

WHITE PAPER

# Lifecycle Service Contracts for Industrial Equipment

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How a Systematic Approach to Long-Term Maintenance Agreements Creates Value for Operators, Service Providers, and Equipment Alike

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## 1. Executive Summary

Capital-intensive industries face a fundamental tension when it comes to equipment maintenance: operators want cost predictability and uptime guarantees, while service providers need sustainable margins and manageable risk exposure. The traditional "fix when it fails" approach satisfies neither party and systematically destroys value for both.

This paper presents the case for lifecycle service contracts as a superior alternative. Drawing on 28 years of direct operational experience in industrial B2B services and over 14 years of designing, pricing, and executing lifecycle service contracts across the challenging markets in MEA, the author demonstrates that a structured, methodology-driven approach to long-term maintenance agreements creates measurable value for all stakeholders: operators, service providers, OEM partners, and the equipment itself.

The paper further argues that the critical success factor is not the contractual framework alone, but the calculation methodology and tooling that underpins it. Without a rigorous, auditable, and repeatable cost model, lifecycle contracts become exercises in guesswork, exposing one or both parties to unacceptable risk.

KhahanA Insights has productised this methodology into a professional-grade Lifecycle Cost Calculation (LCC) platform applicable to any industrial equipment: from urban bus fleets and rail rolling stock to power generation chains, mining operations, and oil and gas installations.

## 2. The Problem: Why Reactive Maintenance Fails at Scale

### 2.1 The Real Cost of "Fix When It Fails"

Most fleet and equipment operators begin with a reactive maintenance model. Equipment is serviced when it breaks down, parts are procured on an emergency basis, and workshop capacity is allocated on a case-by-case basis without forward planning. This approach appears cost-efficient in the short term because it avoids the perceived overhead of structured maintenance planning.

In practice, reactive maintenance creates a cascade of hidden costs:

- **Unplanned downtime:** A single immobilised vehicle in a public transport fleet can cost the operator thousands in penalties, substitute services, and reputational damage per day. In mining, a haul truck standing idle can represent losses exceeding USD 50,000 per shift.
- **Emergency procurement premiums:** Parts ordered under time pressure typically cost 30–60% more than planned procurement. Air freight, expedited customs, and weekend surcharges compound the cost further.
- **Workshop inefficiency:** Reactive work cannot be batched or sequenced. Technicians alternate between emergency jobs and idle periods. Tool and bay utilisation drops. Labour cost per repair hour increases.
- **Accelerated equipment degradation:** When maintenance budgets are unpredictable, operators tend to defer non-critical interventions. Deferred maintenance compounds: a seal not replaced at 500,000 km becomes a gearbox failure at 600,000 km.
- **Budget volatility:** Finance teams cannot forecast OPEX with confidence. Every quarter brings surprises. Capital allocation for fleet renewal is distorted by unpredictable maintenance costs.

### 2.2 The Pricing Paralysis

When operators and service providers attempt to move beyond reactive maintenance into structured contracts, they encounter a different problem: pricing paralysis.

A lifecycle service contract requires the service provider to commit to a fixed price (typically per kilometre, per hour, or per unit per month) for a period ranging from 3 to 25 years. This commitment must account for every variable that affects cost: spare part failure frequencies, overhaul intervals, labour rate inflation, consumable price movements, duty cycle variations, climate factors, operator behaviour, and contractual penalty exposure.

In practice, this means:

- Dozens of cost assumptions, each with its own uncertainty range
- Multiple stakeholders (regional management, group finance, technical teams) with differing risk appetites
- Iterative spreadsheet models that grow in complexity with each review cycle
- Decision timelines measured in months, sometimes exceeding the customer's patience

The author's direct experience illustrates this challenge. Upon taking over regional aftermarket responsibility for a major European OEM in the Middle East 14 years ago, the first major inquiry was a request to price a lifecycle service contract covering the transmission systems of a fleet of over 500 vehicles across a 10-year horizon. The initial reaction was one of complete overwhelm: the number of interacting variables, the length of the commitment, and the financial exposure if assumptions proved wrong made the task feel intractable.

Every financial controller consulted produced a different risk assessment. Every scenario model generated a different price point. The decision process stalled while the customer waited and competitors circled.

This experience became the catalyst for developing a systematic calculation methodology that would eventually be certified by the division CFO, adopted as the organisational standard, and deployed successfully across multiple regions and product lines.

### 3. The Lifecycle Service Contract Model

#### 3.1 Definition and Scope

A lifecycle service contract (also referred to as a frame contract, full-service agreement, or total care package) is a long-term maintenance agreement in which the service provider assumes responsibility for maintaining specified equipment systems at a fixed, pre-agreed price, typically indexed to a measurable output metric such as kilometres driven, hours operated, or units produced.

The scope typically encompasses one or more of the following service elements:

Service Element	Description
Consumable changes	Scheduled fluid and filter replacements (oil, coolant, hydraulic fluid) including materials and labour
Preventive overhauls (POH)	Planned component rebuilds at defined intervals to restore equipment to specification
Corrective overhauls (COH)	Unplanned component repairs triggered by performance degradation or failure
Troubleshooting and repairs	Diagnosis and resolution of electrical, mechanical, and electronic faults
Dismount and remount	Removal and reinstallation of components requiring workshop overhaul
Swap unit management	Provision of exchange units to minimise equipment downtime during overhauls
Remote monitoring (IoT)	Condition monitoring hardware and data services for predictive diagnostics

#### 3.2 The Win-Win-Win Value Proposition

When properly structured and priced, a lifecycle service contract creates simultaneous value for three stakeholder groups:

##### 3.2.1 The Equipment Operator

- **Predictable OPEX:** A fixed price per output unit converts variable maintenance costs into a plannable budget line. Finance teams can forecast with confidence across the full contract horizon.
- **Fast time-to-offer:** When the service provider has a validated calculation methodology, proposals can be generated in days rather than months.
- **Guaranteed availability:** Contractual uptime commitments, backed by penalty mechanisms, ensure that the service provider is financially incentivised to prevent downtime.
- **No deferred maintenance:** Because all maintenance is pre-funded, there is no financial incentive to skip or defer interventions.

##### 3.2.2 The Service Provider / OEM Dealer

- **Plannable revenue:** Long-term contracts provide revenue visibility across multiple fiscal years. Workshop capacity, technician hiring, and parts procurement can be planned proactively.
- **Controlled margins:** A rigorous cost model with built-in overhead, risk, and interest provisions ensures that the contracted price supports sustainable profitability.

- **Operational efficiency:** Planned maintenance can be batched, sequenced, and scheduled during off-peak hours. Parts inventory can be optimised against known demand curves.
- **Scalable model:** Once the calculation methodology is validated, new contracts can be priced rapidly, enabling geographic and segment expansion.

### 3.2.3 The Equipment

- **Optimised condition:** Systematic maintenance keeps all systems within specification. Powertrains maintained under lifecycle contracts routinely exceed design life expectations.
- **Extended asset life:** The author's direct experience includes vehicle transmissions operating beyond 2 million kilometres while remaining within performance specifications, a direct result of consistent, pre-funded lifecycle maintenance discipline. This single-system experience proved the methodology, which has since been extended to cover complete vehicle systems and industrial equipment.
- **Residual value preservation:** Equipment maintained under a documented lifecycle programme commands higher residual values at end of life.

## 4. The Critical Role of Calculation Methodology

### 4.1 Why Spreadsheets Are Not Enough

Most organisations that attempt lifecycle contract pricing rely on one-off spreadsheet models built by individual commercial or technical managers. These models typically suffer from several structural weaknesses:

- **Non-standardised assumptions:** Different users make different assumptions about failure rates, inflation, and overhead allocation, producing inconsistent outputs for similar contracts.
- **Opacity:** Complex spreadsheets with nested formulas and cross-sheet references are difficult for finance teams to audit, creating approval bottlenecks.
- **Version fragmentation:** Multiple versions circulate simultaneously. Scenario comparisons are manual and error-prone.
- **No institutional memory:** When the individual who built the model leaves the organisation, the methodology leaves with them.
- **Slow iteration:** Testing alternative scenarios (different contract durations, scope variations, fleet size changes) requires manual recalculation, slowing the commercial response cycle.

### 4.2 Requirements for a Production-Grade LCC Tool

Based on over 14 years of designing, certifying, and operating lifecycle cost models in production environments, the following requirements emerge for a tool that can support commercial-scale lifecycle contract operations:

Requirement	Rationale
Component-level cost modelling	Each system (transmission, axle, braking, HVAC, etc.) must be modelled independently with its own cost drivers, failure profiles, and overhaul schedules
Spare part failure probability	Individual parts must have assigned failure probabilities, diagnosis types, and repair labour estimates to calculate accurate per-km repair cost rates
Inflation-adjusted escalation	Labour, parts, consumables, and data services must escalate independently across the full contract horizon (up to 25 years)
Scope-of-coverage flexibility	The tool must support any combination of service elements (consumables, overhauls, repairs, monitoring) per system, with cost calculations adjusting automatically
Multi-party profitability view	Both the service company and the parent OEM must see their respective cost structures, margins, and return on sales in a single consolidated view
Scenario comparison	Multiple pricing scenarios must be saveable and comparable side by side to support commercial negotiations
CFO-auditable output	Every calculation step must be traceable from input assumptions to final price-per-km, enabling finance approval without reverse-engineering
OEM and equipment databases	Predefined databases of vehicle OEMs, component manufacturers, and typical spare parts reduce setup time and ensure consistency across proposals

### 4.3 From Methodology to Platform

The methodology described in this paper was originally developed as a proprietary transmission lifecycle cost calculation framework within a European OEM organisation. Over 14 years of active use across the Middle East, Africa, and Turkey, it was iteratively refined based on real contract performance data, audit feedback from group finance, and evolving customer requirements.

KhahanA Insights has since taken this battle-tested methodology and engineered it into a professional-grade digital platform applicable to any industrial equipment sector.

## 5. Cross-Industry Applicability

While the methodology was originally developed for commercial vehicle fleets, the underlying principles of lifecycle cost modelling are universally applicable to any capital-intensive equipment that requires ongoing maintenance. The core question is always the same: what does it cost to keep this equipment running over a defined period, and how should that cost be allocated between the parties?

Industry	Equipment Examples	Typical Contract Horizon	Key Cost Drivers
Public Transport	City buses, BRT fleets, trolleybuses	5–15 years	Transmission overhauls, HVAC, doors, braking systems, battery (BEV)
Rail	EMUs, DMUs, locomotives, trams	10–30 years	Bogie overhauls, traction motors, pantographs, signalling, doors
Trucking & Logistics	Long-haul trucks, distribution fleets	3–10 years	Powertrain, axles, braking, telematics, tyre management
Mining	Haul trucks, excavators, conveyors, crushers	5–20 years	Engine overhauls, hydraulic systems, undercarriage, electrical systems
Power Generation	Gas turbines, steam turbines, generators, BoP	10–25 years	Hot gas path inspections, generator rewinding, auxiliaries, control systems
Oil & Gas	Compressors, pumps, rotating equipment, valves	5–15 years	Bearing replacements, seal systems, vibration monitoring, corrosion management
Marine	Main engines, propulsion systems, auxiliaries, deck equipment	5–15 years	Engine overhauls, propulsion drives, safety systems, hull equipment
Industrial Manufacturing	Production lines, CNC machines, robotics, presses	5–15 years	Spindle overhauls, servo drives, hydraulic units, PLC systems
Water & Utilities	Pumping stations, treatment plants, distribution networks	10–25 years	Pump overhauls, valve replacements, motor rewinding, instrumentation
Construction Equipment	Cranes, concrete pumps, tunnel boring machines	5–15 years	Hydraulic systems, boom mechanisms, drive systems, wear parts
Defence & Aviation GSE	Ground support equipment, armoured vehicle fleets, radar systems	10–25 years	Powertrain, electronics, hydraulic actuators, mission-critical systems

In each of these sectors, the same pattern applies: operators who shift from reactive to lifecycle-based maintenance achieve lower total cost of ownership, higher equipment availability, and more predictable financial performance. Service providers who invest in rigorous cost modelling achieve faster time-to-offer, more competitive pricing, and sustainable margins. The underlying mathematics of failure probability, cost escalation, and risk allocation are universal. Only the component names and duty cycles change.

## 6. Evidence from the Field

### 6.1 Operational Track Record

The methodology described in this paper has been validated through continuous application across transmission lifecycle service contracts spanning more than 14 years. The methodology has since been extended and validated for multi-system and cross-industry application. The following outcomes have been consistently observed:

Metric	Outcome
Contract duration managed	Up to 14 continuous years per fleet
Fleet sizes covered	Up to ~2000 vehicles in contracts
Unplanned contract renegotiations	Zero across all contracts
Powertrain life achieved	Exceeding 2 million km within specification
Unplanned downtime incidents	Approaching zero
Financial controller approvals	Methodology certified by Division CFO and adopted as organisational standard
Cross-regional adoption	Methodology requested and deployed by other regional teams globally

### 6.2 Key Success Factors

Analysis of successful and less successful lifecycle contracts across the author's career reveals several consistent success factors:

- **Invest in the model before the negotiation:** The calculation methodology should be finalised, audited, and certified before the first customer proposal is generated. Retrofitting rigour into an existing commercial process is significantly more difficult.
- **Separate assumptions from calculations:** Every input assumption (failure rate, inflation rate, labour cost, overhead percentage) must be explicitly documented and adjustable without modifying the calculation logic.
- **Build for scenarios:** The ability to instantly compare alternative contract durations, scope configurations, and fleet sizes is a commercial advantage. What-if capability accelerates customer discussions and internal alignment.
- **Monitor against the model:** Once a contract is active, actual performance data (failure rates, overhaul counts, parts consumption) must be tracked against the original assumptions. Deviations inform model refinement for future contracts.
- **Standardise across the organisation:** A validated methodology should be the organisational standard, not one person's spreadsheet. This ensures consistency, enables knowledge transfer, and survives personnel changes.

## 7. KhahanA LCC Pro: The Platform

KhahanA Insights has productised the lifecycle cost methodology described in this paper into a professional-grade calculation platform designed for commercial deployment across any industrial equipment sector. The platform is a self-contained, browser-based application that requires no installation, no server infrastructure, and no internet connection. It runs entirely from a single file, stores data locally, and can be deployed to any commercial or technical team within minutes.

### 7.1 Platform Architecture

The platform is structured around a contract-centric workflow. Rather than treating each equipment system as a separate calculation exercise, the user defines a single service contract and then selects which systems fall within the scope of coverage. All covered systems aggregate into one unified price output.

The workflow follows four stages:

- Stage 1: Contract Setup.** Define the contracting parties (parent OEM, service company), fleet data (vehicle type, OEM, model, fleet size, annual mileage), contract duration, warranty period, labour rates, inflation assumptions, and financial parameters (overhead, risk, interest, profit target). All percentage fields display as human-readable values (e.g., 29% not 0.29) and convert automatically.
- Stage 2: Scope of Coverage.** Select which equipment systems are included in the contract from a visual card-based interface showing all 12 systems. Each enabled system expands to reveal its configuration panel with OEM/Type/Model cascading dropdowns, service scope toggles, and parameter inputs. The interface adapts dynamically: if overhaul scope is not selected, overhaul fields are hidden. If remote monitoring is not selected, IoT fields disappear. Only relevant inputs are shown.
- Stage 3: Analysis.** The calculation engine runs in real time as parameters are entered. The Dashboard displays live KPIs: price per kilometre, required income, total cost, profit, gross margin, and technician count. The Cost Overview and Capacity tables expand dynamically with contract duration (a 2-year contract shows 2 columns, a 12-year contract shows 12, with horizontal scrolling and sticky label/total columns). The Consolidated view shows parent and service company profitability side by side.
- Stage 4: Scenarios.** Save configuration snapshots at any point and compare them in a side-by-side table showing price per km, income, profit, margin, and technician requirements for each scenario. This enables rapid what-if analysis during commercial negotiations.

### 7.2 The Scope of Coverage System

The platform includes 12 predefined equipment systems, each with its own OEM database, consumable definitions, and spare parts library:

System	Consumables	Example OEMs
Transmission	Transmission Oil / Oil Filter	Voith (DIWA), ZF (EcoLife, TraXon), Allison, Eaton
Rear Axle	Axle Oil / Breather Filter	ZF, Dana Spicer, Meritor
Front Axle	Axle Oil / Breather Filter	ZF, Dana Spicer
Steering	Hydraulic Fluid / Hydraulic Filter	ZF Servocom, Bosch Servotronic
Braking	Brake Fluid / Air Dryer Cartridge	Knorr-Bremse, Wabco, Voith Retarder

HVAC	Refrigerant / Cabin Filter	Thermo King, Konvekta, Spheros
Doors	Pneumatic Lubricant / Air Filter	Ventura, Masats
Fire Suppression	Suppression Agent / Nozzle Filter	Fogmaker, Dafo
Battery (EV)	Battery Coolant / Coolant Filter	CATL, BYD
E-Motor	Motor Lubricant / Coolant Filter	Siemens ELFA, Dana TM4, ZF CeTrax
Charging	Contact Cleaner / Air Filter	ABB, Siemens Sicharge
Thermal Mgmt	Coolant / Coolant Filter	Webasto, Modine

Each system supports seven independent scope toggles that can be switched on or off: consumable change labour, consumable material supply, overhaul (POH/COH), troubleshooting and repairs, dismount/remount, and remote monitoring (IoT). The calculation engine adjusts automatically based on which toggles are active.

### 7.3 Spare Part Failure Modelling

The Minor Repairs section implements the same failure probability methodology used in the original Excel-based tool, now with a full interactive spare parts table for each system. The platform includes 88 predefined spare parts across all 12 systems, each with:

- **Part name** selected from a system-specific dropdown (e.g., Speed Sensor, Solenoid Valve, ECU, Hydro Damper for transmissions) or entered manually
- **Quantity per unit** (e.g., 4 solenoid valves per transmission)
- **Diagnosis type** (manual or remote, affecting diagnostic labour cost when IoT monitoring is enabled)
- **Price list price** from which landed cost is auto-calculated using discount, transport, and import duty rates
- **Labour hours** for diagnosis and repair
- **Failure probability** displayed as a percentage (e.g., 10% means 0.10 probability per contract period)

The per-kilometre cost rates (parts/km, fix labour/km, diagnostic labour/km) are calculated automatically from the spare parts table and feed directly into the main calculation engine. An "Add all predefined" button populates the full parts catalogue for any system in one click.

### 7.4 The Calculation Engine

The calculation engine has been verified to produce results accurate to the penny against the original certified Excel model. The engine processes:

- Year-by-year cost escalation using separate inflation rates for labour, parts, consumables, and data services
- Oil change frequency based on mileage intervals and fleet size
- Preventive and corrective overhaul costs with year-specific scheduling
- Minor repair costs derived from the spare parts failure probability table
- Monitoring operational costs with annual data inflation
- Overhead as a percentage of total production cost
- Risk and interest applied to production cost plus overhead
- Profit margin calculated on the total cost to derive required income and price per km
- Capacity planning: field service hours, workshop hours, travel hours, and required technician headcount based on available hours per year

- Consolidated parent/service company profitability with surcharge rates and cost-of-sales breakdown

## 7.5 Predefined Databases

To accelerate proposal preparation, the platform includes extensive predefined databases that can be extended by the user:

Database	Content
Vehicle OEMs	80+ OEMs filtered by vehicle type: 22 Bus, 22 Truck, 15 Coach, 11 Rail, 10 Special Vehicle manufacturers
Component OEMs	Major manufacturers per system with cascading Type and Model selection (e.g., Voith DIWA D864.5)
Spare parts	88 predefined parts across 12 systems with realistic default values for quantity, labour hours, and failure probability
Countries	50+ service market countries
Currencies	30 currencies from EUR, USD, AED to specialised currencies
Powertrain types	Diesel, CNG/LNG, Electric (BEV), Hydrogen (FCEV), Hybrid variants, Trolleybus
Oil brands	12 major commercial vehicle lubricant brands

Every dropdown in the platform includes an "Other (type manually)" option, ensuring that users are never blocked by a missing entry.

## 7.6 Output and Decision Support

The platform produces the following outputs for commercial decision-making:

- **Price per kilometre** (or equivalent unit metric) in both base and local currency
- **Required income** over the full contract period
- **Total cost breakdown** by system, by year, by cost type (labour vs parts)
- **Gross margin and calculated profit** at the service company level
- **Technician headcount** derived from total field and travel hours divided by available hours per year
- **Consolidated profitability** showing parent OEM, service company, and consolidated return on sales
- **Scenario comparison table** with side-by-side metrics for unlimited saved configurations
- **Production cost split** visual bar showing labour vs parts proportion
- **Cost by system bar chart** showing each system's contribution to total cost with percentage

## 7.7 Engagement Model

KhahanA Insights offers lifecycle cost calculation services through several engagement models:

- **Consulting engagement:** KhahanA Insights works directly with the client to build, validate, and deliver a complete lifecycle cost model for a specific contract opportunity.

- **Methodology transfer:** The LCC methodology is transferred to the client organisation through a structured workshop programme, including tool deployment, team training, and model certification.
- **Ongoing advisory:** Retained advisory support for contract monitoring, model refinement, and new opportunity pricing.

## 8. Conclusion

The shift from reactive maintenance to lifecycle service contracts represents one of the most significant value creation opportunities available to operators and service providers of capital-intensive industrial equipment. The evidence from over 14 years of continuous field operation demonstrates that this approach consistently delivers lower total cost of ownership, higher equipment availability, and sustainable profitability for all parties.

However, the success of a lifecycle contract is determined before the first maintenance action is performed. It is determined by the quality of the cost model that underpins the pricing. A rigorous, auditable, and repeatable calculation methodology is not a nice-to-have supplement to the commercial process. It is the foundation upon which every successful lifecycle contract is built.

KhahanA Insights brings together deep domain expertise, a battle-tested calculation methodology, and professional-grade tooling to help operators, service providers, and OEM organisations design, price, and manage lifecycle service contracts with confidence.

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### About the Author

**Alireza Khahan** is the Founder of KhahanA Insights FZ-LLC, a strategic consultancy and Agentic Intelligence solutions firm based in Dubai, UAE. He is also a Senior Advisor at FutureBridge. With 27+ years of B2B experience across mobility, energy, and industrial sectors, including 14 years as Regional VP covering the Middle East, Africa, and Turkey for a European OEM, he brings hands-on expertise in lifecycle service contract design, pricing, and operational management. He has since extended this proven methodology into a universal platform covering complete vehicle systems, rail rolling stock, and industrial equipment.

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