Analysis of Business Process Exploration in Agency Invoice Processing

This article discusses the application of business process mining in an industrial environment, focusing on the analysis of invoice processing in a Dutch government agency. The authors use exploration techniques to examine processes, organization, and individual cases to reveal patterns and structural relationships. They employ the ProM framework, an extensible software framework designed for business process exploration. It relies on plug-ins to add new functionalities: Exploration plug-ins ⮕ to build process models from event logs.
Export plug-ins → to save models and data.
Import plug-ins → to load data in different formats.
Analysis plug-ins → to analyze process models.
Conversion plug-ins → to convert data between different formats.
ProM has integrated earlier tools such as EMiT and Thumb as plug-ins, and its user interface allows visualization of discovered process models.

Figure 1(a): Petri net process model
The Petri net deduced from the log shows that each case starts with activity A and ends with D. There is a choice between running B and C in parallel, or just running E.
(b): Activity-Role-Executor diagram
This diagram links activities to performers, assuming three distinct roles (X, Y and Z) based on the performers of the activities.
(c): Sociogram
The sociogram illustrates the transfer of work between individuals, providing a perspective on the social structure of the organization.

The Dutch Public Works Department, responsible for infrastructure management, was faced with a problem of inefficient invoice processing. With 20,000 invoices processed annually and disparate processes between provincial offices, payments were often delayed, in contradiction with the legal 31-day period. To solve these problems, a Workflow Management System (WfMS) was implemented to unify and accelerate invoice processing.

Analysis of the process revealed recurring loops in invoice processing, indicating inefficiencies. The study used the ProM framework to model and understand the workflow, identifying key steps and unnecessary redundancies that were slowing down the process.
Figure 6: Dependency graph:
The figure shows a dependency graph resulting from process abstraction, showing the main sequence of activities and alternative paths.

Interactions between employees and their roles in the process were highlighted through sociogram analysis. Internal social networks were examined to identify congestion points and work loops, underlining the importance of an optimized organizational structure for an efficient process.

The focus was on the individual properties of invoice cases, seeking to establish correlations between the activities, agents involved, and data associated with the cases. This analysis enabled us to better understand the impact of actions on process duration, and to identify areas for improvement to optimize invoice processing.

Table 3	Intermediary Centrality Ranking	This table ranks users (performers) according to their intermediary centrality score in the social network, indicating their potential role as intermediaries in the process.
Table 4	Invoice payment time	This table compares payment norms (in days) with actual performance before and after the implementation of a workflow management system (WfMS).
Table 5	Payment Time Relative to Invoice Amount	This table shows payment time as a function of invoice amount.
Table 6	Payment Time Distribution	The table shows the relationship between payment time and the number of times a specific activity is processed, illustrating how the frequency of an activity can affect the speed of the payment process.

This reflection highlights the effectiveness of process exploration in identifying opportunities for improvement within organizational operations. The study validates the practical approach of process mining, which revealed specific problems in invoice processing and had a positive impact on managerial decision-making. It provided recommendations for standardizing procedures and training employees, and opens avenues for future research, including the integration of more varied data.

Process mining is proving to be a powerful tool for diagnosing and improving business processes, offering a detailed view of an organization's inner workings. This method exposes discrepancies between processes as executed and as planned, identifying inefficiencies, bottlenecks, and areas for improvement.

The article illustrates the applicability and adds value of business process exploration in a concrete industrial context, using advanced tools to analyze and optimize organizational processes.