

Lightweight AI for process optimization: Big insights from small investments

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AI



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Process optimization is a critical driver for reducing costs, improving efficiency and strengthening core competitiveness. Amid the wave of digital transformation, many organizations turn to RPA, BPM systems or process mining platforms to accelerate process digitization. While these solutions are widely adopted, their high costs, lengthy implementation cycles and heavy organizational commitments often deter adoption. For companies that are not ready to build large-scale platforms or prefer to start with small-scale pilots, is there a more flexible, low-barrier alternative?

This article explores a practical approach to these challenges: leveraging lightweight artificial intelligence (AI) to harness existing enterprise data for process insights and optimization – delivering big insights with small investments. This agile, quickly deployable strategy helps organizations build data-driven capabilities early in their digital journey and provides evidence-based insights to guide future decisions on larger system investments, reducing the risk of blind decision-making.

Positioning lightweight AI: A tool for data insights, not process reconstruction

Before diving into lightweight AI for process optimization, it is important to clarify how it differs from traditional approaches. The primary goal of lightweight AI is to leverage existing process execution data and intelligent algorithms to identify bottlenecks, uncover inefficiencies and simulate potential improvements. In simple terms, it acts as a “data lens”, enabling organizations to clearly understand their current operations before deciding whether to invest in large-scale automation or system upgrades.

It is also worth noting that the lightweight AI applications discussed here are fundamentally different from “business reconstruction AI applications”, which focus on reshaping business logic, creating adaptive rules and building intelligent decision engines. Lightweight AI is about generating actionable insights – not redesigning processes – providing data-driven guidance for improving process management strategies without altering underlying business logic or rules.

Feasibility and prerequisites

Lightweight AI process optimization is highly feasible for two key reasons:

1. Most companies already have a strong data foundation.

Enterprise systems such as ERP, OA and ticketing platforms capture large volumes of process execution data – timestamps, responsible parties, suppliers and more – across steps like requisition, approval, PO generation, receiving, invoice processing and payment. Extracting, filtering and cleaning this data is relatively straightforward and does not require system modifications or complex integrations.

2. The required algorithms are mature, accessible and low-barrier.

Machine learning techniques such as Isolation Forest, Local Outlier Factor (LOF), KMeans and DBSCAN are widely used and validated in domains like industrial monitoring, financial risk control and cybersecurity. With open-source tools like Python, companies can implement anomaly detection and clustering analysis with only a few dozen lines of code – without purchasing expensive process mining licenses, building dedicated data science teams or incurring high tool costs.

```
File Edit View Run Kernel Settings Help Trusted
+ < > Code JupyterLab Python 3 (ipykernel)

[3]:
import pandas as pd
import numpy as np
from sklearn.ensemble import IsolationForest
import matplotlib.pyplot as plt
from matplotlib.font_manager import FontProperties

# =====
# 加载数据
df = pd.read_excel('某大型制造企业P2P流程数据.xlsx')

# =====
# Isolation Forest 检测异常
x = df[['审批耗时 (天)', '发货周期 (天)', '收货周期 (天)', '发票处理时长 (天)']]

model = IsolationForest(contamination=0.05, random_state=42)
df['异常标记'] = model.fit_predict(X)
df['异常标记'] = df['异常标记'].map({1: '正常', -1: '异常'})

# =====
```

Example: Detecting process anomalies with just a few lines of Python code

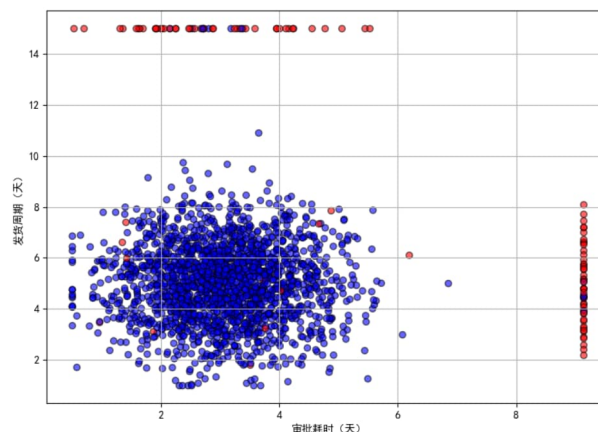
Exploring lightweight AI in the P2P process

The procure-to-pay (P2P) process is an excellent example for applying lightweight AI. Covering key steps such as requisition, approval, ordering, receiving, invoice processing and payment, P2P is highly standardized and data-rich accumulation, making it an ideal candidate for testing AI-driven optimization. Different machine learning algorithms can deliver distinct value across various stages of this process from detecting anomalies to identifying efficiency patterns and simulating improvement scenarios.

- Anomaly detection: Quickly identify process instances that slow overall efficiency

Algorithms like Isolation Forest or LOF can model multiple dimensions, such as node duration, delivery cycle and invoice processing time to detect outliers. This enables companies to pinpoint transactions that drag down efficiency, such as delay approvals, shipments or invoice handling, providing actionable insights for management, such as optimizing approval authority or strengthening supplier performance monitoring.

Case example: A large manufacturing company analyzed 2,000 procurement transactions using the Isolation Forest model, focusing on approval time, delivery cycle, receiving cycle and invoice processing duration. About 5% of transactions showed anomalies, mainly due to approval times twice the average or significantly longer delivery cycles. These anomalies were concentrated in secondary approval steps and two suppliers whose performance cycles fluctuated in specific batches. The pilot provided targeted improvement directions such as streamlining approval flows and enhancing supplier monitoring, supporting broader data-driven process optimization efforts.



Example: P2P process anomaly detection results for a large manufacturing enterprise

- Process pattern classification: Extract common traits of efficient paths

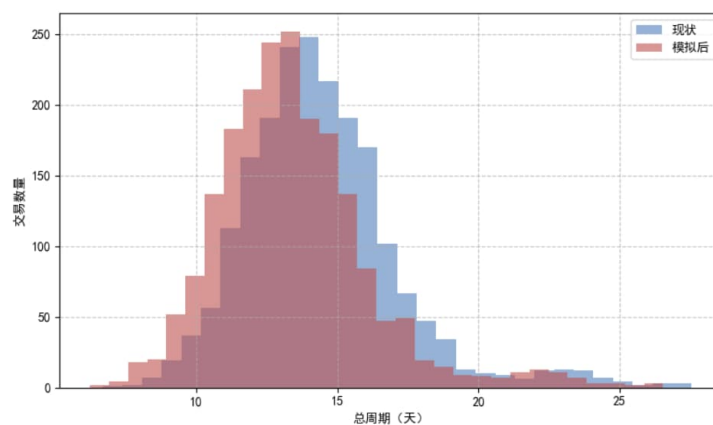
Clustering algorithms like KMeans and DBSCAN can group historical processes into efficient, normal and inefficient clusters. This helps companies identify characteristics of high-performing processes, providing benchmarks for standardization and improvement. KMeans is useful for quick baseline comparisons while DBSCAN excels at detecting complex patterns without predefining cluster numbers.

- Bottleneck analysis: Focus on steps that impact overall efficiency

By combining statistical analysis, clustering and anomaly detection, lightweight AI can identify critical steps with the greatest impact on cycle time, such as approval, receiving or invoice review. This enables companies to prioritize improvements where they will have the most effect.

- Improvement simulation: Preview potential gains before implementation

Using data recalculation or simple regression, lightweight AI can simulate the impact of proposed changes. For example, the same manufacturing company recalculated P2P cycle times after hypothetically reducing approval time by one day (with a minimum of 0.5 days). The average cycle dropped from 14.42 days to 13.44 days – a 6.8% improvement – providing clear evidence for decision-making. A histogram comparison illustrated the reduction in cycle time and variability.



Example: Comparison of P2P process total cycle time distribution (current vs. simulated)

Why it's worth trying

Lightweight AI is not a mandatory approach to process optimization, but for companies hesitant to invest in large platforms immediately or those seeking low-risk pilots, it offers a practical alternative. It enables data-driven insights, quantifies problems and opportunities and avoids relying solely on experience or intuition. More importantly, it serves as a preliminary step before major system investments, lowering risk and supporting informed decision-making. While it may not resolve every process pain point at once, it provides a flexible, low-risk starting point that is well worth considering.

Conclusion

There is no single path to process optimization. For companies looking to explore opportunities and gain visibility into their processes within limited budgets, lightweight AI offers a practical and effective approach. It delivers big insights with small investments, reduces trial-and-error costs, fosters data-driven operations and accelerates digital transformation – ultimately improving management quality and driving sustainable value growth.

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