Research on Full Life Cycle Investment Management Mechanism for Small-Scale Fixed Asset Procurement

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Abstract. To enhance the scientific nature of investment decision-making and the level of refined management for small-scale fixed asset procurement in provincial-managed industrial subsidiaries, this paper constructs an investment management mechanism for such procurement equipment based on Life Cycle Cost Management(LCCM).The mechanism consists of two types of cash flow models:" procurement scheme" and "leasing scheme", systematically incorporating procurement/leasing costs, maintenance, insurance, labor costs, depreciation tax shields, and residual value, and conducts comparative evaluation using both static and dynamic(discounted)approaches. On this basis, a 900mm-section ground-mounted dual-jib derrick is selected as a case study for calculation. The results show that under the given parameter conditions, the total static cash flow of the procurement scheme is reduced by 5.4627 million yuan compared with the leasing scheme, and the total dynamic cash flow is reduced by 2.9601 million yuan, based on which procurement is recommended as the priority. This research provides a replicable quantitative evaluation path for the "buy or lease" decision-making in small-scale procurement for power grid enterprises, and has reference value for improving procurement processes, enhancing investment efficiency, and strengthening control levels.

Keywords: small-scale fixed asset procurement, life cycle cost, lean management, cash flow analysis, investment decision-making, power grid enterprise

1 Introduction

Small-scale fixed asset procurement refers to fixed assets that are not included in large-scale construction projects but can independently perform specific functions, such as instruments, tools, vehicles, and small-scale production and operation equipment. For power grid enterprises, this type of procurement constitutes a significant share of total fixed asset investment and is closely related to the daily operation, maintenance, and service capability of grassroots units [1]. With the continuous promotion of lean management and cost reduction, the investment efficiency and risk control of small-scale fixed asset procurement have attracted increasing attention in provincial-managed in-

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dustrial subsidiaries [2]. Recent international studies have also emphasized that efficient physical asset management is the linchpin for safeguarding resilient services in critical utilities [3]. Furthermore, the implementation of full-process governance mechanisms, such as lifecycle auditing, has been proven effective in enhancing the sustainability of power grid projects [4].

In practice, several prominent management problems can be observed. First, configuration standards for different units, departments, and asset categories are not fully unified, resulting in inconsistencies between actual holdings and standard configurations. Second, pre-investment economic analysis often focuses mainly on the initial purchase price, while operation and maintenance costs, tax effects, and residual value over the whole life cycle are not sufficiently considered, leading to a mismatch between short-term budget constraints and long-term cost effectiveness. Third, equipment ledger data are sometimes incomplete or not updated in a timely manner, which weakens the traceability of post-evaluation and the closed-loop linkage between investment decision-making, process control, and post-operation performance. These issues may cause small-scale fixed asset procurement to deviate from the objectives of refined investment.

Life cycle cost (LCC) and life cycle cost management (LCCM) provide an effective methodological basis to address the above problems. By transforming the initial investment, operation and maintenance expenses, tax effects, and residual value into unified discounted cash flows, LCCM enables decision-makers to evaluate alternative schemes on a consistent life-cycle economic basis. In the field of power grid engineering, Wang et al. [5] developed an LCC model for grid projects using system dynamics to analyze cost factors under power reform. Similarly, Zou et al. [6] proposed a life-cycle cost evaluation system based on fuzzy membership degree, highlighting that non-initial cost components may account for a considerable proportion of the total cost. While LCC methodologies are well-established, their specific application to the "buy-or-lease" decision in power grid subsidiaries remains under-explored.

Equipment replacement and acquisition strategies are complex optimization problems that require balancing capital constraints and operational flexibility [7]. Recent research by Zhang et al. [8] explicitly indicates that under capital-constrained conditions, quantitative comparison models are essential for determining the optimal strategy between purchasing and leasing. Against this background, this paper takes the small-scale fixed asset procurement of a provincial-managed industrial subsidiary as the research object and aims to construct a full life cycle investment management mechanism based on LCCM.

2 Model Construction Principles

Life Cycle Cost Management (LCCM) is a management approach that controls costs over the entire process from project initiation, design, construction, commissioning, operation and maintenance, to decommissioning. It requires that all relevant costs of an asset—such as procurement, operation and maintenance, and disposal—be considered in an integrated manner, so as to support lean investment control rather than one-off budget decisions [4]. In the field of power grid enterprises, LCCM has been applied to construct full life cycle management systems, helping to correct problems such as unscientific asset allocation, idle resources, and fragmented management responsibilities. Drawing on this idea, this paper focuses on small-scale fixed asset procurement in a provincial-managed industrial subsidiary, where investment management is relatively weak and demand submissions often lack a life-cycle perspective [1]. On the basis of LCCM, an investment management mechanism model is established to embed life cycle thinking into the whole process of demand identification, scheme comparison, procurement implementation, and post-operation feedback. The core of the mechanism is a set of comparative cash flow models, which serve as the quantitative basis for the "purchasing or leasing" decision [8].

Specifically, the mechanism model consists of two main parts. The first part is the cash flow analysis of small-scale fixed asset equipment procurement, covering procurement costs, routine and major maintenance costs, insurance costs, labor costs associated with operation, depreciation-related tax deductions, residual value income, and other relevant cash flows. The second part is the cash flow analysis of equipment leasing, which mainly includes leasing costs, labor costs, tax deductions related to leasing payments, and other costs. All cash flows are defined over a given analysis period and discounted using a unified financial discount rate, so that the net present value of life cycle cost for procurement and leasing schemes can be directly compared.

The proposed model draws upon the theoretical foundation of Net Present Value (NPV) analysis, which is widely recognized as a fundamental technique in capital budgeting and investment appraisal. The NPV method evaluates the profitability of an investment by discounting all future cash flows to their present value using a specified discount rate, and comparing the sum to the initial investment. In the context of the buy-or-lease decision, the NPV framework enables a direct comparison of the total economic cost of ownership versus leasing over the entire analysis period.

The model adopts several key assumptions. First, the analysis period is set equal to the depreciation period of the equipment, assuming that the equipment will be used for its full economic life. Second, all cash flows are assumed to occur at the end of each year, which is a standard simplification in discrete-time financial analysis. Third, the discount rate is assumed to remain constant throughout the analysis period, reflecting the opportunity cost of capital for the enterprise. Fourth, maintenance costs are assumed to grow at a constant annual rate, capturing the effect of equipment aging. Fifth, tax effects are incorporated through depreciation tax shields for procurement and expense deductions for leasing, assuming that the enterprise has sufficient taxable income to realize these benefits.

The choice of comparative cash flow analysis over other methods such as Internal Rate of Return (IRR) or Payback Period is deliberate. While IRR provides a measure of investment efficiency, it may lead to ambiguous results when comparing mutually exclusive alternatives. The Payback Period ignores the time value of money and cash flows beyond the payback horizon. In contrast, the NPV-based approach provides an absolute measure of economic value that is directly comparable between alternatives.

By comparing the discounted life-cycle cash flows of procurement and leasing for a given piece of equipment, the model determines the economically preferable scheme under the constraints of budget and configuration standards. In this way, the investment management mechanism supports lean control of small-scale fixed asset procurement and provides a quantitative basis for improving configuration policies and parameter settings in subsequent cycles. The overall structure of the model is shown in Fig. 1.

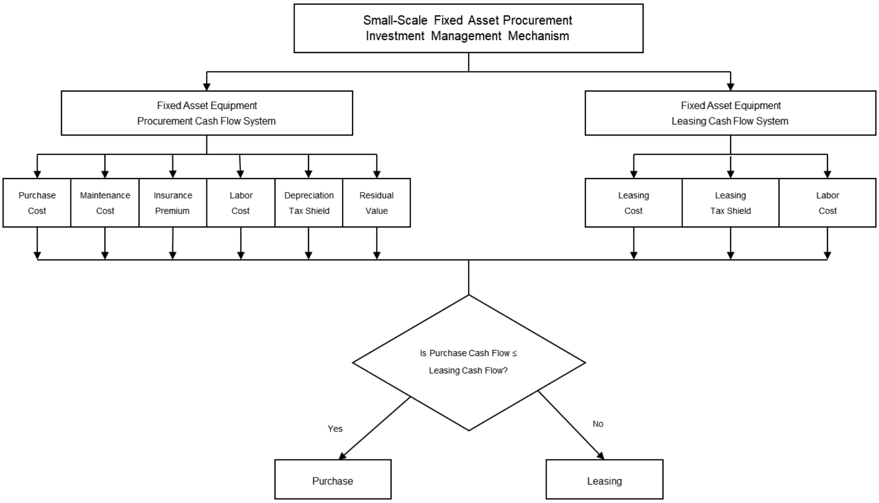

Fig. 1. Investment Management Mechanism Model for Small-Scale Fixed Asset Procurement.

3 Model Construction

3.1 Cash Flow Function Model for Small-Scale Fixed Asset Equipment Procurement

The cash flow for small-scale fixed asset equipment procurement mainly consists of two parts: cash outflow and cash inflow. Its total function expression is as follows:

$$C_{buy} = C_0 + C_m + C_{ins} + C_L - S - T_{dep} \tag{1}$$

Where C_0 is the equipment procurement cost (VAT-inclusive cash outflow), C_m is the total maintenance cost over the analysis period, C_{ins} is the total insurance cost, C_L is the total labor cost, S is the equipment residual value, and T_{dep} is the total income tax deduction from depreciation.

Among them, the cash outflow components are calculated as follows:

The annual maintenance cost in year t is:

$$C_{m,t} = C_0\, r_m\, (1 + g)^{t-1} \tag{2}$$

Where r_m is the maintenance rate, g is the annual growth rate of maintenance costs, and t is the year (t = 1, 2, ..., n). The total maintenance cost over n years (static) is the sum of annual maintenance costs.

The annual insurance cost is constant:

$$C_{ins,t} = C_0\, r_{ins} \tag{3}$$

Where r_{ins} is the insurance rate. The total insurance cost over n years is $C_{ins} = nC_o r_{ins}$.

The annual labor cost is:

$$C_{L,t} = Nwd_1 \tag{4}$$

Where N is the total number of operators, w is the wage per person, and d_1 is the working days. The cash inflow function expression composed of residual value and income tax deduction from depreciation is as follows:

The residual value is calculated based on the VAT-exclusive asset value:

$$S = [\frac{C_0}{(1+\tau_{VAT})}]r_s \tag{5}$$

Where τ_{VAT} is the VAT rate, and r_s is the residual value rate. This reflects that fixed assets are recorded at VAT-exclusive values for accounting purposes.

Using straight-line depreciation, the annual tax shield is:

$$T_{dep,t} = [\frac{C_0}{(1+\tau_{VAT})}]\frac{(1-r_s)}{n}\,\tau_{inc} \tag{6}$$

Where τ_{inc} is the corporate income tax rate, and n is the depreciation period.

3.2 Cash Flow Function Model for Small-Scale Fixed Asset Equipment Leasing

The cash flow for small-scale fixed asset equipment leasing mainly consists of equipment leasing costs, labor costs, and income tax deduction from leasing. The total function expression is as follows:

$$C_{lease} = C_R + C_L - T_R \tag{7}$$

Where C_R is the equipment leasing cost, C_L is the labor cost (same as in the procurement model), and T_R is the income tax deduction from leasing.

Among them, the equipment leasing cost function expression is:

$$C_{R,t} = PQd_2 \tag{8}$$

Where P is the leasing unit price (CNY per day per unit), Q is the quantity of equipment, and d_2 is the annual leasing days.

Since leasing expenses are fully deductible, the annual tax shield is:

$$T_{R,t} = C_{R,t} \cdot \tau_{inc} \tag{9}$$

Where τ_{inc} is the corporate income tax rate, consistent with that in the procurement model.

4 Case Study

This study takes a 900mm-section ground-mounted dual-jib derrick from a provincial-managed industrial subsidiary as an example. The cash flows of equipment purchase and lease are calculated to determine whether the equipment should be purchased directly or leased. For the purchase scheme, the maintenance rate is set at 3%, the annual growth rate of maintenance costs at 4%, the insurance rate at 0.45%, the residual value rate at 5%, and the financial discount rate at 8%. The purchase unit price is 526,000 CNY per unit (tax-inclusive), and the leasing price is 1,800 CNY/day·unit; three units are required and the annual usage time is 153 days. A VAT rate of 13% and a corporate income tax rate of 25% are adopted; for depreciation and residual value calculations, the tax-exclusive asset value $C_0/(1+VAT)$ is used, assuming input VAT is creditable. The procurement and leasing schemes involve equipment of the same specifications, quality standards, and quantity. Each unit of equipment is operated by two personnel, each with a monthly salary of 8,000 yuan, and the number of days for labor cost payment is consistent with the equipment leasing period, i.e., 153 days. The parameter settings for the purchase scheme are shown in Table 1.

Based on the parameter settings in Table 1, the procurement and leasing cash flows for the equipment are calculated, with the results shown in Table 2 and Table 3.

Based on Table 2 and Table 3, a comparison of static and dynamic cash flows for equipment procurement and leasing is conducted, with the comparison results shown in Table 4.

As shown in Table 4, the static cash flow for equipment procurement is 5.4627 million yuan less than the static cash flow for leasing, and the dynamic cash flow is 2.9601 million yuan less than the dynamic cash flow for leasing. Therefore, compared to leasing, equipment procurement is more appropriate for this equipment.

Table 1. Equipment Procurement Parameter Settings.

Equipment Name	Purchase Unit Price (10,000 Yuan) [VAT-inclusive]	Leasing Unit Price (Yuan/day·unit)	Procurement/Leasing Quantity	Depreciation Period (Years)	Usage Time (Days)
900mm-section ground-mounted dual-jib derrick	52.6	1800	3	12	153

Table 2. Cash Flow Calculation Table for 900mm-section ground-mounted dual-jib derrick Procurement (Unit: CNY 10,000).

Item	1	2	3	4	5	6	7	8	9	10	11	12
Cash Outflow												
Purchase Cost	157.8	-	-	-	-	-	-	-	-	-	-	-

Item	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Maintenance Cost	4.73	4.92	5.12	5.33	5.54	5.76	5.99	6.23	6.48	6.74	7.01	7.29
Insurance Premium	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Labor Cost	24.48	24.48	24.48	24.48	24.48	24.48	24.48	24.48	24.48	24.48	24.48	24.48
Total Cost	187.72	30.11	30.31	30.52	30.73	30.95	31.18	31.42	31.67	31.93	32.20	32.48
Cash Inflow												
Residual Value	-	-	-	-	-	-	-	-	-	-	-	6.98
Depreciation Tax Shield	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76
Net Cash Flow	184.96	27.35	27.55	27.75	27.96	28.19	28.42	28.66	28.91	29.16	29.43	22.73
Financial Net Present Value	171.26	23.45	21.87	20.40	19.03	17.76	16.58	15.48	14.46	13.51	12.62	9.03
Cumulative Financial NPV	171.26	194.71	216.57	236.97	256.00	273.77	290.35	305.83	320.29	333.80	346.42	355.45

Table 3. Cash Flow Calculation Table for 900mm-section ground-mounted dual-jib derrick Leasing (Unit: CNY 10,000).

Item	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Cash Outflow												
Leasing Cost	82.62	82.62	82.62	82.62	82.62	82.62	82.62	82.62	82.62	82.62	82.62	82.62
Labor Cost	24.48	24.48	24.48	24.48	24.48	24.48	24.48	24.48	24.48	24.48	24.48	24.48
Cash Inflow												
Leasing Tax Shield	20.66	20.66	20.66	20.66	20.66	20.66	20.66	20.66	20.66	20.66	20.66	20.66
Net Cash Flow	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45	86.45
Financial Net Present Value	80.04	74.11	68.62	63.54	58.83	54.48	50.44	46.70	43.24	40.04	37.07	34.33
Cumulative Financial NPV	80.04	154.15	222.78	286.32	345.15	399.62	450.06	496.77	540.01	580.05	617.13	651.46

Table 4. Comparison Table of Procurement and Leasing Schemes for 900mm-section ground-mounted dual-jib derrick.

Cash Flow Type	**Procurement Scheme (10,000 Yuan)**	**Leasing Scheme (10,000 Yuan)**	**Difference (10,000 Yuan)**	**Recommended Scheme**
Total Static Cash Flow	491.07	1037.34	546.27	Procurement
Total Dynamic Cash Flow	355.45	651.46	296.01	Procurement

5 Conclusions and Prospects

The life-cycle cash flow comparison of the 900mm-section ground-mounted dual-jib derrick demonstrates that when the full life cycle cash flow of equipment procurement is lower than that of leasing, the equipment should be procured; otherwise, leasing should be selected.

At the current stage, the procurement of small-scale fixed asset equipment in provincial-managed industrial subsidiaries mainly rely on the practical experience of grass-roots managers, and the investment analysis mechanism for the full life cycle of equipment still needs to be improved. Based on the life cycle cost management method, this paper constructs a full life cycle cash flow analysis mechanism for small-scale fixed asset equipment procurement and leasing, which can better conduct comparative analysis of the investment benefits over the equipment's full life cycle. This is conducive to subsidiaries continuously optimizing and improving the investment level of small-scale fixed asset procurement and achieving lean management and control.

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