rather than relying on interpretations or recollections. A systematic review of contract documentation was conducted following Turner's (2014) framework for contract analysis, focusing on legally binding elements:
  - Formal agreements and amendments
  - Service level agreements and KPI definitions
  - Risk clauses
  - Regulatory compliance requirements
  - Pricing structures and payment terms
- **Financial Performance Data**: Financial data, including profitability metrics, was sourced directly from IJssels' enterprise resource planning (ERP) system. As Banker et al. (2018) demonstrate, system-generated financial data provides the most reliable basis for performance assessment. This data includes::
  - Revenue and cost structures
  - Profit margins
  - Project financial reports
- **Expert Insights:** For this study, expert insights were gathered by consulting individuals with in-depth knowledge of the specific contracts. The experts included the contract owners, who are directly responsible for each contract and have the most understanding of the terms, conditions, and performance aspects. The experts were asked to score contract attributes using a Likert scale. This approach provided a consistent and structured way to assess subjective factors, ensuring clarity and comparability across different contracts.

  The data was collected through semi-structured interviews and discussions, where the experts were presented with a list of attributes and asked to rate each based on their knowledge and experience with the respective contracts. The scale ranged from 1 to 5, where 1 indicated low presence or importance of an attribute, and 5 represented high presence or importance. To give more direction to the scores, qualitative values were assigned to each numerical rating. This additional qualitative layer ensured that the experts' assessments were more nuanced and consistent across the contracts.

  While contract documentation provides the formal structure, expert insights were particularly valuable for understanding soft factors such as client relationships, organizational culture alignment, and improvement potential - elements that significantly influence contract success but are not captured in formal documents (Zheng et al., 2018). These insights provided essential context about the operational reality of contract execution and the historical development of client relationships.

Once the experts had completed their assessments, the results were used to create an overall picture of the contract attributes for each contract (see the distribution in appendix D). These scores were then used as input for the fsQCA analysis, allowing the subjective evaluations from the experts to be combined with the historical data of the contracts. This method ensured that the qualitative insights were grounded in the practical experience of those who manage and oversee the contracts, aligning with the quantitative data for a more complete understanding of the factors that influence contract outcomes.

Contract Attributes

The contract attributes used in this research are explained below along with their measurement strategies. Each attribute is assessed using contract documentation and expert insights, with a Likert scale applied to score the attributes based on expert evaluations. These scores are then used in the fsQCA analysis to understand how combinations of contract attributes contribute to positive or negative outcomes, an overview off the contract attributes and there scorings can be found in table 1.

Project Complexity

Project complexity reflects the difficulty of executing the contract and is influenced by the nature of activities performed, the level of expertise required, and the involvement of multiple disciplines (Turner, 2014). Higher complexity levels typically involve predictive maintenance on multiple assets, integration of advanced diagnostics, and cross-functional coordination, while lower complexity levels involve routine corrective or preventive maintenance.

Project complexity is measured by reviewing contract documentation, which specifies the nature of the work involved. This contract information is used to establish the scores assigned to complexity. In addition, expert evaluations are used to validate the complexity assessments. Experts score the complexity based on their experience and knowledge of the specific project.

Experts scored the complexity using a Likert scale ranging from 1 to 5:

1. Simple tasks, e.g., lubrication only.
2. Corrective tasks only.
3. Combination of predictive and preventive tasks.
4. Predictive maintenance on a few assets.
5. Predictive maintenance on multiple assets, requiring advanced diagnostics and coordination.

The ratings from experts were consolidated to assess the overall complexity of each contract. This approach aligns with studies emphasizing the importance of complexity in contract design.

Scope

Scope defines the extent to which a contract clearly outlines deliverables, responsibilities, and performance metrics (KPIs). A well-defined scope reduces ambiguity and enhances contract execution, while an unclear scope increases the likelihood of disputes and inefficiencies. The clear definition of scope is important in contract management and project outcomes, as emphasized in contract theory (Murdoch & Hughes, 2002).

Scope clarity is assessed by reviewing contract documents that specify deliverables, key milestones, and KPI definitions. Contracts with detailed performance indicators and structured obligations are classified as having a well-defined scope. In cases where scope clarity was not explicitly stated additional assessments from contract experts were used to evaluate how well the scope was defined based on their experience with similar contracts.

Scoring Method:

- Low (0): Broad/vague scope with no KPIs.
- Medium (0.5): Sufficient scope and KPIs without clear thresholds.
- High (1): Clear scope and KPIs with specific performance thresholds.

Risk Allocation

The distribution of financial, operational, and compliance-related risks between IJssel and the client. Proper risk allocation ensures that responsibilities are clearly defined, preventing disputes and financial losses.

Risk allocation is assessed based on contract documentation, which specifies the extent to which each party is responsible for risks. Additionally, contract owners and experts evaluate how risks are managed and distributed, providing qualitative assessments through structured evaluations.

Experts scored the complexity using a Likert scale ranging from 1 to 5:

1. The client assumes most risks.
2. IJssel takes on some limited risks.
3. Risks are equally shared.
4. IJssel assumes significant operational and financial risks.
5. IJssel bears nearly all risks.

Client Characteristics

The level of maturity and capability of a client in managing asset maintenance and operational efficiency. It reflects whether the client follows structured maintenance strategies or relies on reactive approaches.

Client maturity levels are assessed through IJssels' internal client database, which classifies clients based on their operational maturity. This database includes a score for each client's maturity level, indicating how advanced their asset management and maintenance strategies are. For clients not listed in the database, contract experts provide additional assessments based on their knowledge of the client's operations. These experts evaluate how well the client manages maintenance processes, whether they have standardized procedures in place, or if their approach is more reactive.

Experts scored the complexity using a Likert scale ranging from 1 to 5:

1. Reactive – Focuses on fixing problems as they occur.
2. Standardized – Basic preventive measures.
3. Learning – Uses past data to inform preventive actions.
4. Dynamic – Real-time monitoring and condition-based maintenance.
5. Predictive – Uses AI and advanced analytics for continuous improvement.

Regulatory Rules
The degree of regulatory complexity that affects contract execution, including compliance with safety, environmental, and industry-specific legal requirements.

Regulatory complexity is assessed by reviewing contract documentation to identify the legal and compliance requirements relevant to the specific contract. This includes detailed references to industry regulations, safety standards, environmental laws, and any other legal obligations that need to be met during the contract execution. Additionally, expert evaluations provide insights into how these regulations impact the project. Experts assess whether the contract includes complex regulatory requirements, whether compliance is straightforward or demanding, and how much effort and resources are required to adhere to these regulations.

Experts scored the complexity using a Likert scale ranging from 1 to 5:
1. Minimal regulations, easy compliance.
2. Standard compliance requirements.
3. Moderate regulatory demands.
4. Complex regulations requiring significant resources.
5. Highly stringent regulations requiring continuous monitoring.

Market Conditions
The stability and predictability of external factors influencing contract selection, such as economic trends and industry fluctuations. Factors like economic cycles (high or low conjuncture), buyer's or seller's markets, and overall market stability impact the level of risk associated with a contract.

Market conditions are assessed based on input from contract experts who evaluate how external economic factors influence the contract. These contract owners provide qualitative assessments using a Likert scale, ensuring a structured evaluation of market stability and its impact on contract risk. Additionally, the year of establishment of the contract is considered, as older contracts may have been negotiated under different market conditions than newer ones.

Experts scored the complexity using a Likert scale ranging from 1 to 5:
1. Stable market with predictable costs.
2. Slightly volatile market.
3. Moderate volatility in costs and demand.
4. Highly volatile market.
5. Extremely unstable market, high uncertainty.

Relational Trust
The depth and stability of the working relationship between IJssel and the client, including factors such as the duration of collaboration, reliability, and previous contractual interactions.

Relational trust is assessed by analyzing the length of the relationship. Qualitative feedback from contract expert provide additional insights to ensure an evaluation of trust levels are complete.

Experts scored the complexity using a Likert scale ranging from 1 to 5:
1. Less than 1 year of relationship.
2. 1-3 years of collaboration.

3. 3-5 years of collaboration.
4. 5-10 years of collaboration.
5. Over 10 years of collaboration.

Resource Availability
The extent to which financial, human, and technical resources are accessible to execute the contract effectively, ensuring that necessary resources are in place.

Resource availability is assessed based on expert evaluations regarding the availability of financial, human, and technical resources needed to execute the contract. In cases where resource availability was not explicitly stated in the contract, experts provided additional input based on their knowledge of the project's resource requirements at the time of contract execution.

Experts scored the complexity using a Likert scale ranging from 1 to 5:

1. Insufficient resources.
2. Limited resources with occasional shortages.
3. Adequate resources but with some constraints.
4. Sufficient resources for most needs.
5. Fully sufficient resources available.

Organizational Strategy
The alignment of a contract with IJssels' long-term business objectives, including growth, innovation, and market positioning.

Organizational alignment is assessed based on expert insights and internal documents. Contract owners evaluate how well a contract fits within IJssels' strategic vision. Their qualitative assessments are combined with internal business strategy documents to ensure alignment between contract objectives and the company's long-term goals.

Experts scored the complexity using a Likert scale ranging from 1 to 5:

1. No alignment with strategic goals.
2. Minimal alignment with strategic priorities.
3. Partial alignment, supporting some strategic objectives.
4. Strong alignment with strategic goals in most areas.
5. Full alignment with long-term strategic priorities.

Profitability
The financial success of a contract in terms of revenue and costs.

Profitability is directly extracted from ERP system financial records, focusing on net profit margins, revenue vs. cost breakdowns, and project financial reports.

Contract Type
The classification of a contract based on pricing structure, such as fixed-price or cost-plus.

Contract type is determined by analyzing contract documents that specify pricing structures. Contracts are classified based on whether a fixed-price element is present or if the agreement follows a cost-plus model.

Total Risk
Total Risk represents the overall level of uncertainty in a contract and is derived from Market Conditions, Regulatory Rules, and Relational Trust. High-risk contracts are subject to economic instability, regulatory complexity, and weak client relationships, while low-risk contracts operate in stable, predictable environments with long-term relations.

Each component of Total Risk (Market Conditions, Regulatory Rules, and Relational Trust) is measured individually, using the methods outlined above. The risk scores are generated by multiplying the individually scores with each other in order to get the total risk score.

Internal Alignment
The extent to which a contract fits within IJssels' operational capabilities and strategic direction. It is a combined score of Resource Availability and Organizational Strategy.

Internal alignment is determined by aggregating the scores of Resource Availability and Organizational Strategy, both of which are assessed based on expert insights and internal documents. The individually scores are multiplied in order to get the internal alignment score.

Attributes Scores
The attributes above are scored based on their presence and information in the contract documents, ERP systems or based on expert insights. Experts were consulted through a semi-structured interview, the basis of which can be found in Appendix A. Expert were asked to score the attributes using a Likert scale based on their assessments, table 1 is been used to indicate the scores of the Linkert-scale. A database is created with all the contracts and their qualitative description of the attribute and their scores based on document information and expert insights, this database can be found in Appendix F.

Attribute	Collection Method	Scale Criteria
Project Complexity	Contract Documentation Expert Insights	**Low** (1): Simple tasks like lubrication only **Medium-Low** (2): Corrective tasks only **Medium** (3): Combination of predictive and preventive tasks **Medium-High** (4): Predictive maintenance on a few assets **High** (5): Predictive maintenance on multiple assets
Project Duration	Contract Documentation	Duration of the contract in years. fsQCA software used to calibrate the data.
Scope	Contract Documentation	**Low** (0): Board / vague scope and no KPI's **Medium** (0.5): Sufficient scope and KPI's without clear thresholds **High** (1): Clear scope and KPI's with clear thresholds

Risk Allocation	Contract Documentation Expert Insights	**Low** (1): The client assumes most risks, including financial and operational liabilities. IJssel has minimal accountability. **Medium-Low** (2): IJssel takes on limited operational risks, such as minor penalties for delays or service issues. **Medium** (3): Risks are equally shared, with both parties accountable for financial, operational, and compliance outcomes. **Medium-High** (4): IJssel assumes significant operational and financial risks, while the client retains some oversight. **High** (5): IJssel bears nearly all risks, including financial liabilities and performance penalties, with minimal client responsibility.
Client Characteristics	Contract Documentation Expert Insights	**Low** (1): Reactive – Focuses on fixing problems as they occur **Medium-Low** (2): Standardized – Basic preventive measures **Medium** (3): Learning – Uses past data to inform preventive actions **Medium-High** (4): Dynamic – Real-time monitoring and condition-based maintenance **High** (5): Predictive – Uses AI and advanced analytics for predictive maintenance and continuous improvement
Regulatory Rules	Contract Documentation Expert Insights	**Low** (1): Minimal regulations, easy compliance **Medium-Low** (2): Standard compliance requirements **Medium** (3): Moderate regulatory demands, requiring dedicated resources **Medium-High** (4): Complex regulations with significant compliance effort **High** (5): Highly stringent regulatory environment requiring continuous monitoring and adaptation
Market Conditions	Contract Documentation Expert Insights	**Low** (1): Stable market with predictable costs and demand **Medium-Low** (2): Slightly volatile, with minor price fluctuations

		Medium (3): Moderate volatility, with occasional demand or cost changes **Medium-High** (4): Highly volatile market with frequent cost/demand shifts **High** (5): Extremely unstable market, with significant uncertainty in pricing and demand
Relational Trust	Contract Documentation Expert Insights ERP System	**Low** (1): Less than 1 year **Medium-Low** (2): Between 1 and 3 years **Medium** (3): Between 3 and 5 years **Medium-High** (4): Between 5 and 10 years **High** (5): More than 10 years
Resource Availability	Expert Insights	**Low** (1): Insufficient resources to meet project requirements **Medium-Low** (2): Limited resources with occasional shortages **Medium** (3): Adequate resources but with some constraints **Medium-High** (4): Sufficient resources for most needs **High** (5): Fully sufficient resources readily available for all needs
Organizational Strategy	Expert Insights	**Low** (1): No alignment with strategic goals **Medium-Low** (2): Minimal alignment with strategic priorities **Medium** (3): Partial alignment, supporting some strategic objectives **Medium-High** (4): Strong alignment with strategic goals in most areas **High** (5): Full alignment with long-term strategic priorities
Profitability	ERP system	Actual profit used as input fsQCA software used for calibration.
Contract Type	Contract Documentation	**0** if no fixed price element in the contract **1** if there is a fixed price element in the contract

Table 1: Attributes with Score Criteria's

3.6 Data Calibration

In fsQCA, data calibration is the process of transforming raw data into membership scores for each attribute. To conduct this analysis, specialized fsQCA software developed by Charles Ragin is used. This software provides a structured approach for applying set-theoretic methods, allowing researchers to analyze how different conditions interact to produce specific contract outcomes. The software enables researchers to define membership functions, apply truth table analysis, and identify causal configurations that explain project success or failure (Ragin, 2008). By integrating both qualitative and quantitative data, fsQCA software enhances the accuracy of comparative analysis in complex decision-making environments. Table 1 provides an overview of the calibration scores, and descriptions used for each attribute in this research. These scales ensure that contract characteristics are consistently classified across different cases.

Attribute Thresholds

In fsQCA, threshold values are essential for defining membership scores that determine how cases (contracts) are categorized. The thresholds in Table 3 are designed based on theoretical justifications, expert input, and practical considerations of the contract attributes. These thresholds ensure that the analysis effectively captures the degree of presence or absence of each attribute in a structured and meaningful way.

Each attribute is assigned three key thresholds:

- Full Membership (0.95): A case is considered fully in the set (i.e., the contract strongly exhibits the attribute).
- Crossover Point (0.50): The point of maximum ambiguity, where a case is neither fully in nor fully out of the set.
- Full Non-Membership (0.05): A case is considered fully out of the set (i.e., the contract does not exhibit the attribute significantly).

Attribute	Full Membership (0,95)	Crossover Point (0,50)	Full Non-Membership (0,05)
Project Complexity	4,000	3,000	1,000
Scope	0,950	0,500	0,050
Client Characteristics	4,000	2,000	1,000
Total Risk	0,600	0,100	0,005
Profit	0,180	0,060	0,000

Table 2: Attribute Thresholds

A Likert scale ranging from 1 to 5 was used to evaluate project complexity. A score of 1 reflects minimal complexity, such as a single simple task. Score of 4 represents high complexity, such as complex predictive maintenance performed across multiple installations. A score of 3 represents moderate complexity. Scope was calibrated based on its clarity and the inclusion of measurable KPIs with thresholds. High membership (0.950) was assigned to contracts with well-defined scopes and clearly specified KPIs. Minimal membership (0.050) was assigned to poorly defined scopes lacking measurable KPIs. Client characteristics was assessed using a Likert scale from 1 to 5, the scores are assigned based on the client maturity level, 1 reactive and 5 predictive. A score of 4 or higher indicates advanced operational maturity, characterized by real-time monitoring. A score of 3 represents moderate maturity, where past data informs preventive measures. A score of 1 reflects reactive approaches, focusing only on fixing issues as they occur. Total Risk calibration is a combination of market conditions, regulatory requirements, and relationship and trust. High risk was defined as 0.600 or higher, typically associated with volatile markets with stringent compliance requirements and low trust and relationship. Moderate risk was set at 0.100, and low risk at 0.005, indicating stable conditions and minimal regulatory requirements with a high and trustful client relationship. High profitability was defined as 0.180 or higher, moderate profitability at 0.060, and no profit at 0.000.

3.7 fsQCA Analysis Process

The fsQCA analysis identifies configurations of contract attributes that correlate with positive and negative contract outcomes, following the structured approach outlined by Ragin (2008). The model development undergoes multiple iterations to refine the attribute selection (see section 3.5), validate configurations, and ensure statistical robustness.

Truth Table Construction and Configuration Analysis

The truth table presents the results of the fsQCA analysis, showing key configurations of contract attributes that contribute to successful project outcomes. The rows represent the contract attributes analyzed, such as Project Complexity, Scope, Client Characteristics, and Total Risk, while the columns represent different successful configurations (1, 2, and 3), illustrating which attributes are present or absent in each pathway. Black circles (●) indicate the presence of an attribute in a configuration, whereas crossed-out circles (⊗) signify the absence of an attribute. Blank spaces indicate "don't care" conditions, meaning the attribute does not play a decisive role in that configuration. The size of the circles reflects the importance of the attribute in determining contract outcome. Below the truth table, consistency and coverage scores provide insights into the reliability and explanatory power of each pathway (Rihoux & Ragin, 2008).

Attribute Refinement and Testing

Each iteration of the truth table analysis provided insights into how different attribute combinations affected the results. Some attributes that appeared distinct in theory showed significant overlap in practice. Through multiple test runs and expert validation, the analysis revealed which attribute combinations most accurately represented the real-world dynamics of contract success. This process of testing and refinement continued until the model achieved both statistical validity and alignment with expert insights.

Pathway Identification and Sufficiency Testing

After constructing the truth table, Boolean minimization is applied to reduce complex configurations to their essential components by eliminating redundant conditions.

The minimized configurations are analyzed to identify pathways that are sufficient for achieving successful project outcomes. Each pathway represents a unique combination of attributes that, when present together, lead to project success. These pathways highlight multiple potential routes to success, demonstrating the principle of equifinality, which suggests that there can be different ways to achieve the same outcome. The pathways are inserted in the truth table with the circles explained above. The size of the circles in the truth table reflects the importance of each attribute in determining the success of the contract outcome. Larger circles indicate that the attribute is a core condition, meaning it plays a crucial role in leading to outcome. Smaller circles represent contributing conditions, which means the attribute is present and supports success, but is not essential on its own. In general, larger circles appear in parsimonious solutions, where only the most important conditions are included, while smaller circles may appear in intermediate or complex solutions, indicating a supporting role rather than a decisive factor for success (Ragin, 2008).

Consistency and Coverage Analysis

The fsQCA analysis results in three potential solutions: the Complex Solution, the Parsimonious Solution, and the Intermediate Solution. The Complex Solution includes all logical combinations, providing a detailed view of the pathways, while the Parsimonious Solution focuses on the simplest possible explanations by identifying only core conditions. The Intermediate Solution strikes a balance between theoretical soundness and simplicity. In this analysis, the Complex Solution and the Intermediate Solution are identical, meaning they identify the same pathways with identical raw coverage, unique coverage, and consistency metrics. The Parsimonious Solution is used in Chapter 4, with core contract attributes visually represented as larger circles in the truth tables. The size of the circles reflects the importance of the attribute in determining contract success. There are five main metrics in fsQCA analysis that explain their relevance and reliability, they are as follows:

- **Consistency**: Measures the reliability of a pathway in explaining the outcome. It evaluates how consistently cases with a given configuration lead to the outcome. A value closer to 1 indicates a strong relationship between the pathway and the outcome and a value of 0.75 or higher is acceptable.
- **Raw Coverage:** Indicates the proportion of the outcome explained by a specific pathway. It reflects how much of the observed cases the pathway accounts for, a value above 0.20 is considered meaningful.
- **Unique Coverage:** Shows the unique contribution of a pathway to explaining the outcome, excluding overlap with other pathways. It identifies the distinct importance of each configuration, a value above 0.05 is considered meaningful.
- **Solution Coverage:** Combines all pathways to show the total proportion of the outcome explained by the solution. A value above 0.50 or high is ideal.
- **Solution Consistency:** Indicates the overall reliability of the entire solution in predicting the outcome. Higher values show strong alignment between the solution and the observed data. Higher then 0.75 is ideal (Rihoux & Ragin, 2008).

3.8 Contract Type Recommendation Tool

The Contract Type Recommendation Tool is developed as an evolution of Model-3, refined and expanded into Model-4 through expert input and brainstorming sessions, this model is used to answer the second research question. While Model-3 provided foundational insights into contract success using fsQCA analysis, it lacked the ability to directly recommend contract types for future projects. This limitation aligns with challenges observed in previous studies, where fsQCA results, despite their analytical rigor, have been difficult to translate into practical decision-making frameworks. Studies by Korjani & Mendel (2012) highlight that while fsQCA is effective in identifying complex causal relationships, its application in real-world scenarios requires additional refinement to enhance practical usability. Similarly, Kardaras (2018) identifies difficulties in handling causal complexity and ensuring that fsQCA-derived configurations align with real-world decision-making needs. These findings underscore the importance of bridging the gap between analytical models and actionable business strategies (Korjani & Mendel, 2012; Kardaras, 2018).To bridge this gap, Model-4 enhances the framework by incorporating additional contract attributes, refining decision-making criteria, and ensuring that the recommendation tool is both retrospective and forward-looking (Ragin, 2008; Murdoch & Hughes, 2002).

Brainstorm Session

The initial version of the Contract Type Recommendation Tool was built on Model-3, which provided the foundational framework for selecting the appropriate contract type based on various attributes. However, after conducting several tests and applying the model to real-world contract scenarios, we discovered that Model-3 was not specific enough to consistently recommend the correct contract type. The models' general structure lacked the precision needed to handle the complexities of contract selection effectively.

To improve the model, brainstorming sessions were with stakeholders in the contract selection were held. Stakeholders of whom brought valuable insights based on their extensive experience in contract management. During these sessions, we reviewed the performance of Model-3 and identified key areas where it didn't match practical examples. Detailed discussions revealed that the model's general criteria were not sufficiently tailored to the nuances of different new contract types, which resulted in inaccurate recommendations in some cases. The focus shifted to refining the model by adding more specific criteria, breaking down broad categories into more detailed attributes that could more accurately reflect the conditions under which certain contract types should be selected. This process of collaborative refinement allowed Model-3 to evolve into Model-4, incorporating more precise rules and conditions derived from the collective expertise.

New Contract Type

An important adjustment in Model-4 is the introduction of a new contract type, performance-based contracts, which was not used in past projects but has been added to the recommendation tool to align with industry trends and evolving business strategies. This expansion required adjustments to the model, ensuring that contract selection reflects not only historical success patterns but also new strategic opportunities.

The contract types included in the recommendation tool are:

- Fixed-price / Unit Rate: These contract types are used interchangeably in Chapter 5, as both involve predefined costs per unit of work, ensuring budget predictability.
- Cost-Plus: Contracts where the contractor is reimbursed for costs plus a margin, offering flexibility in uncertain project conditions.
- Performance-Based: A newly introduced contract type that links payments to the achievement of specific performance targets, incentivizing efficiency and long-term value creation.

New Attributes

Model-4 introduces Risk-Taking Willingness and Improvement Potential as additional attributes to enhance contract selection accuracy. These variables refine the model's predictive capability by ensuring that contract recommendations align with IJssels' strategic approach and the nature of the project.

Risk-Taking Willingness was introduced to replace Internal Alignment, which was removed in Model-2 due to a lack of variability across contracts. However, aligning contracts with IJssels' broader strategy remains critical, as different projects require different levels of risk acceptance. By integrating this variable, Model-4 ensures that contract recommendations account for IJssels' financial and operational risk appetite, ensuring alignment with both project characteristics and strategic objectives.

This attribute ranges from low to high (1 to 100) where 100 reflects that IJssel is willing to take high risk.

Improvement Potential was introduced to support the feasibility of Performance-Based Contracts. Performance-based contracting relies on measurable performance improvements over the contract's duration. Without a realistic potential for improvement, such contracts may not be beneficial. This attribute ensures that performance-driven contracts are only recommended when there is a tangible opportunity for efficiency gains, preventing misalignment between contract type and project feasibility. This attribute ranges from low to high (1 to 100) where 100 reflects that there is a very high improvement potential for IJssel to capture.

By incorporating these additional attributes, Model-4 addresses limitations in Model-3 and ensures that contract selection considers both strategic risk acceptance and performance-based feasibility, resulting in better-aligned contract recommendations for IJssel.

Development Recommendation Tool

Before negotiations begin, project-specific details such as complexity, total risk, client maturity, improvement potential, and risk-taking willingness are entered into the model. The system evaluates these attributes against successful configurations identified through fsQCA analysis, supplemented by insights from literature and practical experience within IJssel. By systematically analyzing the interactions between these attributes, the model determines the most relevant attribute combinations and their impact on project outcomes.

To ensure accurate and practically applicable contract recommendations, the development of the model followed an iterative process. Multiple brainstorming sessions were conducted with key stakeholders, including contract managers, project leads, and financial analysts, to identify real-world contract challenges and decision-making factors. These sessions provided insights into how IJssel currently navigates contract selection, revealing essential practical considerations beyond what is found in literature.

The initial model underwent several refinement cycles, incorporating stakeholder feedback and aligning with IJssels' contract structures and strategic priorities. Iterations focused on fine-tuning attribute thresholds, adjusting scoring mechanisms, and ensuring that fsQCA-derived insights remained applicable to real-world contract negotiations. By integrating historical contract data with expert insights, the model captures both empirical trends and industry-specific nuances, leading to contract recommendations that are both data-driven and contextually relevant.

The system ultimately generates a recommendation for the most suitable contract type—Fixed-Price/Unit Rate, Cost-Plus, or Performance-Based Contracts—while providing a rationale that explains how the specific attribute configuration aligns with the recommended contract type. This ensures transparency and clarity in the decision-making process, allowing IJssel to select contracts that optimize profitability, risk mitigation, and client alignment.

By combining quantitative analysis (fsQCA) with qualitative expertise (stakeholder input and practical experience), the model provides a structured, context-aware decision-support tool that improves contract selection and enhances project success (Ragin, 2008; Hofman, Faems, & Schleimer, 2017)..

The tool operates through the following key mechanisms:

- **Attribute Input:** all the attributes in model-4
- **Configuration Matching:** The tool compares the input attributes against the successful configurations identified in the fsQCA analysis, literature and experts insights.
- **Contract Recommendation:** Based on the thresholds matching configuration and contextual data, the model suggests the most suitable contract type, such as fixed-price / unit rate, cost-plus, or performance-based contracts.

3.9 Reliability

The study ensures reliability through a systematic and repeatable approach to data calibration. fsQCA software is used to minimize subjective bias in configuration analysis, while Likert scales with predefined thresholds ensure structured and consistent attribute assessments. Expert insights are gathered through semi-structured interviews, brainstorming sessions, and validation checks, ensuring that contract attribute evaluations align with real-world decision-making processes. This structured approach maintains consistency in qualitative input from stakeholders. Additionally, data from the ERP system is used to assess profitability in contract outcomes, providing an objective financial basis for analysis. By integrating expert feedback, structured calibration, and data-driven validation, the study enhances the reliability and robustness of its findings.

3.10 Validation

The fsQCA analysis was validated through several steps to ensure reliability and robustness. First, the model was calibrated based on expert insights and validated against historical project outcomes. Sensitivity analyses were performed to test the stability of the identified pathways by varying calibration thresholds and assessing the impact on results. Cross-validation was conducted through discussions with contract managers, ensuring that the identified successful pathways align with industry expertise and real-world project performance

The contract recommendation tool was developed through an iterative process involving multiple brainstorming sessions with contract experts, refining the model based on feedback, and aligning it with IJssels' contract selection practices. Each iteration incorporated real-world contract data, ensuring that the tool effectively reflects successful contract configurations identified through fsQCA. To validate the tool, test cases were conducted using historical project data, comparing its recommendations with actual contract outcomes. Discrepancies were analyzed and adjustments were made to improve accuracy. Additionally, expert validation sessions were held to ensure that the recommendations align with practical decision-making within IJssel.

3.10 Ethical Considerations

Ethical considerations in this research include maintaining data confidentiality and obtaining informed consent from stakeholders. Client and project data are anonymized to protect sensitive information about contract terms and project specifics, ensuring that confidentiality is upheld and data privacy standards are met throughout the research process.

To further protect confidentiality, financial information is removed from the research to prevent any disclosure of sensitive financial details related to contract performance or profitability. This decision ensures that data security and corporate privacy are maintained while still allowing for a meaningful analysis of contract attributes and selection criteria.

Stakeholders participating in interviews provide informed consent, with participation being voluntary. Confidentiality is assured to encourage honest and open responses, and participants are informed about the purpose of the research and their role in it, ensuring they are comfortable and willing to share their insights.

3.11 Planning Research

The planning of the research can be found in Appendix B.

4. Combination of Attributes Contributing to Project Outcome

This chapter presents the data collected for conducting the fsQCA test and its results. This chapter covers the evolution to Model-2 and Model-3 defined in chapter3. This chapter answers the following research question in the conclusion of this chapter: "*What combinations of contract attributes contribute to successful contract outcome in asset management?*"

This chapter first takes model-2 into consideration. A database is established containing all relevant information about the contracts and their attributes. It show the current contract types within IJssel and their performance which leads to model-3. The fsQCA software generated output (Appendix E) is put in a truth table, providing essential insights into the interrelations between the contract attributes. Finally, the results of the identified pathways are presented and discussed, highlighting the combinations of attributes that contribute to both positive and negative contract outcomes.

4.1 Contracts within IJssel

In the historical data of IJssel, three different contract types are identified. These contract often include provisions for price adjustments due to factors such as inflation or labor cost increases.

Cost-Plus and fixed price contract (Hybrid)

These type of contracts combine elements of fixed prices and cost-reimbursement. Most of the contract have a fixed price element for the not complex preventive maintenance and a reimbursement element for corrective maintenance and additional work. This reimbursement work is based on a fixed price per hour and has surcharges for overtime. This type of contract are beneficial when certain services are predicable while orders require flexibility to adjust based on the actual need of the client.

Cost-Plus

This type of contract is fully reimbursed based on actual cost incurred. It is used in contracts with uncertain scope, high complexity, or high risk. This type of contract provide flexibility to the client so no upfront agreement about minimal order quantity is required. In these contract there is minimal financial risk for IJssel as the costs are fully reimbursed.

Fixed price

This type of contract is based on a fixed price, mostly used for predictable services or the temporary assignment of a employee for the client per moment. These contract have a well-defined scope and do not have very high project complexity. These contracts are also used for smaller-scale projects, where the scope and required resources can be accurately estimated upfront, such as periodic lubrication services. An advantage is that as employees perform straightforward predictive maintenance services, their skills and efficiency improve over time, leading to increased cost efficiency. The risk for unforeseen circumstances leading to budget overruns are for IJssel.

4.2 FsQCA results Model-2

As outlined in Section 3.5, Model-2 is an optimized version of the initial contract attribute framework, refined based on expert insights and contract document analysis. Unlike Model-1, which was developed purely from literature, Model-2 focuses on four key attributes: Project Complexity, Scope, Client Characteristics, and Total Risk. Model-2 is shown in Figure 3.

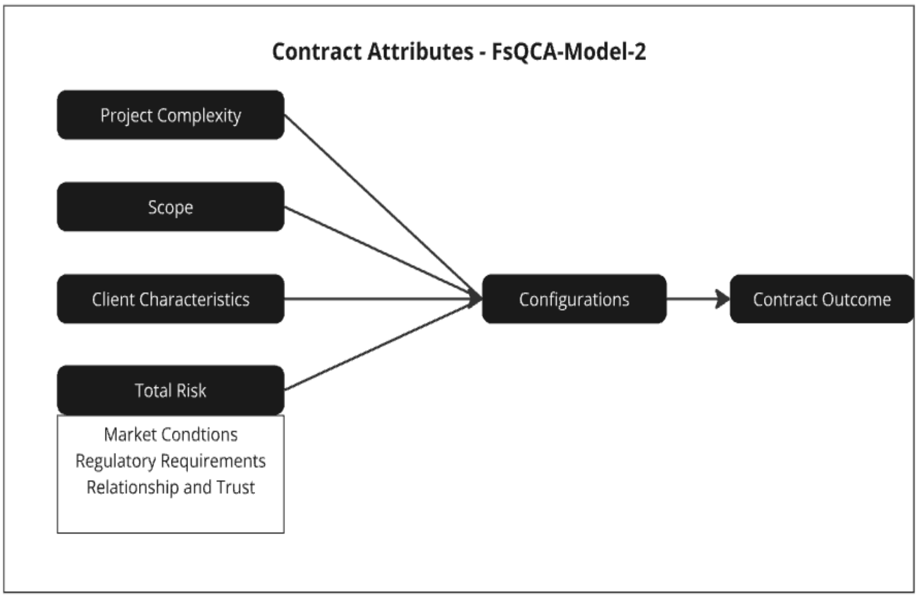


Figure 3: Model-2 fsQCA Analysis

The fsQCA analysis using Model-2 identified both positive and negative pathways that influence contract outcome. The results highlight which combinations of contract attributes lead to successful project outcomes and which conditions contribute to negative profitability.

Positive Pathways

The analysis identifies three pathways, see Table 3, leading to positive project outcomes, each highlighting the role of specific attributes:

1. **Expert-Driven Success in Complex Projects**
   The first pathway shows that for complex projects, having a well-defined scope and a mature client contributes to positive project outcomes. Due to the complexity of the project, IJssel can effectively leverage its expertise. Combined with advanced systems from the client, this often leads to a successful outcome. In this configuration, the level of risk is not a determining factor, as risks can be well mitigated with a mature client and a clear scope. The consistency score for this pathway is 0.8212, with a raw coverage of 0.3853 and a unique coverage of 0.0467, indicating that this configuration explains a significant portion of successful project outcomes but overlaps with other pathways.
2. **High-Risk Well Managed**
   The second pathway demonstrates that when the level of risk is high, a well-defined scope must also be present, along with a mature client. In this case, the complexity of the project does not matter. This is because even a non-complex project can carry risks, but with a well-defined scope and an advanced level of client maturity, this often leads to positive project results. Because of the higher risk, IJssel has the opportunity to demonstrate its expertise and deliver value through risk management and project execution. The consistency score for this pathway is 0.8521, with a raw coverage of 0.3775 and a unique coverage of 0.0581, showing a strong relationship between these attributes and successful project outcomes.
3. **Clarity in Simple Projects**
   The third pathway emphasizes that for non-complex projects, a well-defined scope remains essential, even when working with a less mature client and a low level of risk. This often

contributes to a positive outcome. A well-defined scope provides structure and clarity, enabling even simple projects with limited risks and a less experienced client to be effectively managed with a positive project outcome. The consistency score for this pathway is 0.9674, with a raw coverage of 0.4146 and a unique coverage of 0.2407, indicating that this configuration strongly explains successful contract outcomes and has a high degree of independent explanatory power.

Overall Solution Consistency: 0.8751 - This measures how reliably the identified pathways lead to successful contract outcomes. A value close to 1 indicates a strong predictive power, meaning that the combined pathways are highly consistent in explaining successful projects.

Overall Solution Coverage: 0.6920 – This indicates that the three identified pathways together explain 69.20% of all successful contracts. While this does not capture all successful contracts, it means that the majority of positive outcomes can be attributed to these configurations.

Succesfull Configuration	1	2	3
Project Complexity	●		⊗
Scope	⬤	⬤	⬤
Client Characteristics	●	●	⊗
Total Risk		●	⊗
Consistency	0,8212	0,8521	0,9674
Raw Coverage	0,3853	0,3775	0,4146
Unique Coverage	0,0467	0,0581	0,2407
Overall Solution Consistency		*0,8751*	
Overall Solution Coverage		*0,6920*	

Note: Black Circles (●) indicate the presence of an attribute and circles with an (⊗) indicate the absence of an attribute.
The size of the circle represents the imporatance of the attribute.
Blank spaces are "don't care" conditions

Table 3: Truth Table Positive Pathways

Scope consistently appears as a core condition in all configurations, indicating its important role in achieving project outcomes. A well-defined scope with KPI's clarifies responsibilities, deliverables, and expectations helping to reduce ambiguities. Client characteristics and project complexity appear as peripheral conditions in some pathways. While not essential in every scenario, these attributes can improve outcomes in complex or higher-risk projects.

The findings suggest that simpler projects can achieve success primarily through a clear and well-defined scope. In these cases, the absence of complexity or risk reduces the need for advanced client maturity. A clearly outlined scope provides the structure and clarity necessary for all stakeholders to align on deliverables and timelines, allowing the project to progress according to contract with positive outcome.

More complex or high-risk projects require additional factors to achieve successful outcomes. Mature clients play a role in these scenarios, as they bring advanced systems, processes, and the capacity to collaborate effectively with IJssels' expertise. High-complexity projects work best with mature clients. High-risk projects are an opportunity for IJssel to demonstrate its value by addressing challenges through risk management, whether this is on market conditions regulatory rules.

Equifinality

- **Scope as a core Success Factor:** Across all pathways, a well-defined scope appears as a critical factor, reinforcing its importance in project success.
- **Different Routes to Success:** Pathway 1 shows that high-complexity projects need mature clients and a structured approach. Pathway 2 suggests that high-risk projects can still succeed with a well-defined scope and experienced clients, regardless of complexity. Pathway 3 reveals that even simple projects can achieve success with a clearly outlined scope, even if the client lacks maturity.
- **Risk Management Considerations:** High-risk projects (Pathway 2) demand strong client expertise and well-defined contract scopes, whereas low-risk projects (Pathways 1 & 3) allow for more flexibility.

Negative Pathway

The fsQCA analysis identified one pathway associated with negative profitability. This pathway highlights the conditions under which contract outcomes are negatively influenced. The details of the pathway are shown in the Table 4.

The identified negative pathway reveals that high Project Complexity combined with high Total Risk and an undefined Scope, consistently leads to negative profitability.

Undefined scope is a critical factor, as it creates ambiguity and misaligned expectations with already complex projects. High complexity demands for clear deliverables and KPI's this in combination with a high risk increase the likelihood of inefficiencies and poor contract outcomes.

Succesfull Configuration	1
Project Complexity	●
Scope	⊗
Client Characteristics	
Total Risk	●
Consistency	1,0000
Raw Coverage	0,9097
Unique Coverage	0,1520
Overall Solution Consistency	*1,0000*
Overall Solution Coverage	*0,9097*

Note: Black Circles (●) indicate the presence of an attribute and circles with an (⊗) indicate the absence of an attribute.
The size of the circle represents the imporatance of the attribute.
Blank spaces are "don't care" conditions

Table 4: Truth Table Negative Pathways

4.3 FsQCA results Model-3

In the previous section, the analysis focused solely on how the attributes relate to the contract outcome, resulting in the identification of three positive pathways and one negative pathway. However, this analysis did not take into account the type of contract underlying the contract outcome. To address this, a binary attribute was added to indicate whether a contract includes a fixed-price element (1) or not (0). With this additional attribute, the relationship between the previously identified pathways and the contract type can be examined. The underlying database for this analysis remains unchanged. The new model is illustrated in Figure 4.

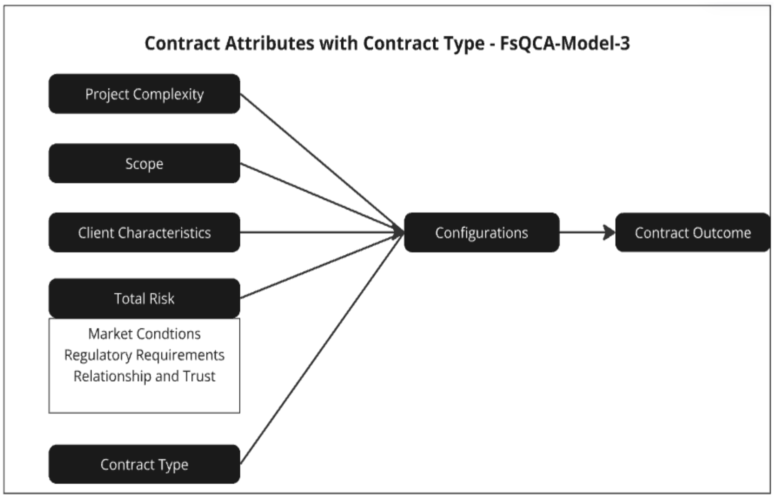


Figure 4: Model 3 - Contract Attributes with Contract Type

Positive Pathways

The analysis identifies three pathways leading to positive project outcomes (Table 5), each highlighting the role of specific attributes:

1. **Hybrid Contract Success in Complex Projects**
   For complex projects, a fixed-price element can still contribute to positive outcomes, provided that the scope is clearly defined and the overall risk is low. In IJssels' case, such projects often feature a hybrid contract structure, where fixed-price elements cover simple, recurring tasks, while cost-plus components handle the more complex and unforeseeable aspects. This hybrid approach balances predictability for routine tasks and flexibility for challenging ones. However, this result may appear slightly skewed due to the definition of a "fixed-price element," as these contracts typically involve both cost-plus and fixed-price components in complex projects. The consistency score for this pathway is 0.9219, with a raw coverage of 0.1031 and a unique coverage of 0.0227, indicating that while this pathway is highly reliable, it has some overlap with other configurations.
2. **High-Risk Well Managed with Cost-Plus Contracts**
   Projects with high risk and mature clients benefit from the absence of a fixed-price element. Cost-plus contracts prove valuable in these situations, allowing for flexibility to manage uncertainties and unforeseen changes. Fixed-price elements in such scenarios could become a liability, as they limit adaptability in high-risk environments. The consistency score for this pathway is 0.7978, with a raw coverage of 0.2586 and a unique coverage of 0.1245, suggesting that this configuration accounts for a significant portion of successful high-risk projects but also overlaps with other successful pathways.
3. **Clarity in Simple Projects with Fixed Price**
   Non-complex projects with a well-defined scope and reactive clients can lead to positive outcomes with a fixed-price element. In this context, the simplicity of the project and the clarity of the scope align well with the predictability of fixed-price contracts. For example, lubrication services are well-suited to this contract type. The consistency score for this pathway is 0.9724, with a raw coverage of 0.2765 and a unique coverage of 0.2080, indicating that this pathway is highly predictive of success and has strong independent explanatory power.

Overall Solution Consistency: 0.8920 – This indicates a high degree of reliability in explaining successful contract outcomes. A value close to 1.0 suggests strong predictive power, meaning that the identified pathways are consistently associated with positive project results.

Overall Solution Coverage: 0.6134 – This means that 61.34% of all successful contracts can be explained through these three identified pathways. While it does not capture all possible successful cases, it shows that the majority

Succesfull Configuration	1	2	3
Project Complexity	●		⊗
Scope	●	●	●
Client Characteristics	●	●	⊗
Total Risk	⊗	●	⊗
Fixed Price Element	●	⊗	●
Consistency	0,9219	0,7978	0,9724
Raw Coverage	0,1031	0,2586	0,2765
Unique Coverage	0,0227	0,1245	0,2080
Overall Solution Consistency		0,8920	
Overall Solution Coverage		0,6134	

Note: Black Circles (●) indicate the presence of an attribute and circles with an (⊗) indicate the absence of an attribute.
The size of the circle represents the imporatance of the attribute.
Blank spaces are "don't care" conditions

Table 5: Truth Table Positive Pathways with Contract Type

of positive contract outcomes fall within these configurations.

A well-defined scope is present across all pathways, underscoring its role in project outcome. Clear responsibilities and deliverables minimize ambiguities. Whether the project is complex or simple, a well-defined scope acts as the foundation for aligning expectations and driving results. While an undefined scope might occasionally result in favorable outcomes for IJssel, this approach introduces significant risks and unpredictability to project execution. As a professional service organization, IJssel should prioritize clearly defined scopes that enable proper planning, risk management, and the consistent delivery of value to clients. A well-defined scope ensures alignment, transparency, and efficiency, reinforcing trust and long-term client relationships.

Fixed-price contracts are effective in predictable environments, such as non-complex or low-risk projects. These contracts provide clarity and cost control, making them suitable for simple, well-defined tasks. However, in high-complexity projects, fixed-price contracts only succeed when paired with cost-plus elements, resulting in a hybrid contract structure. Even in these cases, the fixed-price portion is always limited to the non-complex aspects of the service, ensuring stability in predictable components while allowing flexibility in areas with higher uncertainty.

Additionally, high-complexity hybrid contracts require mature clients with advanced systems, robust processes, and the ability to engage effectively with IJssels' expertise. This enables the structured management of complex projects while maintaining financial and operational control. Therefore, fixed-price contracts—whether standalone or as part of a hybrid model—remain applicable only in stable and predictable environments, where scope and risks are clearly defined.

Equifinality Analysis

- **Different Contract Types Lead to Success**: Pathway 1 and Pathway 3 show that fixed-price elements contribute to success in stable, well-defined projects, whereas Pathway 2 highlights that cost-plus contracts are more effective when risks are high.
- **Scope is a Critical Factor Across All Pathways**: A well-defined scope appears in all successful pathways, underscoring its role in contract success.
- **Client Maturity and Risk Influence Contract Selection**: Complex projects require mature clients (Pathway 1 & 2), whereas simple projects can succeed even with less experienced clients (Pathway 3). High-risk projects (Pathway 2) necessitate cost-plus structures, whereas stable projects (Pathways 1 & 3) benefit from fixed-price components.
- **Multiple Routes to the Same Outcome**: The presence of different pathways confirms equifinality, showing that IJssel can achieve successful project outcomes through varying combinations of attributes depending on the project complexity, client characteristics, and risk level.

Negative Pathways

The negative pathway remains unchanged in Model-3 compared to Model-2 because the newly introduced Fixed Price Element attribute is a "don't care" condition in this context. This means that the presence or absence of a fixed-price element does not systematically influence negative project outcomes.

The underlying database consists of four negative project outcomes, with two contracts including a fixed-price element and two contracts without. This balanced distribution suggests that contract failures are primarily driven by other factors—high project complexity, high total risk, and an undefined scope, rather than the specific contract pricing structure.

As a result, the conditions leading to negative profitability remain the same across both models. The key insight is that contract failures are not necessarily linked to whether a contract includes a fixed-price element but rather to the lack of scope definition and high-risk exposure, which amplify project uncertainties and inefficiencies.

4.4 Conclusion

This chapter answers the research question: "What combinations of contract attributes contribute to successful contract outcomes?" Through fsQCA analysis, the study identified key attribute combinations that consistently lead to positive contract results while also revealing conditions that contribute to negative outcomes.

Expert-Driven Success in Complex Projects (Model-2 and Model-3) shows that complex projects succeed when combined with a well-defined scope and mature client characteristics. These projects enable IJssel to leverage its expertise, and risks are mitigated with clear scope and strong client capabilities. Model-3 confirms that hybrid contracts, mixing fixed-price and cost-plus elements, are commonly used to balance predictability and flexibility in complex settings.

High-Risk Well Managed (Model-2 and Model-3) highlights that high-risk projects can be successful when supported by a well-defined scope and a mature client, regardless of project complexity. Even non-complex projects may involve significant risks, but structured contracts and experienced clients ensure effective risk mitigation. Model-3 indicates that cost-plus contracts are most effective for these projects, offering the flexibility needed to manage uncertainties.

Clarity in Simple Projects (Model-2 and Model-3) emphasizes that non-complex projects with less mature clients achieve positive outcomes when the scope is well-defined, and risk levels are low. Clear project structure ensures smooth execution, even for less experienced clients. Model-3 confirms that fixed-price contracts are commonly used here, offering budget predictability and stability.

Across all pathways, a well-defined scope is the most critical success factor. Clearly outlining project boundaries, deliverables, and KPIs ensures contract effectiveness and minimizes uncertainty. While an undefined scope can occasionally yield short-term profit gains, it introduces significant risks and unpredictability. To ensure long-term stability and strong client relationships, IJssel should prioritize clear scope definition.

Model-3 confirms that Cost-Plus contracts are most suitable for high-risk or complex projects, as they offer the flexibility required for managing uncertainty. Fixed-price contracts work best for non-complex projects with well-defined scopes, providing budget predictability. Hybrid contracts combining fixed-price and cost-plus elements are beneficial in complex projects, provided that the scope is clearly defined and risk remains manageable.

The study identified one key negative pathway: high project complexity and high total risk, combined with an undefined scope, consistently lead to negative profitability. The presence or absence of a fixed-price element does not influence negative outcomes, as both contract types failed under poorly defined scope conditions. This reinforces that scope definition is the most critical factor in preventing contract failures, particularly in high-risk, high-complexity projects.

5. Recommendation Model Contract Selection

This chapter builds upon the model developed through the fsQCA analysis in the previous chapter, using the results as input for a deeper exploration of contract selection. The fsQCA analysis revealed which combinations of attributes lead to positive outcomes with Fixed-Price elements and Cost-Plus contracts based on historical data. However it does not provide a prescriptive framework for future contract decisions. Literature and expert insights suggest that alternative contract structures may present valuable opportunities for improving contract outcomes and aligning incentives more effectively (Selviaridis & Wynstra, 2015). To address this, a refined model is introduced that integrates the empirical insights from the fsQCA analysis with findings from literature and expert perspectives from the industry. The chapter addresses the second research question: *"How can the most suitable contract type be selected based on project context to maximize profitability?"*

The chapter begins by examining why IJssel needs to consider alternative contract types beyond those traditionally used. Afterwards the refined model is presented that introduces new attributes to strengthen the contract type selection process, because the fsQCA analysis focused on identifying successful attribute combinations rather than guiding contract type decisions. The chapter then explains the practical recommendation tool developed from this model, detailing its function and how IJssel can utilize it for future contract selection. The tool focuses on three distinct contract types: Fixed Price / unit rate price, Cost-Plus, and Performance-Based contracts. Unit rate price is now used with fixed price since in the future IJssel can use this interchangeable. These contract types are closely aligned and the unit rate prices can be used when quantity increases, as described in Chapter 3.

Through this systematic approach, the chapter aims to translate the theoretical insights from the fsQCA analysis into practical guidelines for contract selection, enabling IJssel to make more informed decisions that align with specific project contexts and maximize profitability.

5.1 Shifting Incentives Opportunity

As the relationship between IJssel and its clients develops, and as clients progress in their maturity levels, a shift in the incentive structure naturally emerges. In the early stages of a client maturity, a Cost-Plus contract is often used, where IJssel is paid based on the hours worked. This approach is suitable when the client relationship is new and the clients maturity is reactive, and maintenance activities are limited to small, manageable tasks, such as corrective maintenance.

A Cost-Plus contract can make sense initially, as IJssel is still building knowledge and expertise about the client's installations. However, as the client matures and transitions to more structured and proactive maintenance strategies, IJssel gains experience and improves efficiency in its maintenance processes, potentially reducing required maintenance hours. According to a McKinsey (2018) study on industrial maintenance, companies implementing data-driven and predictive maintenance strategies have achieved maintenance cost reductions of 25-40%, alongside improvements in operational reliability. While the client benefits from these efficiency gains through, for example, reduced downtime costs, IJssel paradoxically faces declining revenue since its compensation remains tied to hours worked, despite delivering greater value through improved efficiency.

At this stage, it becomes essential to enhance the contract structure by adding Performance-Based elements while maintaining the Cost-Plus foundation. This approach is recommended because it ensures IJssels' basic costs are always covered through the Cost-Plus component, while the

Performance-Based elements provide additional profit opportunities. As shown in Figure 5, this structure allows IJssel to generate immediate profit from performance improvements (orange line) while maintaining stable cost coverage through the base Cost-Plus contract (blue line). The graph demonstrates how this combined approach leads to increased total turnover for IJssel (green dash-dot line) while simultaneously reducing the client's total costs (gray dash-dot line) through improved operational efficiency.

For clients, shifting towards a Performance-Based contract creates a win-win situation by aligning IJssels' incentives with their operational goals (Selviaridis & Wynstra, 2015). Instead of solely paying for time spent on maintenance, clients incentivize IJssel to actively minimize downtime and optimize equipment efficiency. By tying compensation to measurable outcomes such as uptime and reliability, clients ensure that IJssels' priorities match their own business objectives. This reduces unplanned stoppages, enhances asset utilization, and ultimately leads to lower total costs for the client.

These enhanced contracts align with both the clients' advanced maturity and IJssels' expertise by focusing on measurable outcomes that create additional value. The performance-based components provide bonus opportunities for achievements in for example:

- Increasing machine availability.
- Improving Overall Equipment Effectiveness (OEE).
- Reducing unplanned downtime.
- Lowering maintenance costs.

To facilitate this strategic evolution in contract types, a selection model has been developed that guides IJssel through the decision-making process of choosing the most appropriate contract type based on specific client and project contexts. This model, detailed in the following sections, incorporates both the historical insights from the fsQCA analysis and forward-looking considerations to ensure successful contract transitions.

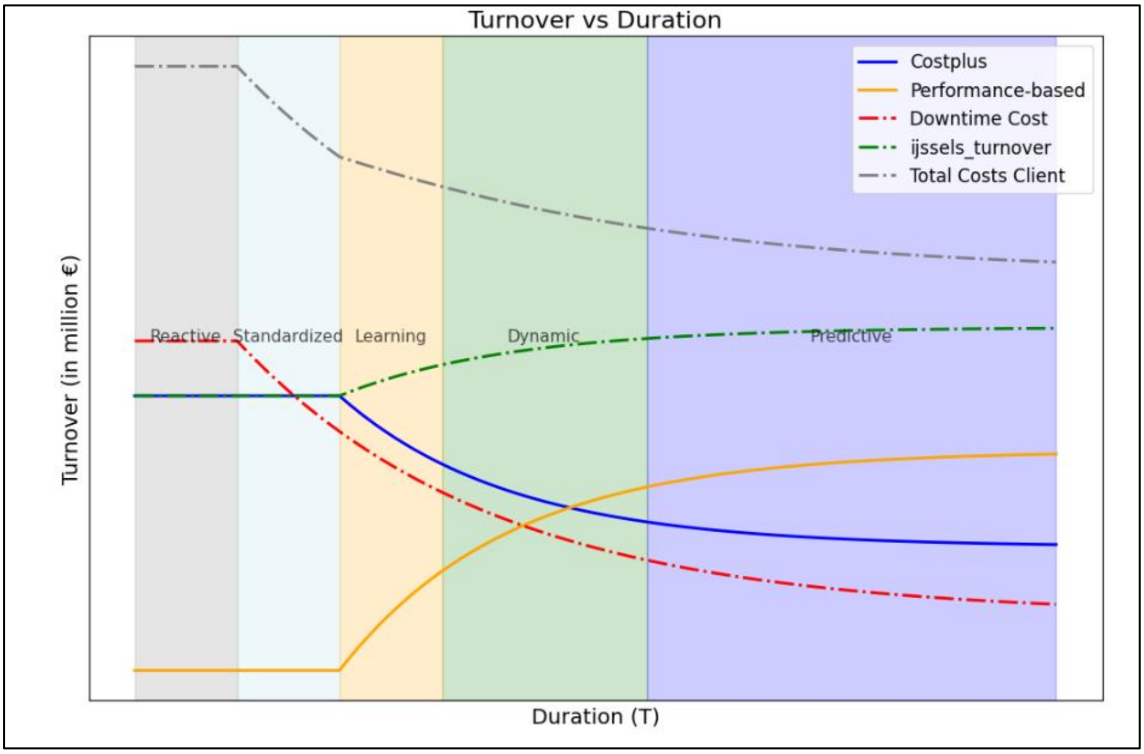


Figure 5: Incentive Shift Contract Type

5.2 Key Attributes for Contract Selection

The previous model defined crucial contract attributes based on historical data analysis. However, these attributes require adaptation because a new contract type (Performance-Based) is introduced to the selection model. While the fsQCA analysis results serve as input for the recommendation models' underlying logic, this refined model introduces five key attributes that are explained below, see figure 6.

Model-4 introduces Risk-Taking Willingness and Improvement Potential as new variables to enhance contract selection. Risk-Taking Willingness is an input variable that reflects the extent to which IJssel is willing to assume financial or operational risks for a given project.

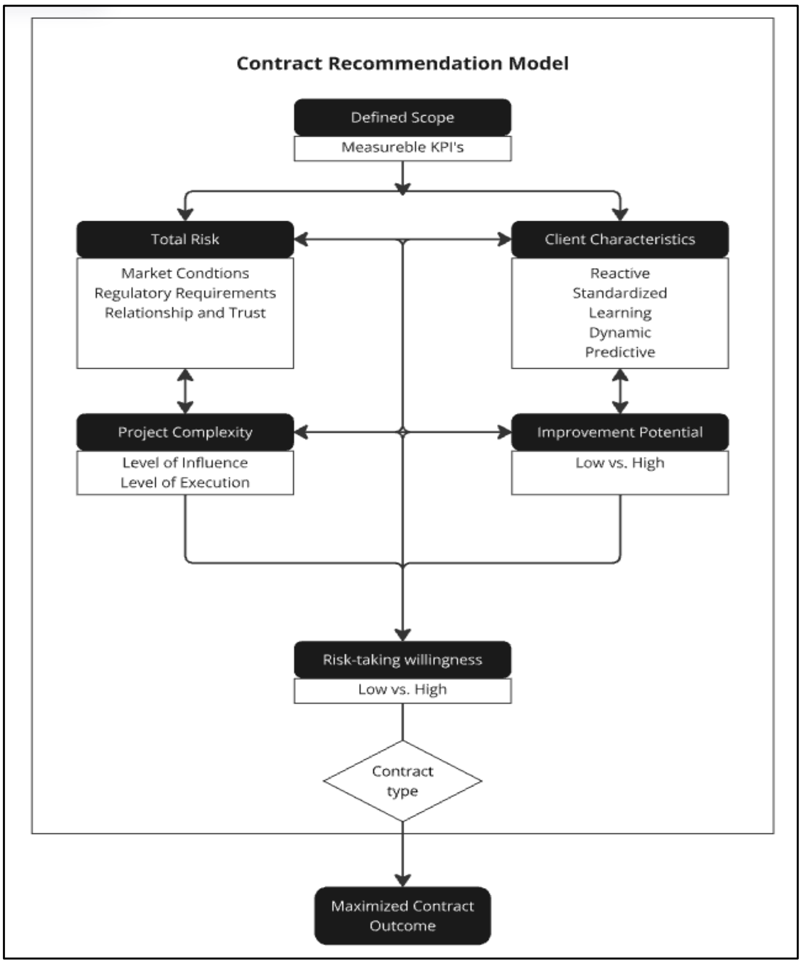


Figure 6: Model 4 - Contract Recommendation

Improvement Potential is introduced to align with Performance-Based Contracts, ensuring that the model accounts for the feasibility and motivation for performance enhancement over the contracts duration. This addition allows the model to better distinguish projects where outcome-based incentives could drive efficiency.

Notably, the fsQCA analysis demonstrated that a well-defined scope is crucial for positive project outcomes. Therefore, this model establishes a fundamental prerequisite: all contracts must have a clearly defined scope with appropriate, measurable KPIs. This requirement eliminates reliance on chance and ensures that contract success is driven by structured and measurable parameters rather than luck and unpredictability.

Total Risk

This attribute represents a composite score based on the client's specific operating context, this attribute did not change compared to Model-3. The score is determined by evaluating external conditions including the market sector in which the client operates (e.g., food industry, chemical sector), current market conditions, and the applicable rules and regulations specific to that sector. For instance, clients operating in highly regulated industries like food or pharmaceuticals inherently face higher risk profiles due to strict compliance requirements and safety standards. Similarly, clients in volatile markets or those subject to intense price fluctuations may present higher risk scores.

The risk profile directly influences contract type selection. In high-risk environments, Cost-Plus contracts often provide the flexibility needed to handle regulatory changes and market volatility. For medium-risk scenarios, a hybrid approach combining Fixed-Price / unit rate price elements for stable operations with Cost-Plus components for variable work may be appropriate. In low-risk environments with stable regulations and market conditions, Fixed-Price / unit rate price or Performance-Based contracts become more suitable options as outcomes are more predictable and measurable.

Client Characteristics

This attribute assesses the client's operational sophistication and maintenance approach, ranging from reactive to predictive maintenance strategies. Based on the fsQCA analysis, client maturity has proven to be a crucial factor in contract success, particularly for complex and high-risk projects. Prior to contract selection, IJssel must conduct a client assessment to establish the clients' current maturity level by evaluating their maintenance practices, data collection capabilities, and operational processes. For example, clients operating with advanced monitoring systems and structured maintenance programs demonstrate higher maturity levels, while those primarily responding to breakdowns exhibit lower maturity levels. The maturity assessment evaluates (International Organization for Standardization, 2024):

- Current maintenance strategy (reactive, standardized, learning, dynamic, or predictive)
- Data collection and analysis capabilities
- Implementation of FMECA (Failure Mode, Effects, and Criticality Analysis)
- Use of monitoring systems and technologies
- Level of process standardization

As shown in Figure 6, in the reactive phase, Cost-Plus contracts are used while downtime costs are high. As clients progress through standardized and learning phases, the base Cost-Plus structure remains essential for covering basic operational costs. However, relying solely on hours worked becomes less effective starting in the learning phase. As clients progress to the learning phase, IJssel gains deeper knowledge of the client's installations and processes. Through this experience, IJssel develops more efficient maintenance strategies and improves its operational methods. As a result, the same maintenance tasks require fewer hours to complete. While this improved efficiency benefits the client through better performance, it paradoxically reduces IJssels' revenue under a pure hours-worked model.

For mature clients operating in low to medium-risk environments with well-defined scopes, adding Performance-Based elements becomes particularly effective. These elements are added on top of the existing Cost-Plus foundation. This combination enables both reduced downtime costs and increased value creation. The enhanced contracts keep the Cost-Plus component as a secure foundation. Performance incentives are then added to reward improvements beyond basic service delivery. Figure 7 illustrates this transition. It shows how IJssels' turnover includes both Cost-Plus revenue for hours worked and additional performance-based earnings.

This combined approach creates a win-win scenario. Clients benefit from cost savings through higher reliability and availability. Meanwhile, IJssel secures its basic operational costs while earning extra rewards for delivering improved performance.

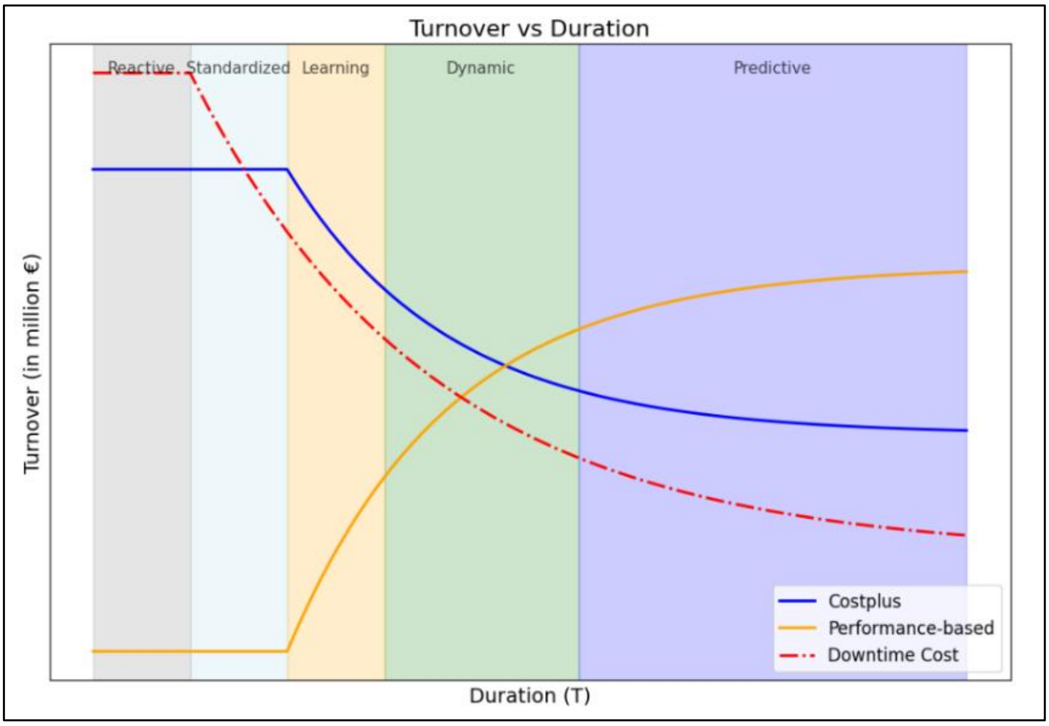


Figure 7: Client Maturity and Contract Type

Improvement Potential

Improvement potential assesses the extent to which IJssel, with it's expertise, can enhance the client's operations and outcomes through its services. If a client already maintains for example, an uptime of 95%, the opportunity for IJssel to deliver meaningful improvements is minimal. In such cases, incorporating performance-based elements into the contract becomes irrelevant, as the potential to create a win-win is limited since the client is already performing on a high level. When improvement potential is minimal, achieving even small gains requires disproportionate effort, making the costs of performance-based incentives exceed the benefits for either IJssel, the client, or both, ultimately rendering such contracts financially unviable.

When a client operates with lower efficiency or has identifiable areas for improvement, performance-based contracts become a much more suitable option. These contracts incentivize shared success by directly tying outcomes to measurable improvements, such as increased uptime, cost efficiency, or reduced maintenance costs. IJssels' expertise and the clients' specific improvement goals can be aligned through this contract type. This agreement creates a collaborative framework that drives operational and financial gains for both parties. This makes performance-based contracts effective in scenarios where value can be added.

Project Complexity

The quantification of project complexity provides a more structured approach compared to the previous chapter. While historical contracts lacked this level of quantification, this method is suited for assessing complexity in future contracts. Complexity is determined based on two key dimensions: the level of influence and the level of execution. By plotting these dimensions on a graph (see Figure 8), a clearer understanding of project complexity can be described.

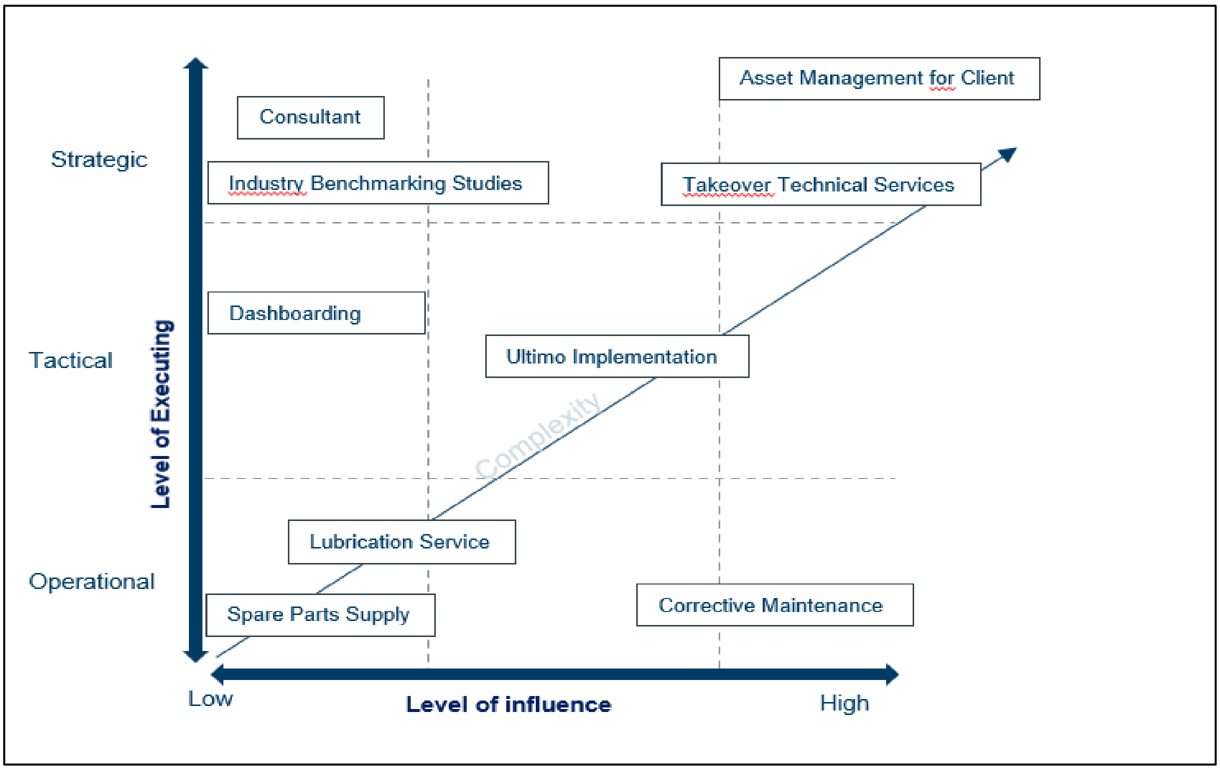


Figure 8: Complexity Matrix (IJssel Technology Services 2025)

The X-axis represents the Level of Influence, ranging from low to high, and the Y-axis denotes the Level of Executing, divided into operational, tactical, and strategic categories. For example, projects such as Lubrication Services fall under the operational level with low influence, representing minimal complexity. Tactical-level projects, such as the implementation of Ultimo, carry a moderate level of influence. At the strategic level, contracts such as consulting assignments may have a high level of execution but exhibit low influence, as they primarily involve advising clients rather than driving direct influence on change. Project like taking over the technical services of an organization combine a high level of strategic execution with significant influence, leading to greater complexity. Figure 8 provides some examples placed on this matrix.

This matrix is essential for selecting the most suitable contract type because it aligns the nature of the project with the appropriate contractual framework. Contracts with low influence, such as operational tasks like Lubrication Services, typically focus on routine, predefined deliverables. In such cases, performance-based elements are less relevant, as the scope of work, complexity, has limited variability and minimal impact on broader organizational outcomes. These contracts are better suited for fixed-price / unit rate price, ensuring clarity and efficiency without the need for complex performance metrics. As the level of influence increases, the complexity and impact of the project expand, often requiring more adaptive and collaborative approaches. High-influence projects, particularly those at the strategic level, offer greater opportunities to achieve measurable outcomes tied to organizational goals. In these cases, incorporating performance-based elements becomes advantageous. Such contracts incentivize both parties to focus on achieving defined objectives, such as cost savings, uptime improvements, downtime reduction and thereby aligning the project's complexity with the desired outcomes.

This framework allows IJssel to better classify and assess the complexity of future contracts, enabling better understanding which type of contract is suitable for the assignment.

Risk-Taking Willingness

This attribute represents IJssels' willingness to accept financial and operational uncertainty in a specific contract situation. As an input variable, it allows for the integration of non-tangible and internal strategic factors, such as IJssels' financial stability, long-term objectives, and internal risk appetite, into the contract selection model and decision-making process. The variable is scored from 1 to 100, where 1 indicates the lowest risk tolerance and 100 the highest. The score is not a factual measurement but a strategic input, reflecting IJssels' stance on risk at the time of contract selection.

The determination of this score considers multiple internal factors, including the specific project context, IJssels' financial stability, and its strategic goals and priorities. Since external risk factors, such as market conditions, are already accounted for in the Total Risk attribute, Risk-Taking Willingness strictly captures IJssels' internal perspective on risk. By incorporating this variable into the model, IJssel gains the flexibility to adjust contract selection based on its current position and long-term vision, ensuring that risk-taking aligns with broader business strategy rather than being solely dictated by contract-specific conditions.

The risk-taking willingness score reflects IJssels' ability and choice to manage contractual risks. With high risk-taking willingness (higher scores), fixed-price / unit rate price contracts become more suitable, despite their inherent risks. These risks include potential cost overruns, unforeseen circumstances, material price fluctuations, and efficiency challenges that IJssel would need to manage since the price is fixed or based on predetermined unit rates. High risk-taking willingness indicates IJssels' confidence and capability to handle these uncertainties through proper planning, efficient execution, and risk mitigation strategies. Conversely, with low risk-taking willingness (lower scores), cost-plus contracts are more appropriate, as they allow cost variability to be passed on to the client.

Performance-based contracts inherently involve risk as they are tied to achieving specific outcomes. They are best suited for situations where IJssels' expertise and control over influencing factors provide a reasonable likelihood of success. A moderate to high risk-taking willingness is typically needed for these contracts.

Aligning the contract type with IJssels' risk-taking willingness ensures a balanced approach that corresponds with the company's strategic goals and internal resources availability in the chapter before for each specific project or client situation.

5.3 Development of Contract Recommendation Tool

The tool's purpose is to provide a structured, data-driven approach for determining the most appropriate contract types based on contract attributes. It systematically evaluates attributes, including total risk, client characteristics, improvement potential, project complexity and risk-taking willingness. By incorporating these factors, the tool minimizes reliance on intuition and ensures that recommendations are based in empirical evidence.

Input Parameters

The tool considers a range of input variables drawn from the slicer values on the Contract Recommendation Tool worksheet. These input variables are validated to ensure numeric values between 0 and 100 before processing or a string value with determined values in a dropbox. The contract attributes which are the input parameters are shown (Figure 9) below:

1.1 Regulatory Score: Measures the level of regulatory compliance requirements and restrictions
1.2 Market Score: Evaluates market conditions and volatility
1.3 Trust Score: Assesses the relationship stability between IJssel and the client
2. Client Characteristics Score: Quantifies client maturity levels from reactive to predictive maintenance
3. Improvement Potential: Measures the opportunity for operational enhancement
4.1 Execution Level: Categorizes project execution as Operational, Tactical, or Strategic
4.2 Influence Level: Measures IJssels' direct control and ability to impact project outcomes
5. Risk-Taking Willingness: Reflects IJssels' risk appetite for the specific project

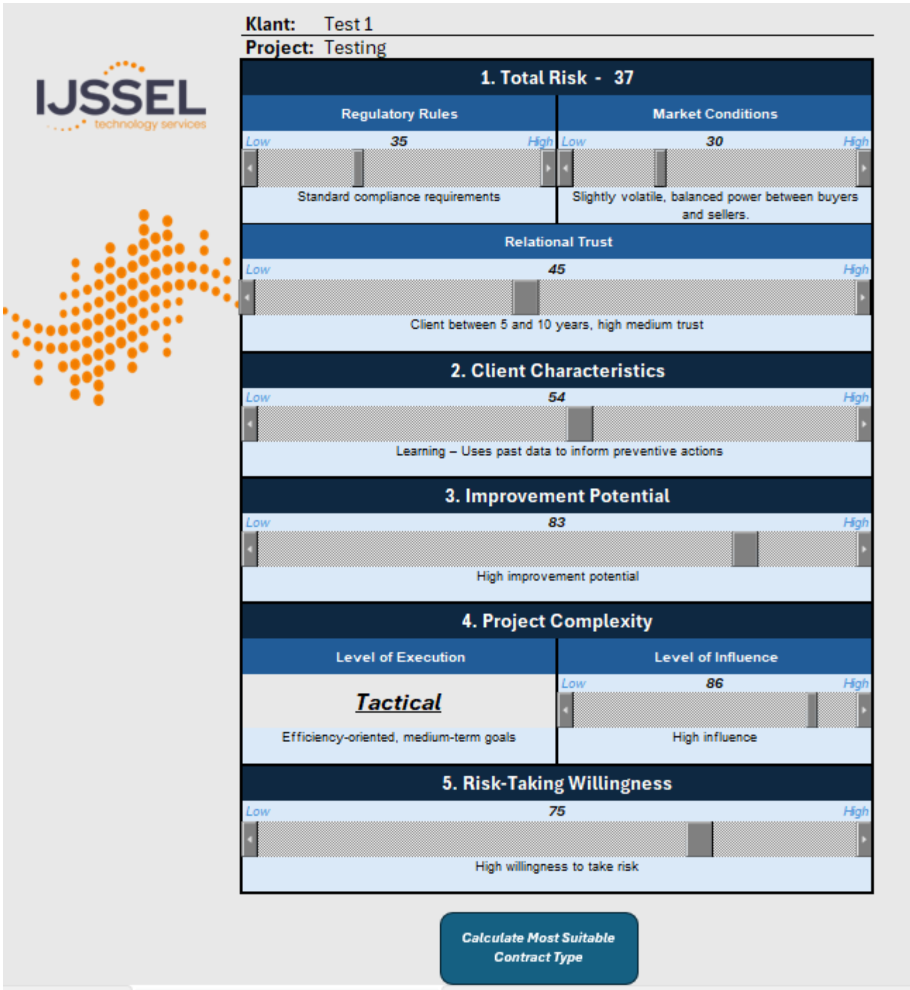


Figure 9: Recommendation Tool Input Fields

Tool Logic

The tool employs specific criteria combinations to recommend the most suitable contract type based on project and organizational characteristics (see code in Appendix E). The scoring system is relative rather than absolute, meaning that scores can and must be adjusted based on the evaluation of the tool's performance over time. Continuous refinement ensures that the recommendations remain relevant and aligned with evolving project conditions, strategic priorities, and practical insights from real-world applications.

Performance-based Element

For Performance-Based Contracts, the tool looks for scenarios with significant improvement opportunities and strategic-level engagement. These contracts are recommended when there is improvement potential (over 50) at a strategic execution level, combined with IJssel having influence (above 60) over the project outcomes. Additionally, IJssel must demonstrate high risk-taking willingness (above 66), and the client should show sufficient maturity in their operations (client characteristics score above 40, in the learning phase). This combination of factors ensures that performance-based agreements are only suggested when there is both the opportunity and capability to deliver measurable improvements.

The improvement potential needs to exceed 50 because performance-based contracts rely on IJssels' ability to create measurable improvements. When the improvement potential is below 50, it indicates that current operations are already relatively efficient, making it difficult to achieve significant gains that would justify a performance-based payment structure. The room for improvement and thus the potential for performance-based rewards would be limited.

The requirement for strategic-level execution reflects the comprehensive nature of performance-based contracts. At the strategic level, IJssel has the scope to implement systemic changes that affect overall operational performance. This differs from tactical or operational levels where improvements might be more localized. Strategic execution enables IJssel to address root causes, implement solutions, and drive improvements that justify performance-based compensation.

The influence threshold of 60 is critical for performance-based contracts. Unlike consulting roles where influence might be limited to recommendations, IJssel needs direct control over the factors that affect performance outcomes. This high threshold ensures that IJssel can actually implement the changes necessary to achieve the contracted performance targets. For instance, if IJssel is responsible for increasing equipment uptime but lacks authority over maintenance schedules or improvement initiatives, they would be taking on performance risk without the means to manage it effectively.

The high risk-taking willingness threshold of 66% is necessary because performance-based contracts inherently carry more risk than cost-plus contracts. IJssel needs to be confident in their ability to achieve the promised performance improvements, as their compensation depends on it.

Client maturity above 40, which corresponds with the learning phase or higher, is essential because performance-based contracts require sophisticated collaboration between IJssel and the client. This threshold indicates that the client has:

- Established maintenance processes
- Reliable data collection systems
- Clear performance metrics

- Understanding of performance improvement methodologies

These client capabilities are crucial for accurately measuring and validating performance improvements, which directly affect IJssels' compensation. Without sufficient client maturity, it becomes difficult to implement and measure the improvements that form the basis of performance-based contracts.

Fixed-Price / unit-rate price Element

Fixed-Price / unit-rate price Contracts become viable options in more controlled environments, particularly for tactical or operational-level projects as showed in the fsQCA results. The tool recommends these contracts when the total risk assessment falls below 40 and IJssel shows moderate to high risk-taking willingness (above 60). These contracts are particularly suited for projects where IJssel maintains some influence over outcomes (above 30) but operates at tactical or operational levels rather than strategic ones. This arrangement allows for predictable pricing while maintaining reasonable control over project delivery.

The total risk score must be below 40 because fixed-price / unit rate price contracts require predictable conditions. When risk levels are higher, it becomes more difficult to accurately estimate costs and maintain profitability under a fixed-price / unit rate price structure. Higher risk levels could lead to unexpected costs that IJssel would have to absorb.

The risk-taking willingness needs to exceed 60 because even in low-risk environments, fixed-price / unit rate price contracts still require IJssel to commit to a predetermined price. They must be willing to accept the risk of potential cost overruns or unforeseen circumstances.

The influence level requirement of above 30 ensures that IJssel maintains enough control to manage costs effectively. While this threshold is lower than for performance-based contracts, some level of influence is still necessary to manage project execution within the fixed price constraints.

Cost-Plus

The fsQCA analysis demonstrated that Cost-Plus contracts were successful across various attribute combinations, particularly when project complexity or risk was high. Building on these empirical findings, the recommendation tool positions Cost-Plus contracts as the default choice when projects don't fully align with either Performance-Based or Fixed-price / unit rate price criteria. This conservative approach aligns with the fsQCA results, which showed Cost-Plus contracts providing flexibility in scenarios with mixed indicators or uncertain conditions.

When projects don't meet these thresholds, Cost-Plus becomes the default because it offers the most flexibility and lowest risk for IJssel. This contract type allows for adjustments based on actual costs and effort, making it suitable for situations where:

- The improvement potential is unclear or limited
- Risk levels are high
- IJssels' influence is limited
- The client's maturity level is low
- IJssels' risk-taking willingness is low

Output

The tool provides decision-makers with a comprehensive recommendation package containing both a primary recommendation and supporting analyses, see figure 10, 11 and 12. The output is completely dynamic, so if the input is changed and the most suitable contract type is calculated all the visualization are regenerated.

Primary Contract Recommendation The tool presents the recommended contract type with a clear explanation of the selection rationale based on the analyzed input parameters. This transparency ensures stakeholders understand why a particular contract type is most suitable for their situation.

Supplementary Analyses

The tool visualizes potential revenue scenarios for different contract types. For Performance-Based contracts, it shows potential revenue growth through efficiency improvements. Fixed-price / unit rate price projections demonstrate stable revenue streams, while Cost-Plus scenarios illustrate revenue based on expected work hours.

A matrix plots the project's position based on execution level and IJssels' influence level. This visualization contextualizes the project's complexity and control aspects, supporting the contract recommendation through clear positioning of the project characteristics.

An AI-driven analysis evaluates potential risks specific to the recommended contract type, considering historical project data and current risk factors. This helps identify potential challenges and necessary mitigation strategies.

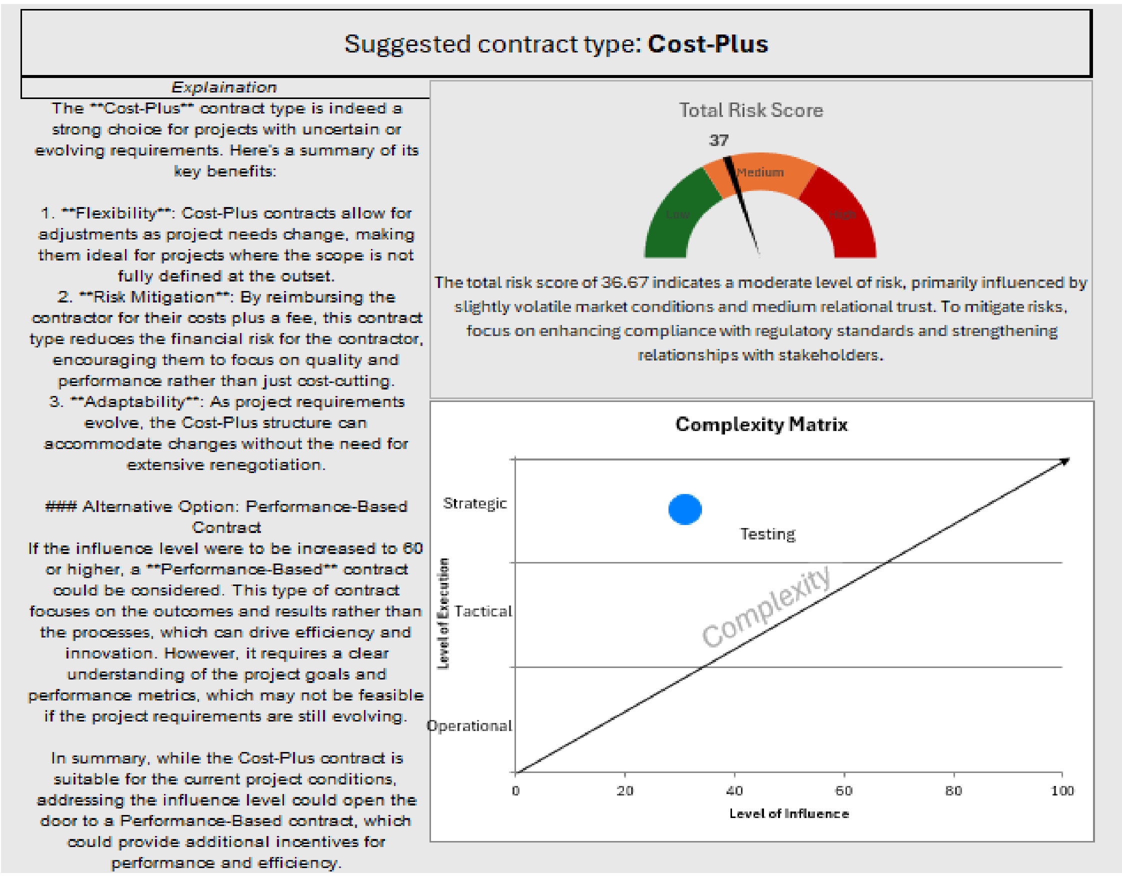


Figure 10: Output Recommendation Tool

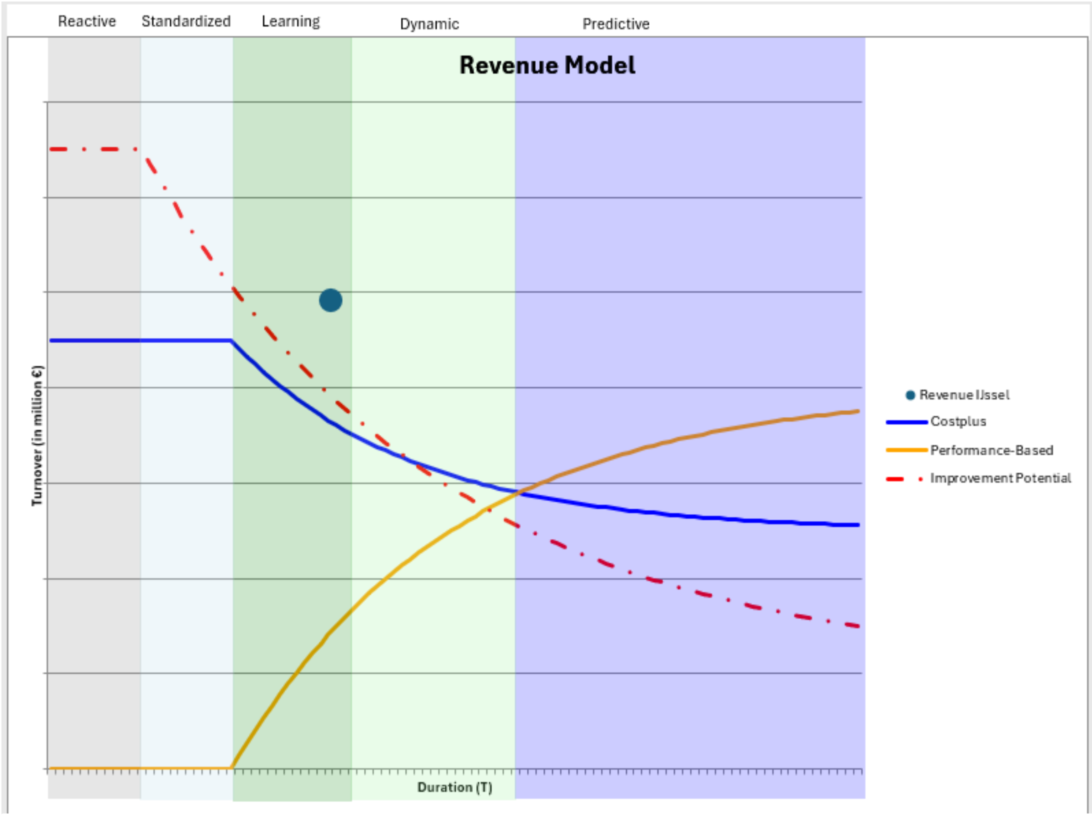


Figure 11: Dynamic Revenue Model Recommendation Tool

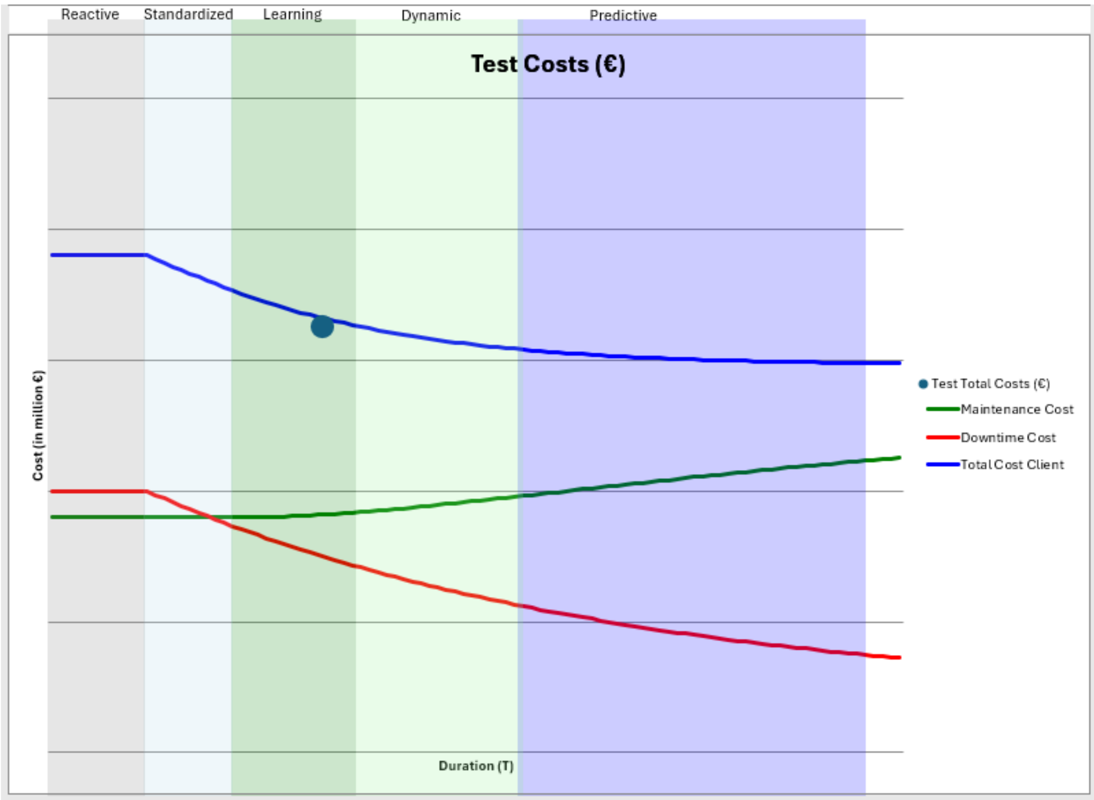


Figure 12: Dynamic Total Cost Client

5.4 Conclusion

The research question "*How can the most suitable contract type be selected based on project context to maximize profitability?*" can be answered through the systematic approach developed in this chapter. The study has demonstrated that optimal contract type selection requires an evaluation of five key attributes: total risk, client characteristics, improvement potential, project complexity, and risk-taking willingness. These attributes, when assessed through the structured recommendation tool, guide the selection between three primary contract types: Cost-Plus, Fixed-price / unit rate price, and Performance-Based contracts.

The recommendation tool developed in this study operationalizes these criteria into a practical decision-making framework. It processes multiple input parameters to generate evidence-based contract type recommendations, supported by visualizations of revenue scenarios and risk analyses. This systematic approach ensures that contract selection aligns with project context while maximizing profitability potential.

Importantly, the research reveals that maximizing profitability requires moving beyond traditional Cost-Plus arrangements as client maturity increases. The transition to Performance-Based contracts, particularly in scenarios with high improvement potential and strategic influence, enables IJssel to capture value from efficiency gains rather than solely from hours worked. This shift in contract type can lead to increased profitability while simultaneously reducing client costs, creating a win-win scenario.

The model also emphasizes the importance of risk management in contract selection. By carefully evaluating total risk against IJssels' risk-taking willingness, the framework ensures that contract choices balance profit potential with risk exposure. This balanced approach helps avoid scenarios where pursuing maximum profitability might expose the company to unsustainable levels of risk.

With this tool and structured approach IJssel can make informed decisions that align with specific project contexts while optimizing profitability. The framework provides not just a theoretical model but a practical tool that can be immediately implemented in the contract selection process, ensuring decisions are based on empirical evidence rather than intuition alone.

6. Research Conclusions

This research addressed the challenge faced by IJssel following their 2023 strategic shift towards becoming a more service-oriented organization. The core problem was their lack of a systematic, data-driven methodology for contract form selection, which led to suboptimal financial outcomes. Through analysis and model development, this study has provided solutions to both research questions while addressing the identified research gap in asset management contract selection.

Main Findings from Research Question 1

The first research question, "*What combinations of contract attributes contribute to successful contract outcome in asset management?*" was answered through fsQCA analysis of 33 contracts. The analysis revealed:

- Well-defined scope emerged as the fundamental for contract success, directly addressing IJssels' need for clear alignment between contract forms and project characteristics. This finding provides an empirical basis for moving beyond intuitive contract selection.
- Three pathways to successful contract outcomes were identified, each representing different combinations of attributes that consistently lead to positive results:
  1. Expert-Driven Success in Complex Projects: Complex projects succeed when they have a well-defined scope and mature client characteristics. These projects allow IJssel to leverage its expertise, and risks are mitigated through structured scope and strong client capabilities. Hybrid contracts, which combine fixed-price for predictable tasks and cost-plus for complex and uncertain work, are most suitable in these cases, balancing cost control and flexibility.
  2. High-Risk Well Managed: High-risk projects achieve success when supported by a well-defined scope and mature clients, regardless of project complexity. Even non-complex projects may involve substantial risks, but structured contracts and experienced clients ensure effective risk mitigation. Cost-plus contracts work best in these cases, as they provide the adaptability needed to manage uncertainties in high-risk environments, avoiding the constraints of fixed pricing.
  3. Clarity in Simple Projects: Non-complex projects succeed with less mature clients when scope is well-defined and risks are low. A clear structure enables smooth execution, even with clients who have limited contract experience. Fixed-price and unit-rate contracts are most effective in these cases, providing budget predictability and operational stability while ensuring cost-efficiency.
- The analysis also identified one key negative pathway, demonstrating that high project complexity, high total risk, and an undefined scope consistently lead to negative profitability. The presence or absence of a fixed-price element does not influence negative outcomes, as both contract types failed under poorly defined scope conditions. This reinforces that scope definition is the single most critical factor in preventing contract failures, particularly in high-risk, high-complexity projects.

Main Findings from Research Question 2

The second research question, *"How can the most suitable contract type be selected based on project context to maximize profitability?"* was answered through the development of a structured recommendation model.

Five attributes were identified as determinants for optimal contract selection:

- Total risk (combining market conditions, regulatory requirements, and trust and relation)
- Client characteristics (maturity levels)
- Improvement potential
- Project complexity
- Risk-taking willingness

The Performance-Based contracts require specific contextual conditions to be successful. These contracts are appropriate when there is significant improvement potential within the client's operations, project execution occurs at a strategic level, and IJssel maintains influence over project outcomes. Additionally, IJssel must be willing to accept higher risk, and clients must demonstrate sufficient level maturity.

Fixed-price / unit rate price contracts are suitable for predictable environments with controlled risk levels and clear operational scope. When conditions don't align with either Performance-Based or Fixed-price / unit rate price requirements, Cost-Plus remains the appropriate choice, providing flexibility in uncertain or evolving project contexts.

To operationalize these findings, a systematic decision-support tool was developed that processes these criteria to recommend the most suitable contract type. This tool enables IJssel to make data-driven contract selections that maximize profitability while managing risk. This framework supports aligning contract choices with specific project contexts, moving beyond intuitive decision-making to an evidence-based approach.

6.1 Discussion

This study's findings make several contributions to both theoretical understanding and practical application of contract attributes and contract selection in asset management. The discussion examines these findings in relation to existing literature and their implications for practice.

Theoretical Contributions

The study builds upon and extends existing contract theory in three main areas:

First, while Turner (2017) established the importance of matching contracts to specific projects and clients, this research provides empirical evidence for exactly which combinations of attributes lead to success. The fsQCA analysis identified specific pathways to positive outcomes, moving beyond general principles to actionable combinations of attributes. This addresses a gap in the literature by demonstrating how multiple attributes interact to influence contract success in asset management contexts. Fiss (2011) highlights the significance of configurational causality in fsQCA, underscoring the importance of understanding how combinations of conditions, rather than isolated variables, determine outcomes. Our findings contribute to this theory by revealing that specific pathways involving the interaction of risk, client maturity, scope, and complexity lead to success, supporting the concept of equifinality in contract selection.

Second, the research extends Murdoch and Hughes's (2002) work on contract structuring by empirically validating the critical role of well-defined scope. While previous literature emphasized clear contract structuring in general terms, our fsQCA analysis provides specific evidence for scope definition as a fundamental attribute for success in asset management contracts. This finding strengthens the theoretical foundation for scope definition's importance. This aligns with Turner's (2014) framework, which emphasizes the direct relationship between scope clarity and project success.

Third, this study advances Rahman and Kumaraswamy's (2002) work on risk allocation by revealing how risk interacts with other contract attributes. While they focused on risk distribution in isolation, our research demonstrates interactions between risk, client maturity, scope, and project complexity. These interactions underscore that a comprehensive approach to risk management, which incorporates multiple contract attributes, is essential for successful project outcomes (Rahman & Kumaraswamy, 2002).

Our research reveals that contract success patterns are not static but evolve as client relationships mature. The progression from Cost-Plus to Performance-Based contracts suggests that successful contracting requires a dynamic approach that adapts to changing client capabilities and market conditions. This aligns with Zheng et al. (2008), who found that contract relationships evolve through different stages of trust. The temporal dimension has been underexplored in existing contract theory, which often treats contract selection as a one-time decision rather than an evolutionary process (Cao et al., 2022). This static view contrasts with Zheng et al.'s (2008) finding that successful long-term contracts require adaptation mechanisms to accommodate changing circumstances. As Turner (2014) notes, the dynamic nature of project environments necessitates flexible contracting approaches, yet traditional contract theory has not fully incorporated this temporal perspective into its frameworks.

However, organizations like IJssel may also choose to maintain Cost-Plus contracts while creating value through operational excellence. This approach leverages IJssels' expertise in rapid cost reduction and efficient resource allocation. When Cost-Plus contracts achieve consistent cost reductions, the freed-up capacity can be deployed to new projects, maintaining profitability through volume rather than contract structure evolution. This strategy aligns with Rahman and Kumaraswamy's (2002) findings that contract success depends more on effective execution than contract type alone.

The increasing digitalization of asset management creates new opportunities and challenges for contract design. Our findings suggest that as organizations adopt more sophisticated monitoring and predictive maintenance capabilities, the feasibility of performance-based contracting increases. This supports Selviaridis and Wynstra's (2015) findings on the evolution of performance-based contracts in complex service environments. This technological evolution may require a fundamental rethinking of how contracts are structured and managed in the digital age.

Two important methodological insights emerged from our analysis. First, regarding internal strategy alignment, which can be linked to the risk-taking willingness in the recommendation model, the fsQCA analysis could not effectively evaluate this variable because all contracts in IJssels' portfolio demonstrated high strategic alignment, there was no variability to analyze. This limitation reflects IJssels' careful approach to only entering contracts that align with their organizational strategy, rather than suggesting that all service-oriented asset management organizations maintain such alignment. In other organizations this might be a important contract attribute for a successful outcome. Because no variability was detected, the attribute has been renamed to risk-taking willingness in the recommendation tool. Through this approach, IJssel can incorporate the amount of risk they are willing to take, which aligns with their current internal strategy.

The progression from empirical analysis to operational recommendation model also contributes to methodology literature. The transformation of fsQCA findings into practical decision tools required the development of more specific, operational measures like improvement potential, complexity, and risk-taking willingness. This demonstrates how theoretical insights can be translated into practical applications while maintaining their empirical foundation.

While our findings provide clear pathways to successful contract outcomes, different stakeholders may interpret and value these success factors differently. Financial managers might prioritize risk allocation, while operational managers focus on scope definition. Understanding these varying perspectives is crucial for successful implementation of our recommendations, as contract selection often involves negotiation between multiple stakeholders with different priorities.

Practical Contribution

This research's primary practical contribution is the development of a data-driven contract recommendation tool that enables IJssel to systematically evaluate and select optimal contract types for specific project contexts. The tool provides several key benefits:

First, it moves IJssel beyond intuitive decision-making to a structured approach for contract selection. By incorporating multiple attributes such as total risk, client characteristics, complexity, risk-taking willingness, and improvement potential, the tool helps ensure consistent and objective evaluation of contract options. This systematic approach reduces reliance on individual judgment and provides a common framework for decision-making across the organization. The tool thus supports a more rational decision-making process, which is critical for large-scale, service-oriented organizations (Carroll, 1999)

Second, the tool identifies opportunities for implementing performance-based contracts alongside traditional Cost-Plus and Fixed-price / unit rate price options. This is particularly valuable as IJssel evolves toward more service-oriented operations. When clients demonstrate sufficient maturity and clear improvement potential exists, the tool helps identify scenarios where performance-based elements could create additional value while maintaining the security of a Cost-Plus foundation.

Third, the recommendation tool provides dynamic visualization of contract scenarios, helping decision-makers understand the implications of different contract choices. By showing potential revenue scenarios, risk analyses, and project complexity positioning, the tool supports more informed discussions with both internal stakeholders and clients about contract structure.

Finally, the tool serves as a risk management framework by defaulting to Cost-Plus contracts when conditions for other contract types aren't clearly met. This ensures IJssel has a secure foundation while remaining able to implement more advanced contract structures when projects meet the required criteria.

6.2 Limitations

Sample Size and Data Constraints

The study analyzed 33 contracts, which although sufficient for fsQCA analysis (Ragin, 2008), presents limitations in terms of statistical generalizability. The sample primarily consisted of contracts from IJssels' asset management division, focusing on A+, A, and B clients. A larger sample size across different client categories might reveal additional patterns or contract attribute combinations. Schneider and Wagemann (2012) discuss that small sample sizes may limit the diversity of configurations, potentially impacting the comprehensiveness of the analysis.

Geographic and Industry Scope

The research was limited to IJssels' operations in the Netherlands in asset management, primarily in manufacturing, processing, and food industries. This geographic and industry-specific focus may limit the applicability of findings to other regions or sectors with different regulatory environments, market conditions, or maintenance practices. Sehring et al. (2013) note that the contextual specificity inherent in case-oriented research like fsQCA can constrain the generalizability of results beyond the studied environment.

Methodological Considerations

The fsQCA methodology, while valuable for identifying attribute combinations, requires setting specific thresholds for calibration. This calibration process involves subjective judgments about what constitutes full membership and non-full membership for each attribute. These subjective thresholds could affect the identification of success patterns - different calibration choices might lead to different conclusions about which attribute combinations are most important for success. Schneider and Wagemann (2012) further elaborate on the challenges of calibration, highlighting the need for transparency and justification in the selection of threshold values.

Contract Recommendation Tool Limitations

The contract recommendation tool relies heavily on stakeholder input, which introduces subjectivity into the decision-making process. While some attributes like client maturity level have objective measurements based on established asset management frameworks, other critical inputs remain subjective. For example, improvement potential is currently assessed on a simple scale from low to high, rather than being based on quantified performance metrics.

To enhance the tool's precision and client-specific applicability, future development should focus on quantifying these subjective elements:

- Improvement potential could be calculated using actual performance data, equipment efficiency metrics, or measured downtime costs
- Risk assessment could incorporate more concrete metrics like historical incident rates, compliance scores, or market volatility indicators

Client Acceptance

Client acceptance of new contract models represents a critical challenge not explored in this research. While the benefits of evolved contract structures are demonstrated, the research doesn't address strategies for overcoming client resistance to change, particularly when existing contract arrangements are familiar and well-understood.

6.3 Future Research

Based on the identified limitations, future research opportunities can be divided into two main categories: studies aimed at overcoming current limitations and research that builds upon and extends the current findings.

Expanded Scope and Generalizability

Future research should address the current study's limitations by expanding both the scope and depth of analysis. To improve generalizability, studies should include contracts from multiple asset management organizations beyond IJssel, incorporating different client segments and industries. This broader analysis would help validate whether the identified success patterns are universal or organization-specific. Cross-industry research comparing contract effectiveness across sectors like manufacturing, healthcare, and utilities would provide valuable insights into how industry context affects contract success factors. Pappas and Woodside (2021) recommend expanding sample diversity to validate whether identified success patterns are universal or context-specific. Cross-industry research can provide valuable insights into how different contexts affect contract success factors.

Client Transition Understanding

Research is needed to understand client acceptance of new contract models. Studies should examine effective strategies for transitioning clients from traditional to performance-based contracts, including how to overcome resistance to change. Understanding the factors that influence client willingness to adopt new contract structures would provide valuable insights for implementing more sophisticated contract models.

Tool Enhancement and Validation

Future research should focus on enhancing and validating the contract recommendation tool. This includes developing systems for real-time integration with operational data and creating dynamic KPI tracking mechanisms. Research should examine how the tool's recommendations perform over time, studying the long-term effectiveness of different contract choices in various contexts. The tool could be further enhanced by making attributes more client-specific and operational. For example, improvement potential could be evaluated by actually measuring machine downtime costs and systematically analyzing potential improvements. By incorporating such specific operational metrics, the tool would become less generic and could be used to address highly targeted, client-specific scenarios. This would transform it from a general recommendation framework into a precise decision-making tool tailored to individual client situations.

Transitioning from subjective assessments to objective metrics can improve the precision of recommendation model. For instance, quantifying attributes like improvement potential using performance data or risk assessment through historical incident rates can reduce biases. Douglas, Shepherd, and Prentice (2020) emphasize the importance of integrating objective measures to enhance the reliability of model outcomes.

Long-term Performance Studies

Longitudinal research could provide insights into the effectiveness of performance-based contracts over complete client maturity cycles. This research should examine the long-term financial impacts of different contract types and how client-contractor relationships evolve under various contract structures. Understanding the impact of market cycles on contract performance would be valuable.

6.4 Practical Recommendations

Initial Client Assessment

Before establishing new contracts, IJssel must conduct a thorough client maturity assessment to understand the starting point of the relationship. This assessment should evaluate:

- Current maintenance strategies and practices
- Data collection and monitoring capabilities
- Existing asset management processes
- Improvement potential

This initial evaluation sets the foundation for contract selection and future growth opportunities.

Well-Defined Scope

Following client assessment, IJssel must ensure all contracts have clearly defined scopes with measurable KPIs. Based on the fsQCA analysis, this is a critical prerequisite for success regardless of contract type. Each contract should specify:

Contract Structure Evolution

IJssel should maintain Cost-Plus as the foundation of all contracts to ensure basic operational costs are covered. As clients mature and there is a significant improvement potential and the management is willing to take some risk, performance-based elements should be added on top of this base structure, but only when scope is well-defined. This hybrid approach ensures financial stability while creating opportunities for additional value capture through performance improvements. IJssel is now not only getting paid for the hours worked but also for the value creation in the clients organization.

Implementation Strategy

A phased implementation approach is recommended for adopting the contract recommendation tool. Start with pilots among established A+ clients who demonstrate sufficient maturity levels and have clearly defined scopes with improvement potential.

Establish robust systems for measuring and monitoring performance metrics before implementing performance-based elements. Create standardized reporting frameworks that clearly show the relationship between performance improvements and value creation. Ensure both IJssel and clients have access to and understand these monitoring systems.

Thresholds Recommendation Model

The contract recommendation tool relies on thresholds to determine the most suitable contract type based on project and organizational characteristics. These thresholds define the conditions under which different contract types, such as Fixed-Price, Cost-Plus, or Performance-Based contracts, are recommended. However, the scores used in the model are relative rather than absolute, meaning they should be periodically reviewed and adjusted to ensure continued accuracy and relevance.

Since the tool is designed to support dynamic decision-making, threshold values must be evaluated and refined over time based on real-world contract outcomes and feedback from users. The scores in the model are not fixed metrics but adaptable inputs that should be recalibrated as IJssel gathers more insights from practical applications, project performance reviews, and strategic developments.

Bibliography

Banker, R. D., Byzalov, D., & Chen, L. (2018). Performance measurement systems in service organizations: An empirical investigation. *Management Science*, 64(8), 3867-3883.

Belton, V., & Stewart, T. (2002). *Multiple criteria decision analysis: An integrated approach.* Springer-Science + business media bv.

Bower, D. (2003). *Management of procurement.* London: Thomas Telford.

Bugrov, & Bugrova. (2019). An algorithm of selecting the pricing model for a construction contract. *Eastern-European Journal of Enterprise Technologies.*

Cao, D., Wang, Y., Berkeley, N., & Tjahjono, B. (2022). Cao, D., Wang, Y., Berkeley, N., & Tjahjono, B. *Long Range Planning*, 55.

Carroll, A. (1999). Corporate social responsibility: Evolution of a definitional construct. *Business & Society*, pp. 268-295.

Chen, Xia, Jin, Wu, & Hu. (2016). Choosing Appropriate Contract Methods for Design-Build Projects. *Journal of Management in Engineering*, 32.

Clemen, R. T., & Reilly, T. (2001). Making hard decisions with decision tools. *Duxbury Press.*

Eriksson, & Westerberg. (2011). Effects of cooperative procurement procedures on construction project performance: A conceptual framework. *International Journal of Project Management*, 197-208.

Galeazzo, A., & Furlan, A. (2018). Lean bundles and configurations: a fsQCA approach. *International Journal of Operations & Production Management*, 513-533.

Gao, C., Shen, Y., Xu, W., Zhang, Y., Tu, Q., Zhu, X., . . . Yang, Y. (2023). A fuzzy-set qualitative comparative analysis exploration of multiple paths to users' continuous use behavior of diabetes self-management apps. *International Journal of Medical Informatics,*, p. 172.

Hofman, E., Faems, D., & Schleimer, S. (2017). Governing Collaborative New Product Development: Toward a Configurational Perspective on the Role of Contracts. *Journal of Product Innovation Management*, pp. 739-756.

International Organization for Standardization. (2024). *Asset management – Overview, principles and terminology. (ISO55000).* ISO.

Kern, F. (2018). The Trials and Tribulations of Applied Triangulation: Weighing Different Data Sources. *Journal of Mixed Methods Research*, pp. 166-181.

Kumar, S., Sahoo, S., Lim, W. M., Kraus, S., & Bamel, U. (2022). Kumar, S., Sahoo, S., Lim, W. M., Kraus, S., & Bamel, U. (2022). Fuzzy-set qualitative comparative analysis (fsQCA) in business and management research: A contemporary overview. *Technological Forecasting and Social Change,*, 178.

Korjani, M. M., & Mendel, J. M. (2012). *Fuzzy Set Qualitative Comparative Analysis (fsQCA):*

Challenges and Applications. *Proceedings of the Annual Meeting of the North American Fuzzy Information Processing Society (NAFIPS)*, 1-6.

Lou, Z., Ye, A., Mao, J., & Zhang, C. (2022). Supplier selection, control mechanisms, and firm innovation: Configuration analysis based on fsQCA. *Journal of Business Research*, 81-89.

Love, Edwards, & Irani. (2016). Project Pathogens: The Anatomy of Omission Errors in Construction and Resource Engineering Project Management. *IEEE Transactions on Engineering Management*, 324-335.

Lumineau, F., & Malhotra, D. (2016). Shadow of the contract: How contract structure shapes interfirm dispute resolution. *Strategic Management Journal*, 37(1), 1181-1201.

Luu, D. N., & Chen. (2003). Parameters governing the selection of procurement system – an empirical survey. *Engineering, Construction and Architectural Management*, 10.

Meerdink, N., & Boeve, M. (2024, 12 12). Contracts Attributes. (J. Welles, Interviewer)

Murdoch, J., & Hughes, W. (2002). *Construction contracts: law and management.* Routledge.

Osipova, E., & Eriksson, P. E. (2013). Balancing control and flexibility in joint risk management: Lessons learned from two construction projects. *International Journal of Project Management*, 391-399.

Pappas, I. O., & Woodside, A. G. (2021). Fuzzy-set Qualitative Comparative Analysis (fsQCA): Guidelines for research practice in Information Systems and marketing. *International Journal of information Management*.

Prentice, C. (2019). Testing complexity theory in service research. *Journal of Services Marketing.*

Quinlan, J. R. (1986). Induction of decision trees. *Machine Learning*, 81-106.

Ragin, C. C. (2008). *Redesigning Social Inquiry: Fuzzy Sets and Beyond.* Chicago : University of Chicago Press.

Rahman, & Kumaraswamy. (2002). Joint Risk Management through Transactionally Efficient Relational Contracting. *Construction Management and Economics*, 45-54.

Rihoux, B., & Ragin, C. C. (2009). *Configurational comparative methods: Qualitative comparative analysis (QCA) and related techniques.*

Selviaridis, K., & Wynstra, F. (2015). Performance-based contracting: A literature review and future research directions. *International Journal of Production Research*, p. 53.

Shang, K., Wu, J., & Cao, Y. (2023). Study on the Impact of Trust and Contract Governance on Project Management Performance in the Whole Process Consulting Project—Based on the SEM and fsQCA Methods. *Buildings*, 13.

Sluis, & Giovanni. (2016). The selection of contracts in supply chains: An empirical analysis. *Journal of Operations Management*, 1-11.

Smith, & Bohn. (2009). Project Risk Management Practices: The Impact of Risk Management on Project Success. . *International Journal of Project Management*, 99-105.

Schneider, C. Q., & Wagemann, C. (2012). Set-Theoretic Methods for the Social Sciences. Cambridge University Press.

Sehring, J., Korhonen-Kurki, K., & Brockhaus, M. (2013). Qualitative Comparative Analysis (QCA): An Application to Compare National REDD+ Policy Processes. CIFOR, 121.

Turner, J. R. (2014). *The handbook of project-based management: Leading strategic change in organizations.* McGraw-Hill Education.

Turner, J. R. (2017). *Contracting for Project Management.* New York: Routledge.

Turner, R. (2009). *Handbook of Project-based Management: Leading Strategic Change in Organizations.* The McGraw-Hill Companies.

Appendix

A. Interview Guide for Stakeholder Interviews

The interview is structured into five main sections, designed to explore stakeholders' views on key contract attributes, decision-making processes, and attribute importance.

Project Complexity

1. How would you describe the complexity of the contract in terms of technical execution, coordination, and required expertise?
2. Does the contract involve multiple disciplines or teams, requiring extensive collaboration?
3. Are there advanced technologies or innovative processes involved that add complexity?
4. Have unforeseen technical challenges impacted the execution of similar contracts in the past?
5. How does the complexity of this contract compare to others within IJssel?
6. Based on a scale from 1 to 5, with 1 being low complexity (simple tasks) and 5 being high complexity (multidisciplinary, high-tech projects), how would you rate this contract?

Client Characteristics

1. Can you describe the client's current approach to maintenance? (Options: reactive, standardized, learning, dynamic, predictive)
2. How would you rate their willingness to adapt to advanced maintenance strategies, such as predictive maintenance?
3. Does the client's operational maturity impact how risks and responsibilities are allocated in contracts?
4. Have you encountered challenges in working with clients of varying maturity levels?
5. Are there specific examples where a client's maturity level positively or negatively affected contract performance?
6. Based on a number 1 to 5 with 1 reactive and 5 predictive which grade do you give client x?

Regulatory Rules

1. What industry-specific regulations or legal requirements apply to this contract?
2. Are there strict environmental, safety, or operational compliance requirements?
3. Does the contract require additional oversight due to regulatory complexity?
4. Have compliance challenges arisen in similar contracts?
5. Do regulatory requirements affect contract flexibility or risk allocation?
6. How does the regulatory burden for this contract compare to others within IJssel?
7. Based on a scale from 1 to 5, with 1 being minimal regulatory requirements and 5 being highly stringent compliance demands, how would you rate this contract?

Market Conditions

1. How stable are the market conditions for this project or client?
2. Are there significant price fluctuations or demand changes that impact contract terms?

3. What specific challenges does market volatility present during negotiations?
4. Do these challenges lead to adjustments in pricing mechanisms, payment terms, or other contractual clauses?
5. How does IJssel manage uncertainty in market conditions when structuring contracts?
6. Based on a number 1 to 5, with 1 stable market and 5 really unstable markets which grade do you give the moment contract x was in negotiation?

Relational Trust

1. How long has IJssel been working with this client? (Less than 1 year, 1–3 years, 3–5 years, 5–10 years, more than 10 years)
2. Has the duration of the relationship influenced the nature of contracts?
3. How would you describe the current level of trust between IJssel and the client?
4. Are there specific incidents or actions that have strengthened or weakened this trust?
5. In your experience, does a high-trust relationship affect the allocation of risks in contracts?
6. For high-trust relationships, are more flexible terms or incentives included?
7. Based on a number 1 to 5, with 1 new client with not a good relation and 5 long term client with a good relation and trust which grade do you give client x?

Resource Availability

1. What types of resources (e.g., financial, human, technical) are most critical for ensuring successful contract execution?
2. Are these resources adequately available for the projects under this contract?
3. Have there been instances where resource constraints (on IJssels' or the client's side) led to revisions in contract terms?
4. How do these constraints impact timelines, scope, or deliverables?
5. Does resource availability play a role in determining the flexibility or rigidity of the contract terms?
6. Are certain types of projects more vulnerable to resource challenges?
7. Based on a number from 1 to 5, with 1 no resource where available in the start of this contract and 5 lots of resources where available the IJssel was happy to take new work, which grade do you give this contract?

Organizational Strategy

1. How well do you think the contracts support IJssels' long-term strategic goals?
2. Are there specific objectives (e.g., profitability, sustainability, innovation) that influence the negotiation process?
3. Are there instances where strategic alignment has led to significant adjustments in contract structure or terms?
4. Do these adjustments improve project outcomes or client satisfaction?
5. Do you think there are gaps between contract outcomes and IJssels' strategic priorities?
6. What steps could be taken to better align contracts with organizational goals?

7. Based on a number from 1 to 5, with 1 not aligned with organization strategy and 5 fully aligned with the organization long term strategy, which grade do you give this contract?

B. Research Planning

Phase	Activity	11-15 nov wk1	18-22 nov wk2	25-29 nov wk3	2-6 Dec wk4	9-13 Dec wk5	16-20 Dec wk6	23-27 Dec wk7	30 -3 Jan wk8	6-10 Jan wk9	13-17 Jan wk10	20-24 Jan wk11	27-30 Jan wk12	3-7 Feb wk13	10-14 Feb wk14
Finalize Research Proposal	Refine proposal and summit, work on feedback supervisor														
Data Collection	Collect historical project data from IJssel Technology.														
Data Collection	Create data collection tools and calibration criteria.														
Data Collection	Prepare and conduct initial stakeholder interviews for qualitative insights.														
Data Collection	Complete the collection of historical project data.														
Data Collection	Finish all stakeholder interviews to ensure a robust qualitative dataset.														
Data Calibration	Transcribe and analyze interview data.														
Data Calibration	Calibrate data into fuzzy sets.														
fsQCA Analysis	Construct the truth table for fsQCA analysis.														
fsQCA Analysis	Boolean minimization.														
fsQCA Analysis	Identify and validate pathways.														
fsQCA Analysis	Finalize pathways and conduct consistency and coverage analysis.														
Recommendations	Refine pathways with stakeholder insights.														
Recommendations	Develop contract type recommendations.														
Write report	Draft findings, implications, and decision-support tool.														
Finalize report	Finalize report														
Ask feedback on final report	Greenlight														
Colloquium	Colloquium														

Original Overrun

C. Contract attributes

Project complexity

The complexity of projects varies across the different contracts. High-complexity projects typically involve predictive, preventive and corrective maintenance across multiple installations, requiring planning, compliance, and operational coordination. These contracts also tend to generate the highest revenues. Medium-complexity projects focus on predictive and preventive maintenance for a smaller number of assets, balancing operational challenges and scale. In contrast, low-complexity projects often consist of simpler tasks, such as lubrication or corrective maintenance on specific systems or the temporary assignment of a employee for the client per moment. These contracts are generally less resource-intensive.

Scope

The scope of the analyzed contracts aligns closely with their complexity. Low-complexity contracts typically feature well-defined and narrowly focused scopes, such as simple lubrication or basic corrective tasks. In contrast, higher-complexity contracts involve broader and more interactive responsibilities, such as preventive and predictive maintenance across multiple assets, process optimization, or system upgrades. The quantification of these scopes is often tied to measurable Key Performance Indicators (KPIs) specified within the contracts. These KPIs range from operational metrics like reliability, uptime, and safety to financial targets like cost savings or efficiency improvements. While some contracts include KPIs with specific thresholds, others do not enforce such limits. Notably, none of the contracts include explicit penalties for failing to meet KPIs, relying instead on mutual trust and collaboration to achieve the desired outcomes.

Risk Allocation

Risk allocation varies again in the different contracts within the analysis. In many contracts, risks related to compliance and performance are shared, with clients often retaining strategic control while delegating operational risk to IJssel. Cost-Plus contracts place less financial risk on IJssel, as costs are calculated directly to the client, but these contracts often come with no guaranteed revenue or purchase obligations, leaving IJssel exposed to variability in revenue. In contrast, fixed price contracts expose more risks to IJssel, especially when unforeseen costs in the operation arise, but IJssel also provides from the opportunity of efficiency gains. Price indexation clauses, present in most contracts, help mitigate financial risks by allowing for adjustments due to inflation or wage increases. Warranty obligations in some contracts extend IJssels' responsibility, ensuring quality for a specific period. Insurance requirements, such as liability coverage and compliance with safety standards, safeguard both parties against unforeseen incidents. Exclusive agreements with minimum commitments offer a degree of revenue stability. However, most contracts lack explicit penalties for non-performance, instead emphasizing mutual trust and collaboration to achieve objectives. Some clients pre-approve high-cost items, which helps distribute financial responsibility and align risks with the complexity of the contract.

Client Characteristics

In the analyzed database, none of the clients have reached the fully predictive stage of operational maturity. he majority of clients are categorized as learning, indicating they utilize structured methods such as Failure Mode, Effects, and Criticality Analysis (FMECA) to analyze past failures and improve preventive measures. These clients have not yet adopted advanced tools like real-time monitoring or AI. A smaller group of clients are classified as reactive or standardized. Reactive clients primarily address issues as they arise, with minimal emphasis on prevention. Standardized clients, on the other hand, have adopted basic preventive measures but lack full operational integration. In both cases, corrective maintenance continues to play a major role, indicating their early stage of maturity.

Duration

The documents that are analyzed have significant variation in their durations and extensions mechanisms. Some contracts are short-term, lasting only a few months, and have a specific end date. These contracts are often liked to temporary assignments or project-based work. Other contracts, mostly complex contracts, are open-ended with no specified end date, reflecting long-term partnerships. Several contract include an initial fixed duration, such as 2 years, with the option to extend for additional periods, typically in increments of 1 or 2 years. Many contracts also feature automatic renewals, where the agreement is extended unless one of the parties explicitly terminates the contract within the agreed notice period. This is beneficial since les frequent negotiations are required.

Regulatory Requirements

The contracts analyzed have varying levels of regulatory requirements. Simpler contracts often focus on basic safety and operational compliance, such as adherence to VCA (Veiligheid, Gezondheid en Milieu) standards and ISO 9001 (Quality Management Systems) certifications. These contracts typically involve tasks like lubrication and basic maintenance, with limited audit or reporting obligations. In contrast, more complex contracts include stringent regulatory demands tied to health, safety, and environmental (SHE) standards, as well as advanced technical and quality requirements. These may involve compliance with ATEX (ATmosphères EXplosibles) explosion risk guidelines, SCIOS (Stichting Certificatie Inspectie en Onderhoud van Stookinstallaties) certifications for equipment inspections, and adherence to industry-specific standards like HACCP (Hazard Analysis and Critical Control Points) and FDA (Food and Drug Administration) for food safety or ISO 14001 (Environmental Management Systems) for environmental management. Additional obligations, such as regular audits, extensive reporting, and permits for high-risk activities, are common in these agreements. Most of the contracts have insurance requirements and periodic audits. This provides a foundation for risk management and ensures compliance with both legal and client-specific regulations.

Market Conditions

In IJssels' current contract portfolio, most contracts are situated between slightly volatile and moderately volatile market conditions. Extreme market conditions, such as highly stable or unstable markets, are not encountered. However, it is important to note that some industries naturally experience more volatile market conditions than others. For example, industries reliant on global supply chains or heavily impacted by fluctuating raw material prices are more likely to experience moderate to high volatility compared to industries with more stable demand and localized operations.

Cost-plus with fixed price contracts are mostly applied in slightly volatile market conditions. This is because fixed-price / unit rate price components are less suited to highly volatile environments, as they expose sellers to risks from fluctuating costs, such as materials or labor, which can significantly affect profitability. In industries with volatile markets, such contracts must include mechanisms for cost adjustments or risk-sharing to mitigate these challenges which are mostly cost plus contract.

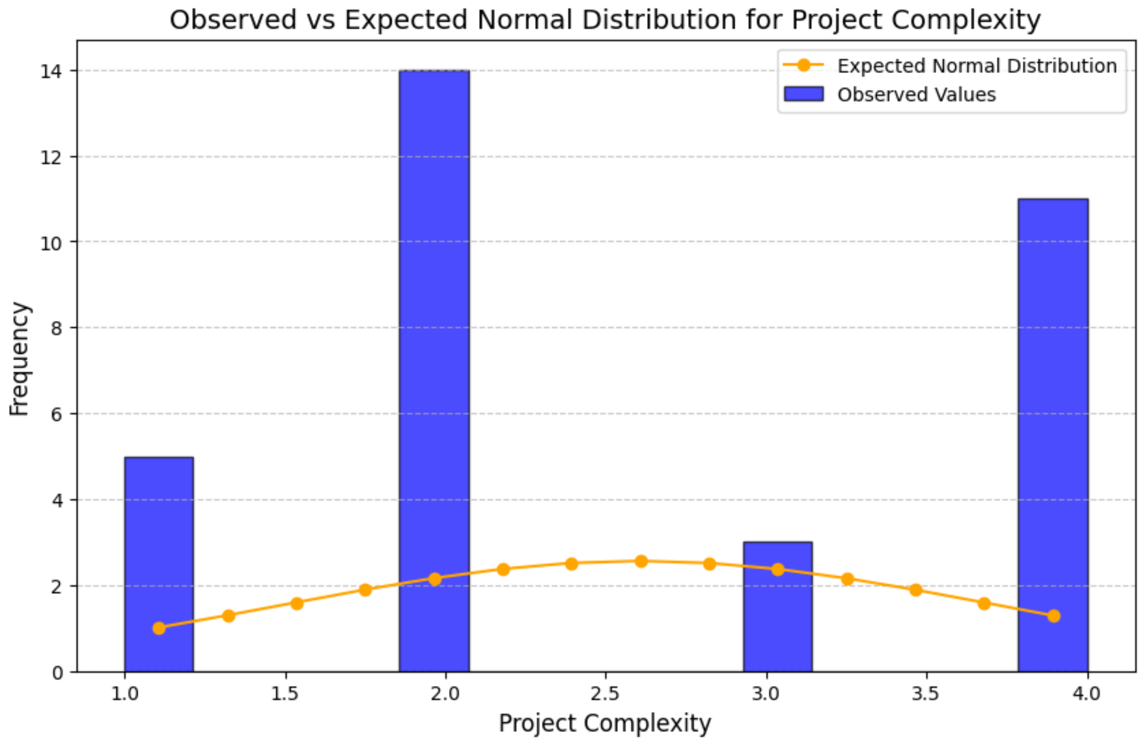
Relation and Trust
For new clients, the relationship is in its early stages, and trust is still being developed. These clients often require more focus on understanding their needs, processes, and operational context. Regular evaluations to align expectations, and build confidence. For long-term clients, the relationship is more established, with a stronger foundation of trust and mutual understanding. Over time, IJssel develops a deeper knowledge of the client's data, installations, and processes. Regular evaluations remain essential to maintain alignment, address new developments, and ensure continuous improvement.

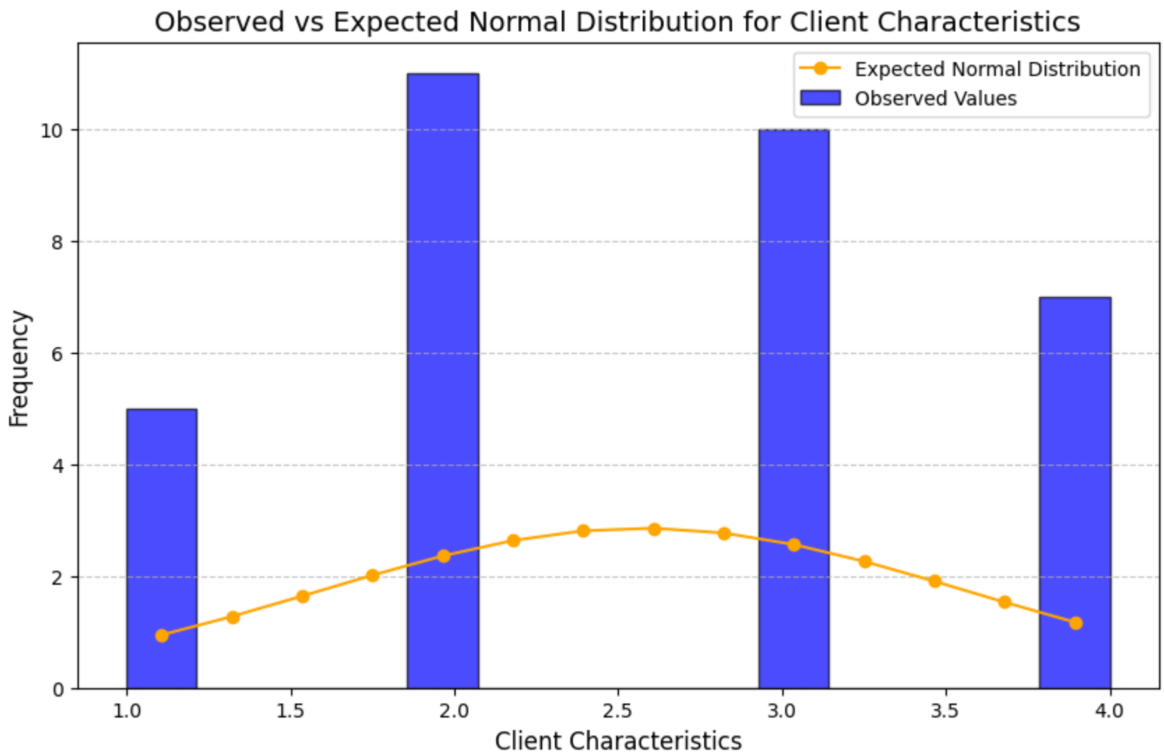
However, even with long-term relationships and high levels of trust, some clients have the right to conduct audits within IJssels' organization to ensure compliance and accountability. Certain clients enforce strict liability and compensation procedures as part of their risk management strategies.

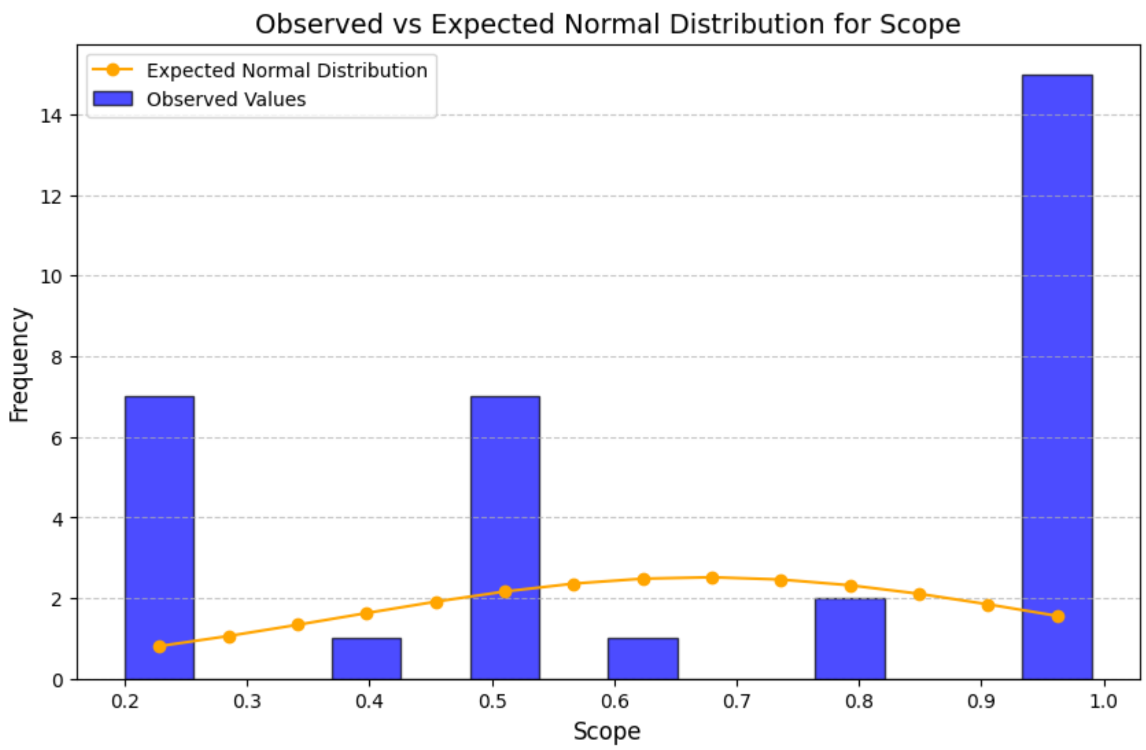
Resources Availability
With all the contracts there were adequate resources but with some constraints, which makes the attribute unusable because it does not provide any meaningful differentiation between the contracts. If all contracts share similar levels of resource availability, the attribute cannot serve as a variable to explain differences in outcomes such as profitability.

Organizational Strategy
Organizational Strategy refers to how well contracts align with IJssels' long-term strategic goals and priorities. In the analyzed database, there are no contracts that completely lack alignment with strategic goals, as all contracts must meet a baseline level of alignment to justify their execution. Contracts with minimal alignment typically involve smaller projects, such as temporary staffing or short-term services within an organization. These contracts contribute to operational needs but do not significantly support IJssels' broader strategic objectives. The larger contracts that generate the most revenue show full alignment with IJssels' long-term strategic priorities. These contracts are integral to achieving the company goals, such as building sustainable partnerships, enhancing operational efficiency, and driving innovation in asset management.

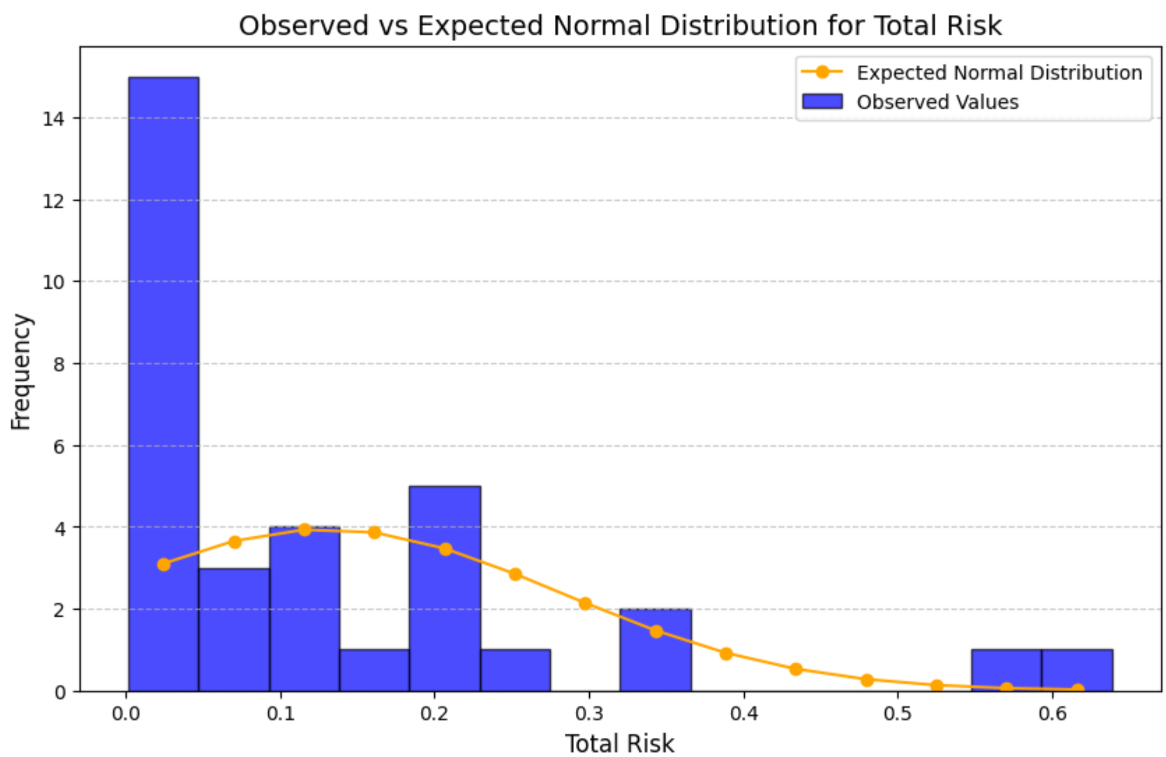
D. Distribution of Attributes







Observed vs Expected Normal Distribution for Scope
Expected Normal Distribution
Observed Values
Frequency
Scope

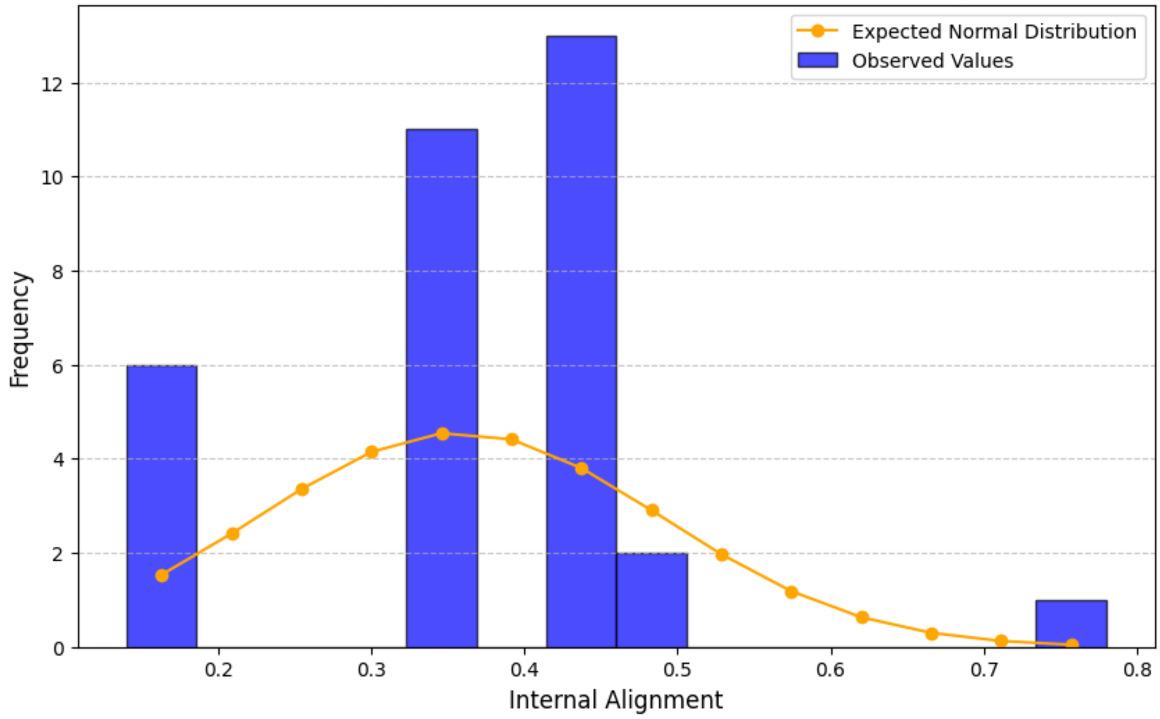


Observed vs Expected Normal Distribution for Total Risk
Expected Normal Distribution
Observed Values
Frequency
Total Risk

Observed vs Expected Normal Distribution for Profit

[redacted]

Observed vs Expected Normal Distribution for Internal Alignment



E. Output fsQCA Software:

Positive path

****

TRUTH TABLE ANALYSIS

****

File: C:/Users/jens.welles/OneDrive - IJssel/Thesis Jens/02 - Verslag/Results fsqca/fsqca complete2.csv

Model: Profit_CAL2 = f(ProjectComplex_CAL, Scope, ClientChar_CAL, Total_RISK_CAL)

Algorithm: Quine-McCluskey

--- COMPLEX SOLUTION ---

frequency cutoff: 2

consistency cutoff: 0.842391

raw unique

coverage coverage consistency

---------- ---------- ----------

ProjectComplex_CAL*Scope*ClientChar_CAL 0.385321 0.0467453 0.821229

Scope*ClientChar_CAL*Total_RISK_CAL 0.377457 0.0581039 0.852071

~ProjectComplex_CAL*Scope*~ClientChar_CAL*~Total_RISK_CAL 0.414592 0.240716 0.96738

solution coverage: 0.692005

solution consistency: 0.875138

****

TRUTH TABLE ANALYSIS

****

File: C:/Users/jens.welles/OneDrive - IJssel/Thesis Jens/02 - Verslag/Results fsqca/fsqca complete2.csv

Model: Profit_CAL2 = f(ProjectComplex_CAL, Scope, ClientChar_CAL, Total_RISK_CAL)

Algorithm: Quine-McCluskey

--- PARSIMONIOUS SOLUTION ---

frequency cutoff: 2

consistency cutoff: 0.842391

raw unique

coverage coverage consistency

---------- ---------- ----------

Scope 0.801223 0.801223 0.833258

solution coverage: 0.801223

solution consistency: 0.833258

****

TRUTH TABLE ANALYSIS

****

File: C:/Users/jens.welles/OneDrive - IJssel/Thesis Jens/02 - Verslag/Results fsqca/fsqca complete2.csv

Model: Profit_CAL2 = f(ProjectComplex_CAL, Scope, ClientChar_CAL, Total_RISK_CAL)

Algorithm: Quine-McCluskey

--- INTERMEDIATE SOLUTION ---

frequency cutoff: 2

consistency cutoff: 0.842391

Assumptions:

raw unique

coverage coverage consistency

---------- ---------- ----------

ProjectComplex_CAL*Scope*ClientChar_CAL 0.385321 0.0467453 0.821229

Scope*ClientChar_CAL*Total_RISK_CAL 0.377457 0.0581039 0.852071

~ProjectComplex_CAL*Scope*~ClientChar_CAL*~Total_RISK_CAL 0.414592 0.240716 0.96738

solution coverage: 0.692005

solution consistency: 0.875138

Negative path

File: C:/Users/jens.welles/OneDrive - IJssel/Thesis Jens/02 - Verslag/fsqca results Neg-result.csv

Model: NegProfit_CAL = f(ProjectComplex_CAL, Scope, ClientChar_CAL, Total_RISK_CAL)

Algorithm: Quine-McCluskey

--- PARSIMONIOUS SOLUTION ---

frequency cutoff: 2

consistency cutoff: 1

raw unique

coverage coverage consistency

---------- ---------- ----------

~Scope 0.909798 0 1

Complexity_CAL 0.975117 0.00699848 1

Total_RISK_CAL 0.968118 0 1

solution coverage: 0.975117

solution consistency: 0.987402

****

TRUTH TABLE ANALYSIS

****

File: C:/Users/jens.welles/OneDrive - IJssel/Thesis Jens/02 - Verslag/fsqca results Neg-result.csv

Model: NegProfit_CAL = f(ProjectComplex_CAL, Scope, ClientChar_CAL, Total_RISK_CAL)

Algorithm: Quine-McCluskey

--- INTERMEDIATE SOLUTION ---

frequency cutoff: 2

consistency cutoff: 1

Assumptions:

raw unique

coverage coverage consistency

---------- ---------- ----------

Complexity_CAL*Risk_CAL*~Scope 0.909798 0.909798 1

solution coverage: 0.909798

solution consistency: 1

E. Tool logic code VBA

```
Public GlobalContractType As String


Sub DetermineContractType()

   Dim ws As Worksheet

   Set ws = ThisWorkbook.Sheets("Contract Recommendation Tool") ' Adjust sheet name as needed


   ' Read input attributes

   Dim regulatoryScore As Double, marketScore As Double, trustScore As Double

   Dim totalRiskScore As Double, clientCharScore As Double, improvementPotential As Double

   Dim Executionlevel As String, influenceLevel As Double, riskWillingness As Double


   regulatoryScore = ws.Range("H8").value

   marketScore = ws.Range("L8").value

   trustScore = ws.Range("H15").value

   clientCharScore = ws.Range("H22").value ' Client Characteristics score

   improvementPotential = ws.Range("H29").value

   Executionlevel = ws.Range("G38").value ' Text input: Operational, Tactical, or Strategic

   influenceLevel = ws.Range("L38").value

   riskWillingness = ws.Range("H45").value


   ' Calculate Total Risk Score

   totalRiskScore = (regulatoryScore + marketScore + trustScore) / 3


   ' Determine contract type

   If improvementPotential > 50 And (Executionlevel = "Strategic") And _

      influenceLevel > 60 And riskWillingness > 66 And clientCharScore >= 40 And totalRiskScore <= 80
Then
```

```
    ' Suggest Performance-Based
    GlobalContractType = "Performance-Based"
  ElseIf totalRiskScore < 40 And riskWillingness > 60 And _
    (Executionlevel = "Tactical" Or Executionlevel = "Operational") And influenceLevel > 30 Then
    ' Suggest Fixed-Price
    GlobalContractType = "Unit-Rate / Fixed-Price"
  Else
    ' Default to Cost-Plus
    GlobalContractType = "Cost-Plus"
  End If

  ' Output the result in cell P2 with part of the text bold
  With ws.Range("P2")
    .value = "Suggested contract type: " & GlobalContractType
    .Characters(Start:=26, Length:=Len(GlobalContractType)).Font.Bold = True
  End With

  ' Call other subroutines
  GenerateTurnoverGraphDynamicDowntime
  GenerateComplexityMatrix
  With ThisWorkbook.Sheets("Contract Recommendation Tool")
    .Range("Q13").Formula2R1C1 = "=AI.ASK(BuildCompactRiskPrompt())"
    .Range("P5").Formula2R1C1 = "=AI.ASK(BuildCompatcontractPrompt())"
  End With

  ' Display the result in a message box
  MsgBox "The suggested contract type is: " & GlobalContractType, vbInformation, "Contract Recommendation"
```

```
End Sub


Sub GenerateRecommendation()
    Dim prompt As String
    prompt = BuildPrompt()

    ' Output the prompt to the Immediate window or use it with AI API
    Debug.Print prompt

    ' Example: Send the prompt to AI API or other systems
    MsgBox prompt
End Sub
Function GetDescription(value As Double, descriptions As Variant, thresholds As Variant) As String
    Dim i As Integer
    For i = LBound(thresholds) To UBound(thresholds)
        If value <= thresholds(i) Then
            GetDescription = descriptions(i)
            Exit Function
        End If
    Next i
    GetDescription = descriptions(UBound(descriptions)) ' Default to the last description if value exceeds
thresholds
End Function


Function BuildCompatcontractPrompt() As String
    Dim ws As Worksheet
    Set ws = ThisWorkbook.Sheets("Contract Recommendation Tool") ' Adjust sheet name as needed
```

```
' Read input attributes
Dim regulatoryScore As Double, marketScore As Double, trustScore As Double
Dim totalRiskScore As Double, clientCharScore As Double, improvementPotential As Double
Dim Executionlevel As String, influenceLevel As Double, riskWillingness As Double
Dim contractType As String, alternativeContract As String
Dim unmetConditions As Integer
Dim unmetConditionDescriptions As String
Dim importantAspects As String

regulatoryScore = ws.Range("H8").value
marketScore = ws.Range("L8").value
trustScore = ws.Range("H15").value
clientCharScore = ws.Range("H22").value
improvementPotential = ws.Range("H29").value
Executionlevel = ws.Range("G38").value
influenceLevel = ws.Range("L38").value
riskWillingness = ws.Range("H45").value

' Calculate Total Risk Score
totalRiskScore = (regulatoryScore + marketScore + trustScore) / 3

' Determine contract type
If improvementPotential > 50 And (Executionlevel = "Strategic") And _
  influenceLevel > 60 And riskWillingness > 66 And clientCharScore > 40 And totalRiskScore <= 80 Then
   contractType = "Performance-Based"
   importantAspects = "- Links payment to the achievement of specific performance goals." & vbNewLine & _
```

```
                "- Encourages efficiency and accountability in project execution." & vbNewLine & _
                "- Suitable for high improvement potential with measurable outcomes."
  ElseIf totalRiskScore < 40 And riskWillingness > 60 And _
      (Executionlevel = "Tactical" Or Executionlevel = "Operational") And influenceLevel > 30 Then
    contractType = "Unit-Rate / Fixed-Price"
    importantAspects = "- Provides cost certainty for both parties." & vbNewLine & _
                "- Ideal for low-risk projects with clearly defined requirements." & vbNewLine & _
                "- Encourages contractors to deliver efficiently within the agreed cost."
  Else
    contractType = "Cost-Plus"
    importantAspects = "- Offers flexibility for uncertain or evolving project requirements." & vbNewLine & _
                "- Minimizes financial risk to the contractor by reimbursing costs." & vbNewLine & _
                "- Suitable for projects where exact requirements are not fully defined."
  End If

' Check unmet conditions for alternative suggestion
unmetConditions = 0
unmetConditionDescriptions = ""

If improvementPotential <= 50 Then
  unmetConditions = unmetConditions + 1
  unmetConditionDescriptions = unmetConditionDescriptions & "- Improvement Potential is not greater than 50." & vbNewLine
End If
If Executionlevel <> "Strategic" Then
  unmetConditions = unmetConditions + 1
  unmetConditionDescriptions = unmetConditionDescriptions & "- Execution Level is not Strategic." & vbNewLine
```

```
End If

If influenceLevel <= 60 Then

   unmetConditions = unmetConditions + 1

   unmetConditionDescriptions = unmetConditionDescriptions & "- Influence Level is not smaller than 60." & vbNewLine

End If

If riskWillingness <= 66 Then

   unmetConditions = unmetConditions + 1

   unmetConditionDescriptions = unmetConditionDescriptions & "- Risk Willingness is not greater than 66 try mitaging the risk in order to reduce risk." & vbNewLine

End If

If totalRiskScore >= 80 Then

   unmetConditions = unmetConditions + 1

   unmetConditionDescriptions = unmetConditionDescriptions & "- Total Risk is to high." & vbNewLine

End If

If clientCharScore <= 40 Then

   unmetConditions = unmetConditions + 1

   unmetConditionDescriptions = unmetConditionDescriptions & "- Client Characteristics Score is not greater than 40." & vbNewLine

End If

'If totalRiskScore >= 40 And Executionlevel <> "Strategic" Then

 '  unmetConditions = unmetConditions + 1

  '  unmetConditionDescriptions = unmetConditionDescriptions & "- Total risk is too high." & vbNewLine

'End If


' Determine alternative contract type

If unmetConditions = 1 Then

   ' Handle specific conditions for Performance-Based
```

```
    If Executionlevel <> "Strategic" Or influenceLevel <= 60 Or clientCharScore <= 40 Or riskWillingness <= 66 Or totalRiskScore >= 80 Then

        alternativeContract = "Performance-Based"

    ' Handle specific conditions for Unit-Rate / Fixed-Price

    ElseIf improvementPotential <= 50 Then

    alternativeContract = "None"

    ElseIf totalRiskScore >= 40 And Executionlevel <> "Strategic" Then

        alternativeContract = "Unit-Rate / Fixed-Price"

    End If

Else

    alternativeContract = "None"

End If



    ' Build the prompt

    Dim prompt As String

    prompt = "The suggested contract type is **" & contractType & "** because it aligns with the project's requirements and characteristics." & vbNewLine & vbNewLine


    prompt = prompt & "### Important Aspects of the Recommended Contract:" & vbNewLine & importantAspects & vbNewLine & vbNewLine


    If alternativeContract <> "None" Then

        prompt = prompt & "### Alternative Option:" & vbNewLine & _

                "If one unmet condition were addressed, a **" & alternativeContract & "** contract could be a viable alternative. The unmet condition is:" & vbNewLine & _

                unmetConditionDescriptions & vbNewLine

    Else

        prompt = prompt & "No viable alternative contract type. thats it" & vbNewLine
```

```
    End If


    BuildCompatcontractPrompt = prompt
End Function







Function ClassifyScore(score As Double, thresholds As Variant, descriptions As Variant) As String
    Dim i As Integer
    For i = LBound(thresholds) To UBound(thresholds)
        If score <= thresholds(i) Then
            ClassifyScore = descriptions(i)
            Exit Function
        End If
    Next i
    ClassifyScore = descriptions(UBound(descriptions))
End Function



Function BuildCompactRiskPrompt() As String
    Dim ws As Worksheet
```

```
Set ws = ThisWorkbook.Sheets("Contract Recommendation Tool") ' Vervang "YourSheetName" met de naam van je werkblad

' Haal de waarden op
Dim regulatoryScore As Double
Dim marketScore As Double
Dim trustScore As Double
Dim totalRiskScore As Double

regulatoryScore = ws.Range("H8").value
marketScore = ws.Range("L8").value
trustScore = ws.Range("H15").value
totalRiskScore = (regulatoryScore + marketScore + trustScore) / 3 ' Gemiddelde van de drie scores

' Dynamische beschrijvingen ophalen
Dim regulatoryDesc As String
Dim marketDesc As String
Dim trustDesc As String

regulatoryDesc = GetDescription(regulatoryScore, Array("Minimal regulations", "Standard compliance", "Moderate demands", "Complex effort", "Highly stringent"), Array(20, 40, 60, 80))
marketDesc = GetDescription(marketScore, Array("Stable market", "Slightly volatile", "Moderate volatility", "High volatility", "Unstable market"), Array(20, 40, 60, 80))
trustDesc = GetDescription(trustScore, Array("High trust (>10 years)", "Medium trust (5-10 years)", "Low-medium trust (2-5 years)", "Low trust (<2 years)"), Array(25, 50, 75))

' Bouw de compacte prompt
Dim prompt As String
prompt = "Total Risk Score: " & Round(totalRiskScore, 2) & vbCrLf
```

```
    prompt = prompt & "Regulatory Rules: " & regulatoryDesc & vbCrLf
    prompt = prompt & "Market Conditions: " & marketDesc & vbCrLf
    prompt = prompt & "Relational Trust: " & trustDesc & vbCrLf
    prompt = prompt & "Key Drivers: Analyze the highest contributors and suggest risk mitigation steps."
      prompt = prompt & "Summarize the risks and suggest 2 key actions for mitigation."
      prompt = prompt & "summarize the risk in one compact sentence based on the scores. the rest of the information is not required."



    BuildCompactRiskPrompt = prompt
End Function
Sub GenerateTurnoverGraphDynamicDowntime()
    Dim wsData As Worksheet
    Dim wsChart As Worksheet
    Dim chartObj As ChartObject
    Dim shape As shape
    Dim x As Double, y As Double
    Dim dataStartRow As Integer
    Dim i As Integer
    Dim improvementPotential As Double
    Dim phaseNames As Variant, phaseColors As Variant
    Dim phaseStart As Variant, phaseEnd As Variant
    Dim chartLeft As Double, chartTop As Double, chartWidth As Double, chartHeight As Double
    Dim offsetFactor As Double
    Dim Executionlevel As String
    Dim clientMaturity As Double
     Dim foundRow As Range
    Dim result As Double
```

```
    Dim bulletX As Double, bulletY As Double

    Dim rowToSubtractFrom As Range

    Dim result2 As Double


    Dim scatterChartObj As ChartObject




  ' Disable screen updating and calculation to improve performance

    Application.ScreenUpdating = False

    Application.Calculation = xlCalculationManual


    ' Set the worksheets

    Set wsData = ThisWorkbook.Sheets("Contract Recommendation Tool") ' Data and chart location

    Set wsChart = ThisWorkbook.Sheets("Contract Recommendation Tool") ' Chart location (same sheet)


     ' Check if any charts exist after row 12 on the sheet and delete them

    For Each chartObj In wsChart.ChartObjects

        If chartObj.TopLeftCell.Row > 40 Then

            chartObj.Delete

        End If

    Next chartObj


    ' Get the value in H29 from "Contract Recommendation Tool"

    improvementPotential = wsChart.Range("H29").value

    Executionlevel = wsChart.Range("G38").value

    levelOfInfluence = wsChart.Range("L38").value
```

```
' Define data start row
dataStartRow = 2

' Clear previous data from "Contract Recommendation Tool"
wsData.Range("AM:AR").ClearContents ' Clear data columns AM to AP


' Generate data points for duration in columns AM to AP
wsData.Cells(1, 39).value = "Duration (T)" ' Column AM
wsData.Cells(1, 40).value = "Costplus"    ' Column AN
wsData.Cells(1, 41).value = "Performance-Based" ' Column AO
wsData.Cells(1, 42).value = "Downtime Cost" ' Column AP
wsData.Cells(1, 43).value = "Client maturity" ' Column AP

For i = 1 To 100
  x = 1 + (i - 1) * (10 - 1) / 99 ' Generate 100 points between 1 and 10
  wsData.Cells(dataStartRow + i - 1, 39).value = Round(x, 0) ' Column AM
        ' Populate Column AQ with numbers 1 to 100
wsData.Cells(dataStartRow + i - 1, 43).value = i ' Column AQ
       ' Costplus logic
         If Executionlevel = "Strategic" Then
           If levelOfInfluence > 60 Then
             If improvementPotential > 60 Then
               ' Strategic, High Influence, High Improvement Potential
               If x < 3 Then
                 y = 9
```

```
        Else
          y = 4 + (9 - 4) * Exp(-0.5 * (x - 3))
        End If
      ElseIf improvementPotential <= 60 And improvementPotential > 50 Then
        ' Strategic, High Influence, Medium Improvement Potential
        If x < 3 Then
          y = 9
        Else
          y = 5 + (9 - 5) * Exp(-0.4 * (x - 3))
        End If
      ElseIf improvementPotential <= 50 Then
        ' Strategic, High Influence, Low Improvement Potential
        If x < 3 Then
          y = 9
        Else
          y = 5 + (9 - 5) * Exp(0 * (x - 3))
        End If
      End If
    ElseIf levelOfInfluence <= 60 Then
      ' Strategic, Low Influence, High Improvement Potential
      If improvementPotential > 75 Or improvementPotential >= 50 Then
        y = 7
      End If
    End If
  ElseIf Executionlevel = "Tactical" Then
    If levelOfInfluence > 60 Then
      ' Tactical, High Influence, High Improvement Potential
```

```
            y = 7
          ElseIf levelOfInfluence < 60 Then
            ' Tactical, Low Influence, High Improvement Potential
            y = 7
          End If
        ElseIf Executionlevel = "Operational" Then

            ' Operational, High Influence, High Improvement Potential
            y = 7

        End If

        ' Assign calculated value to the relevant cell
        wsData.Cells(dataStartRow + i - 1, 40).value = y ' Column AN



    ' Performance-Based logic
    If Executionlevel = "Strategic" Then
      If levelOfInfluence > 60 Then
        If improvementPotential < 50 Then
          y = 0
        ElseIf improvementPotential >= 50 And improvementPotential < 60 Then
          If x < 3 Then
            y = 0
          Else
            y = 8 - 8 * Exp(-0.2 * (x - 3))
```

```
        End If
      Else
        If x < 3 Then
          y = 0
        Else
          y = 9 - 9 * Exp(-0.4 * (x - 3))
        End If
      End If
    Else
      ' Default logic if levelOfInfluence <= 60
      y = 0 ' Example of fallback logic
    End If
  Else
    ' Default logic if Executionlevel is not Strategic
    y = y = 8 - 8 * Exp(-0 * (x - 3)) ' Example of fallback logic
  End If
  wsData.Cells(dataStartRow + i - 1, 41).value = y ' Column AO


 ' Improvement Potential logic
  If improvementPotential >= 60 Then
    ' High Improvement Potential (> 75)
    If x < 2 Then
      y = 13
    Else
      y = 2 + (13 - 2) * Exp(-0.3 * (x - 2))
    End If
```

```
ElseIf improvementPotential < 60 And improvementPotential >= 50 Then
    ' Medium Improvement Potential (< 75 > 50)
    If x < 2 Then
        y = 10
    Else
        y = 2 + (10 - 2) * Exp(-0.2 * (x - 2))
    End If
ElseIf improvementPotential < 50 And improvementPotential >= 25 Then
    ' Low Improvement Potential (< 50 > 25)
    If x < 2 Then
        y = 5
    Else
        y = 2 + (5 - 2) * Exp(0 * (x - 2))
    End If
ElseIf improvementPotential < 25 Then
    ' Very Low Improvement Potential (< 25)
    If x < 3 Then
        y = 0
    Else
        y = (0) * Exp(0 * (x - 3))
    End If
End If

' Assign calculated value to the relevant cell
wsData.Cells(dataStartRow + i - 1, 42).value = y ' Column AP

Next i
```

```
Set foundRow = Nothing

 wsData.Range("AV:AW").ClearContents
    ' Get the value from H22
    clientMaturity = wsData.Range("H22").value

    ' Check if the value is between 1 and 100
    If clientMaturity >= 1 And searchValue <= 100 Then

       ' Find the value in Column AQ
Set foundRow = wsData.Columns("AQ").Find(What:=clientMaturity, LookIn:=xlValues, LookAt:=xlWhole)

    ' If the value is found, calculate the sum and place it in Column AR
    If Not foundRow Is Nothing Then
 Select Case True
        Case foundRow.Row < 80 And foundRow.Row > 40
            Set foundRow = wsData.Rows(foundRow.Row - 20)
        Case foundRow.Row <= 40 And foundRow.Row > 20
            Set foundRow = wsData.Rows(15)
        Case foundRow.Row <= 10
            Set foundRow = wsData.Rows(2)
    End Select
```

```
    ' Calculate the sum and place it in Column AR
    result = wsData.Cells(foundRow.Row, 40).value + wsData.Cells(foundRow.Row, 41).value ' AN + AO

    result2 = wsData.Cells(foundRow.Row, 47).value
    wsData.Cells(foundRow.Row, 48).value = Round(result2, 1)
    wsData.Cells(foundRow.Row, 44).value = Round(result, 1) ' Place the sum in Column AR
    bulletX = wsData.Cells(foundRow.Row, 39).value ' Column AM (x-value)
    bulletY = result ' Column AR (y-value) now contains the sum
End If
End If



   ' Create the chart in "Contract Recommendation Tool" at Q43
Set chartObj = wsChart.ChartObjects.Add(Left:=wsChart.Range("Q43").Left, _
                              Top:=wsChart.Range("Q43").Top, _
                              Width:=700, Height:=500)
chartObj.ShapeRange.ZOrder msoSendToBack



With chartObj.Chart
    .ChartType = xlLine ' Line chart without markers
    .HasTitle = True
```

```
.ChartTitle.Text = "Revenue Model"

.Axes(xlCategory).HasTitle = True

.Axes(xlCategory).AxisTitle.Text = "Duration (T)"

.Axes(xlCategory).TickLabelPosition = xlNone ' Remove x-axis numbers

.Axes(xlValue).TickLabelPosition = xlNone

.Axes(xlValue).HasTitle = True

.Axes(xlValue).AxisTitle.Text = "Turnover (in million €)"


' Add Costplus series

.SeriesCollection.NewSeries

If GlobalContractType = "Unit-Rate / Fixed-Price" Then

 .SeriesCollection(1).Name = "Unit-Rate / Fixed-Price"

Else

.SeriesCollection(1).Name = "Costplus"

End If




.SeriesCollection(1).XValues = wsData.Range(wsData.Cells(dataStartRow, 39), wsData.Cells(dataStartRow + 99, 39)) ' Column AM

.SeriesCollection(1).Values = wsData.Range(wsData.Cells(dataStartRow, 40), wsData.Cells(dataStartRow + 99, 40)) ' Column AN

.SeriesCollection(1).Format.Line.ForeColor.RGB = RGB(0, 0, 255) ' Blue solid line


' Add Performance-Based series

.SeriesCollection.NewSeries

.SeriesCollection(2).Name = "Performance-Based"

.SeriesCollection(2).XValues = wsData.Range(wsData.Cells(dataStartRow, 39), wsData.Cells(dataStartRow + 99, 39)) ' Column AM
```

```
    .SeriesCollection(2).Values = wsData.Range(wsData.Cells(dataStartRow, 41), wsData.Cells(dataStartRow + 99, 41)) ' Column AO

    .SeriesCollection(2).Format.Line.ForeColor.RGB = RGB(255, 165, 0) ' Orange solid line


    ' Add Downtime Cost series

    .SeriesCollection.NewSeries

    .SeriesCollection(3).Name = "Improvement Potential"

    .SeriesCollection(3).XValues = wsData.Range(wsData.Cells(dataStartRow, 39), wsData.Cells(dataStartRow + 99, 39)) ' Column AM

    .SeriesCollection(3).Values = wsData.Range(wsData.Cells(dataStartRow, 42), wsData.Cells(dataStartRow + 99, 42)) ' Column AP

    .SeriesCollection(3).Format.Line.DashStyle = msoLineDashDot ' Red dashed line

    .SeriesCollection(3).Format.Line.ForeColor.RGB = RGB(255, 0, 0) ' Red line

' Set the y-axis (Value Axis) to be fixed from 0 to 14

    With .Axes(xlValue)

        .MinimumScale = 0

        .MaximumScale = 14

    End With




End With



  ' Add the scatter plot chart in "Contract Recommendation Tool" at a specified location

    Set scatterChartObj = wsChart.ChartObjects.Add(Left:=wsChart.Range("Q43").Left, _

                                Top:=wsChart.Range("Q43").Top, _

                                Width:=700, Height:=500)
```

```
With scatterChartObj.Chart
    .ChartType = xlXYScatter ' Scatter plot
    .HasTitle = True
    .ChartTitle.Text = "Revenue Model"

    ' Remove axis titles and labels
    .Axes(xlCategory).HasTitle = False
    .Axes(xlCategory).TickLabels.Delete
    .Axes(xlValue).HasTitle = False
   .Axes(xlValue).TickLabels.Delete

    ' Add series for scatter plot
    .SeriesCollection.NewSeries
    .SeriesCollection(1).Name = "Revenue IJssel"
    .SeriesCollection(1).XValues = wsData.Range(wsData.Cells(dataStartRow, 39), wsData.Cells(dataStartRow + 99, 39)) ' Column AM

    .SeriesCollection(1).Values = wsData.Range(wsData.Cells(dataStartRow, 44), wsData.Cells(dataStartRow + 99, 44)) ' Column AR

    .SeriesCollection(1).MarkerStyle = xlMarkerStyleCircle
    .SeriesCollection(1).MarkerSize = 15
    .SeriesCollection(1).Format.Line.Visible = msoFalse
```

```
    ' Remove gridlines
    .Axes(xlCategory).MajorGridlines.Format.Line.Visible = msoFalse
    .Axes(xlValue).MajorGridlines.Format.Line.Visible = msoFalse

    ' Ensure full transparency for the plot area and chart area
    With .plotArea.Format.Fill
        .Visible = msoTrue
        .ForeColor.RGB = RGB(255, 255, 255)
        .Transparency = 1
    End With
    With .ChartArea.Format.Fill
        .Visible = msoTrue
        .ForeColor.RGB = RGB(255, 255, 255)
        .Transparency = 1
    End With

        ' Keep only the legend and adjust its position
    .HasLegend = True
    .Legend.Position = xlLegendPositionRight
    .Legend.Top = .Legend.Top - 35 ' Move the legend slightly higher
         .Legend.Left = .Legend.Left - 40 ' Move the legend slightly to the left
' Set the y-axis (Value Axis) to be fixed from 0 to 14
With .Axes(xlValue)
    .MinimumScale = 0
    .MaximumScale = 14
```

```
End With



End With


Dim shapeNames As Variant
shapeNames = Array("predictive", "dynamic", "learning", "standard", "reactive")
Dim shapeName As String
 For Each shape In wsChart.Shapes

  shapeName = shape.Name

  ' Check if the shape name matches any in the array
  Dim j As Integer
  For j = LBound(shapeNames) To UBound(shapeNames)
    If LCase(shapeName) = LCase(shapeNames(j)) Then
      shape.Visible = msoFalse ' Make the shape invisible
      Exit For ' Exit loop once a match is found
    End If
  Next j
Next shape

If GlobalContractType = "Performance-Based" Then
  ' Calculate Maintenance Cost and Total Cost Client
  Dim maintenanceCostRange As Range, downtimeCostRange As Range, totalCostRange As Range
  Dim Clientchart As ChartObject
```

```
' Define ranges for the new calculations

Set maintenanceCostRange = wsData.Range(wsData.Cells(dataStartRow, 45), wsData.Cells(dataStartRow + 99, 45)) ' Column AS

Set downtimeCostRange = wsData.Range(wsData.Cells(dataStartRow, 46), wsData.Cells(dataStartRow + 99, 46)) ' Column AT

Set totalCostRange = wsData.Range(wsData.Cells(dataStartRow, 47), wsData.Cells(dataStartRow + 99, 47)) ' Column AU


wsData.Range("AS:AU").ClearContents



' Add headers

wsData.Cells(1, 45).value = "Maintenance Cost"

wsData.Cells(1, 46).value = "Downtime Cost"

wsData.Cells(1, 47).value = "Total Cost Client"


' Populate data for Maintenance Cost, Downtime Cost, and Total Cost

For i = 1 To 100

    maintenanceCostRange.Cells(i).value = wsData.Cells(dataStartRow + i - 1, 40).value + wsData.Cells(dataStartRow + i - 1, 41).value ' Costplus + Performance-Based

    downtimeCostRange.Cells(i).value = wsData.Cells(dataStartRow + i - 1, 42).value ' Downtime Cost (Improvement Potential)

    totalCostRange.Cells(i).value = maintenanceCostRange.Cells(i).value + downtimeCostRange.Cells(i).value ' Total Cost = Maintenance + Downtime

Next i


' Add the graph

Set Clientchart = wsChart.ChartObjects.Add(Left:=wsChart.Range("Q79").Left, _

                    Top:=wsChart.Range("Q79").Top, _

                    Width:=700, Height:=500)
```

```
With Clientchart.Chart
    .ChartType = xlLine ' Line chart
    .HasTitle = True
    .ChartTitle.Text = wsChart.Range("H2") & " Costs (€)"
    .Axes(xlCategory).HasTitle = True
    .Axes(xlCategory).AxisTitle.Text = "Duration (T)"
    .Axes(xlValue).HasTitle = True
    .Axes(xlValue).AxisTitle.Text = "Cost (in million €)"
   .Axes(xlCategory).TickLabels.Delete
    .Axes(xlValue).TickLabels.Delete

    ' Add Maintenance Cost series
    .SeriesCollection.NewSeries
    .SeriesCollection(1).Name = "Maintenance Cost"
    .SeriesCollection(1).XValues = wsData.Range(wsData.Cells(dataStartRow, 39), wsData.Cells(dataStartRow + 99, 39)) ' Column AM
    .SeriesCollection(1).Values = maintenanceCostRange ' Column AS
    .SeriesCollection(1).Format.Line.ForeColor.RGB = RGB(0, 128, 0) ' Green solid line

    ' Add Downtime Cost series
    .SeriesCollection.NewSeries
    .SeriesCollection(2).Name = "Downtime Cost"
    .SeriesCollection(2).XValues = wsData.Range(wsData.Cells(dataStartRow, 39), wsData.Cells(dataStartRow + 99, 39)) ' Column AM
    .SeriesCollection(2).Values = downtimeCostRange ' Column AT
    .SeriesCollection(2).Format.Line.ForeColor.RGB = RGB(255, 0, 0) ' Red solid line
```

```
        ' Add Total Cost Client series
        .SeriesCollection.NewSeries
        .SeriesCollection(3).Name = "Total Cost Client"
        .SeriesCollection(3).XValues = wsData.Range(wsData.Cells(dataStartRow, 39), wsData.Cells(dataStartRow + 99, 39)) ' Column AM
        .SeriesCollection(3).Values = totalCostRange ' Column AU
        .SeriesCollection(3).Format.Line.ForeColor.RGB = RGB(0, 0, 255) ' Blue solid line

        ' Set the y-axis range
        With .Axes(xlValue)
            .MinimumScale = 0
            .MaximumScale = 25
        End With

    End With

    ' Send the chart to the background
    Clientchart.ShapeRange.ZOrder msoSendToBack



     Set scatterChartObj = wsChart.ChartObjects.Add(Left:=wsChart.Range("Q79").Left, _
                                       Top:=wsChart.Range("Q79").Top, _
                                       Width:=700, Height:=500)

    With scatterChartObj.Chart
        .ChartType = xlXYScatter ' Scatter plot
        .HasTitle = True
        .ChartTitle.Text = wsChart.Range("H2") & " Costs (€)"
```

```
' Remove axis titles and labels
.Axes(xlCategory).HasTitle = False
.Axes(xlCategory).TickLabels.Delete
.Axes(xlValue).HasTitle = False
.Axes(xlValue).TickLabels.Delete

' Add series for scatter plot
.SeriesCollection.NewSeries
.SeriesCollection(1).Name = wsChart.Range("H2") & " Total Costs (€)"
.SeriesCollection(1).XValues = wsData.Range(wsData.Cells(dataStartRow, 39), wsData.Cells(dataStartRow + 99, 39)) ' Column AM
.SeriesCollection(1).Values = wsData.Range(wsData.Cells(dataStartRow, 48), wsData.Cells(dataStartRow + 99, 48)) ' Column AR
.SeriesCollection(1).MarkerStyle = xlMarkerStyleCircle
.SeriesCollection(1).MarkerSize = 15
.SeriesCollection(1).Format.Line.Visible = msoFalse



' Remove gridlines
.Axes(xlCategory).MajorGridlines.Format.Line.Visible = msoFalse
.Axes(xlValue).MajorGridlines.Format.Line.Visible = msoFalse

' Ensure full transparency for the plot area and chart area
With .plotArea.Format.Fill
    .Visible = msoTrue
    .ForeColor.RGB = RGB(255, 255, 255)
```

```
        .Transparency = 1
    End With
    With .ChartArea.Format.Fill
        .Visible = msoTrue
        .ForeColor.RGB = RGB(255, 255, 255)
        .Transparency = 1
    End With

        ' Keep only the legend and adjust its position
    .HasLegend = True
    .Legend.Position = xlLegendPositionRight
    .Legend.Top = .Legend.Top - 35 ' Move the legend slightly higher
         .Legend.Left = .Legend.Left - 15 ' Move the legend slightly to the left



With .Axes(xlValue)
    .MinimumScale = 0
    .MaximumScale = 25
End With

End With
  ' Array of shape names to hide



' Loop through shapes in the chart worksheet
For Each shape In wsChart.Shapes
```

```
        shapeName = shape.Name

        ' Check if the shape name matches any in the array
        Dim K As Integer
        For K = LBound(shapeNames) To UBound(shapeNames)
          If LCase(shapeName) = LCase(shapeNames(K)) Then
            shape.Visible = msoTrue ' Make the shape invisible
            Exit For ' Exit loop once a match is found
          End If
        Next K
      Next shape

End If
  ' Loop through shapes in the chart worksheet



'End If
  ' Define phases
   'phaseNames = Array("Reactive", "Standardized", "Learning", "Dynamic", "Predictive")

   'phaseStart = Array(0.58, 1.35, 2.1, 3.2, 4.5)
   'phaseEnd = Array(1.35, 2.1, 3.2, 4.5, 7.4)

   ' Add background shapes and phase labels for phases
   'chartLeft = chartObj.Left
   'chartTop = chartObj.Top
   'chartWidth = chartObj.Width
```

```
'chartHeight = chartObj.Height
'offsetFactor = chartWidth / 10 ' Width of one unit (T=1)

'For i = LBound(phaseNames) To UBound(phaseNames)
   ' Add background rectangle for the phase
  ' Set shape = wsChart.Shapes.AddShape(msoShapeRectangle, _
  '                           chartLeft + phaseStart(i) * offsetFactor, _
   '                          chartTop, _
    '                         (phaseEnd(i) - phaseStart(i)) * offsetFactor, _
     '                        chartHeight)
   ' shape.Fill.ForeColor.RGB = phaseColors(i)
    'shape.Fill.Transparency = 0.8 ' Semi-transparent
    'shape.Line.Visible = msoFalse ' Hide the border of the rectangle

    ' Add phase name text
    'Set shape = wsChart.Shapes.AddTextbox(msoTextOrientationHorizontal, _
     '                        chartLeft + ((phaseStart(i) + phaseEnd(i)) / 2) * offsetFactor - 40, _
      '                       chartTop - 20, _
       '                      80, _
        '                     20)
    'shape.TextFrame.Characters.Text = phaseNames(i)
    'shape.TextFrame.HorizontalAlignment = xlHAlignCenter
    'shape.Line.Visible = msoFalse ' Optional: Hide the border around the text box
'Next i
```

```
    ' Restore screen updating and calculation
    Application.Calculation = xlCalculationAutomatic
    Application.ScreenUpdating = True

End Sub



Sub GenerateComplexityMatrix()
    Dim ws As Worksheet
    Dim influenceRange As Range
    Dim executionRange As Range
    Dim labelRange As Range
    Dim cht As Chart
    Dim chObject As ChartObject
    Dim influence As Double
    Dim executing As String
    Dim executionValue As Double
    Dim labelText As String
    Dim chartExists As Boolean
    Dim shp As shape

    ' Set the current worksheet
    Set ws = ThisWorkbook.Sheets("Contract Recommendation Tool") ' Adjust "YourSheetName" to the actual sheet name
```

```
' Define named ranges for merged cells (use top-left cell of the merged range)
On Error Resume Next
Set influenceRange = ws.Range("InfluenceInput").Cells(1, 1)
Set executionRange = ws.Range("ExecutionInput").Cells(1, 1)
Set labelRange = ws.Range("H3").Cells(1, 1) ' Adjust as needed
On Error GoTo 0

If influenceRange Is Nothing Or executionRange Is Nothing Or labelRange Is Nothing Then
    MsgBox "Named ranges 'InfluenceInput', 'ExecutionInput', or the label cell are not properly defined.", vbCritical
    Exit Sub
End If

' Validate inputs
If IsEmpty(influenceRange.value) Or IsEmpty(executionRange.value) Or IsEmpty(labelRange.value) Then
    MsgBox "One or more of the input cells are empty. Please provide valid inputs.", vbExclamation
    Exit Sub
End If

' Retrieve values from the named ranges
executing = executionRange.value
influence = influenceRange.value
labelText = labelRange.value

' Map execution level to numeric values (Reversed for Y-axis)
Select Case UCase(Trim(executing))
```

```
        Case "STRATEGIC"
            executionValue = 83
        Case "TACTICAL"
            executionValue = 50
        Case "OPERATIONAL"
            executionValue = 17
        Case Else
            MsgBox "Invalid value in ExecutionInput. Please use 'Operational', 'Tactical', or 'Strategic'.", vbExclamation
            Exit Sub
    End Select

    ' Check if the chart exists
    chartExists = False
    For Each chObject In ws.ChartObjects
        If chObject.Name = "ProjectMatrix" Then
            chartExists = True
            Exit For
        End If
    Next chObject

    ' Create the chart if it doesn't exist
    If Not chartExists Then
        Set chObject = ws.ChartObjects.Add(Left:=ws.Range("Q19").Left, _
                                Top:=ws.Range("Q19").Top, _
                                Width:=400, _
                                Height:=300)
        chObject.Name = "ProjectMatrix"
```

```
End If


' Update the chart
Set cht = ws.ChartObjects("ProjectMatrix").Chart
With cht
    .ChartType = xlXYScatter

    ' Add or update data point
    If .SeriesCollection.Count = 0 Then
        With .SeriesCollection.NewSeries
            .XValues = Array(influence)
            .Values = Array(executionValue)
            .MarkerStyle = xlMarkerStyleCircle
            .MarkerSize = 20
            .MarkerBackgroundColor = RGB(0, 128, 255)
            .MarkerForegroundColor = RGB(0, 128, 255)
        End With
    Else
        With .SeriesCollection(1)
            .XValues = Array(influence)
            .Values = Array(executionValue)
            .MarkerStyle = xlMarkerStyleCircle
            .MarkerSize = 20
            .MarkerBackgroundColor = RGB(0, 128, 255)
            .MarkerForegroundColor = RGB(0, 128, 255)
        End With
    End If
```

```
' Remove any existing label
For Each shp In cht.Shapes
   If shp.Name Like "Label*" Then shp.Delete
Next shp

' Add a new label next to the dot
Dim newLabel As shape
Set newLabel = .Shapes.AddTextbox(msoTextOrientationHorizontal, _
                          cht.plotArea.InsideLeft + (influence / 100) * cht.plotArea.Width + 15, _
                          cht.plotArea.InsideTop + cht.plotArea.Height - (executionValue / 100) * cht.plotArea.Height, _
                          200, 30)
With newLabel
   .Name = "Label" & CStr(.ID)
   .TextFrame.Characters.Text = labelText
   .TextFrame.HorizontalAlignment = xlHAlignLeft
   .TextFrame.VerticalAlignment = xlVAlignCenter
   .TextFrame.Characters.Font.Size = 12
End With

' Add title
.HasTitle = True
.ChartTitle.Text = "Complexity Matrix"
.ChartTitle.Font.Size = 14

' Format X axis
With .Axes(xlCategory)
```

```
    .HasTitle = True
    .AxisTitle.Text = "Level of Influence"
    .MinimumScale = 0
    .MaximumScale = 100
    .TickLabels.NumberFormat = "0"
  End With
  ' Format Y axis
    With .Axes(xlValue)
      .HasTitle = True
      .AxisTitle.Text = "Level of Executing"
      .MinimumScale = 0
      .MaximumScale = 100
      .MajorUnit = 33
      .TickLabels.Font.Color = RGB(255, 255, 255) ' Make numbers white
      ' Move the Y-axis title further to the left
      .AxisTitle.Left = .AxisTitle.Left - 40
    End With

    ' Remove legend if present
    If .HasLegend Then .Legend.Delete

    ' Add custom text labels to Y-axis
   '  Dim i As Integer
   '  Dim yLabels As Variant
  '   yLabels = Array("Strategic", "Tactical", "Operational")
   '  For i = 1 To 3
    '    cht.Shapes.AddTextbox(msoTextOrientationHorizontal, _
```

```
    '                   cht.plotArea.InsideLeft - 50, _
     '                  cht.plotArea.InsideTop + (i - 1) * cht.plotArea.Height / 3, _
      '                 100, 15).TextFrame.Characters.Text = yLabels(i - 1)
   ' Next i
  ' Format Y axis
  With .Axes(xlValue)
    .HasTitle = True
    .AxisTitle.Text = "Level of Execution"
    .MinimumScale = 0
    .MaximumScale = 100
    .MajorUnit = 33
    .TickLabels.Font.Color = RGB(255, 255, 255)
  End With
  ' Remove legend if present
  If .HasLegend Then .Legend.Delete
 End With
 ' Send chart to background
 ws.ChartObjects("ProjectMatrix").ShapeRange.ZOrder msoSendToBack

End Sub
```

F. Database Contacts

Excel file on Flash drive.