The Proactive Insights Engine: Process Mining meets Machine Learning and Artificial Intelligence

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Abstract. This demo presents the features of the Proactive Insights (PI) engine, which uses machine learning and artificial intelligence capabilities to automatically identify weaknesses in business processes, to reveal their root causes, and to give intelligent advice on how to improve process inefficiencies. We demonstrate the four PI elements covering Conformance, Machine Learning, Social, and Companion. The new insights are especially valuable for process managers and academics interested in BPM and process mining.

Keywords: process mining, process intelligence, machine learning, artificial intelligence

1 From Process Discovery to Process Intelligence

Process mining is a technique used to reconstruct, analyze, and improve business processes using recorded event data from transactional IT systems [1,2,3]. Mining process data commonly starts with process discovery [1,2], i.e. the analysis of the process model reproduced from event logs. During process discovery, users investigate the actual process model and drill-down the process data to identify undesired patterns and sources of inefficiencies [2]. The insights of the discovery phase are the starting point for process improvements through reductions in throughput times, manual rework or increasing efficiency and customer satisfaction [5,6].

A disadvantage of this explorative mining approach is that it requires the user to gain process knowledge by deeply investigating the process data, while having an ex ante hypothesis on where to shine the light. To enhance user-driven process mining, we created the Proactive Insights Engine (PI). It combines process mining with machine learning and artificial intelligence in order to achieve highly smart and fully automated insights into business processes. PI automatically analyzes business processes, uncovers hidden problems, and reveals prescriptive recommendations on how to improve them in real-time. This new technology understands workflows and draws conclusions from them. It conducts research on root causes of process violations and provides recommendations for action. Therefore, PI enlarges previous process mining solutions by going from an explorative process discovery to an intelligent and fully automated process analysis.

PI consists of the following four components:

PI Conformance compares the actual 'as-is' process with the documented 'to-be' process. It automatically identifies the highest priority issues and their root causes, which allows users to take immediate action. Therefore, PI Conformance extends the many existing applications for conformance checking, as it automatically reveals a list of process violations, drills them down to their root causes, and makes intelligent suggestions for how to fix them. The software develops these recommendations based on the process data, adapts and continuously improves these recommendations as more data is being processed.

PI Machine Learning integrates advanced statistical analyses and machine learning algorithms natively into Celonis. The application fully supports R-scripting language. This allows the user to run advanced prediction techniques directly in Celonis. Historic process data and the findings of process discovery serve as an input to create predictions of the future. For example, users can proactively monitor process performance by evaluating how ongoing cases will flow through the process until their completion

PI Social adds the social aspect of processes to Celonis. PI Social maps process data to different teams and organizations to show how they interact with each other. It identifies critical roles within the process, workload imbalances, and other team inefficiencies. The visualization of the network of social process interactions uncovers issues in organizational structures and the interactions among people involved in the process.

PI Companion integrates Celonis into business management systems. It acts as a 'process advisor' and identifies recommendations at the time when critical business decisions are made. This allows process analysis while the process is being executed, rather than analyzing processes after their completion. The new add-on interacts with SAP systems and supports decisions by using relevant data from historical transactions. For example, users can check which vendor had the fastest delivery record in the last month or analyze customers' payment behavior for well-grounded decisions on payment terms.

2 Case study

For the case study, we apply the new PI features on a demo data set for the Purchase-to-Pay (P2P) process. The demo data covers 279,000 purchase order items.

After loading the predesigned to-be process model, the conformance checker scans the actual process, shows conformance history, key statistics about conformance, and a list of violations sorted by their frequency. Figure 1 illustrates that 57% of the cases are compliant with the target process model. PI detects 15 process violations. From the KPIs shown in the middle of Figure 1, we can see that the average throughput time of non-compliant cases is 31.1, which is higher than the 29 days that compliant cases need to go through the process. Further user-specific KPIs can be added using the integrated formula editor. Moreover, the list at the bottom of Figure 1 reveals that in 14% of the cases, the price of a purchase order is changed, which is a frequent source of manual rework. In 7% of the cases, the process starts with the scan of the invoice and not with

the creation of a purchase order item/requisition item as defined in the uploaded ‘to-be’ process model. This process deviation is often caused by maverick buying violating corporate compliance. Acceptable violations can be added to a whitelist.

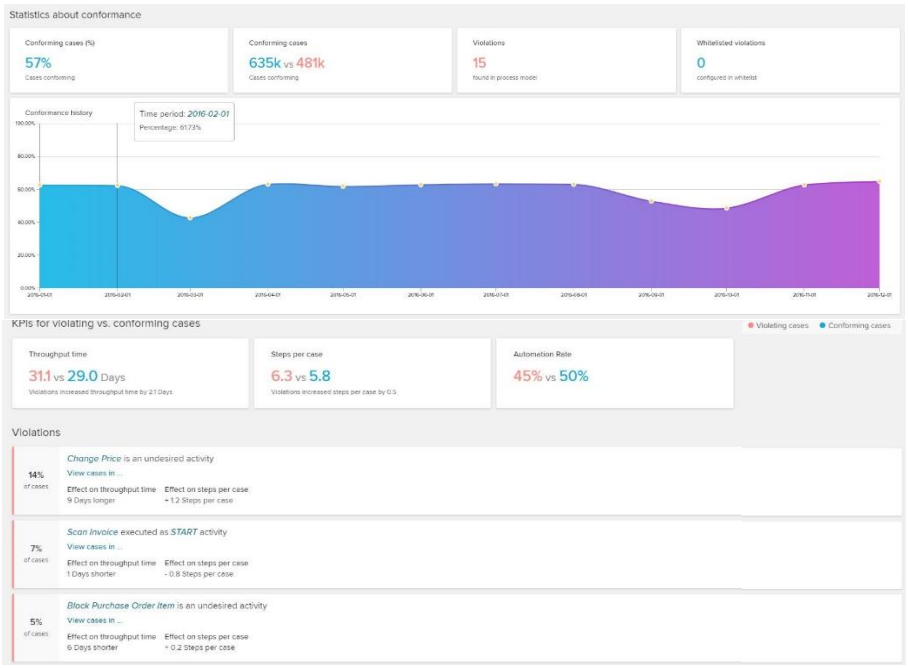

Fig. 1. PI Conformance reveals conformance trends over time, KPIs of compliant vs. non-compliant cases, and a list of most frequent violations.

More information about each violation can be retrieved by clicking on the items in the list. Figure 2 refers to a violation, where the procurement process starts with the scan of the invoice. PI automatically displays possible root causes for this violation. For example, in 6,000 cases when the process starts with the scan of an invoice, the vendors Unisono AG, IDES Consumer Products, and six other vendors are involved in the transaction.

PI Machine Learning enables users to execute R-statements and to access R-libraries in Celonis. R-statements can be executed on the process data, for example, to calculate the 95% quantile of the throughput time for each vendor. Results are displayed in Celonis and can be re-used for filtering the process data or as input for further analyses.

In the social overview in Figure 3, information about the people working in the process and their collaboration is displayed. By clicking on a specific user, PI Social shows several performance measures, e.g., the number events per day for the Team 2 (35 users) is 226 and their throughput time is 718.8 hours.

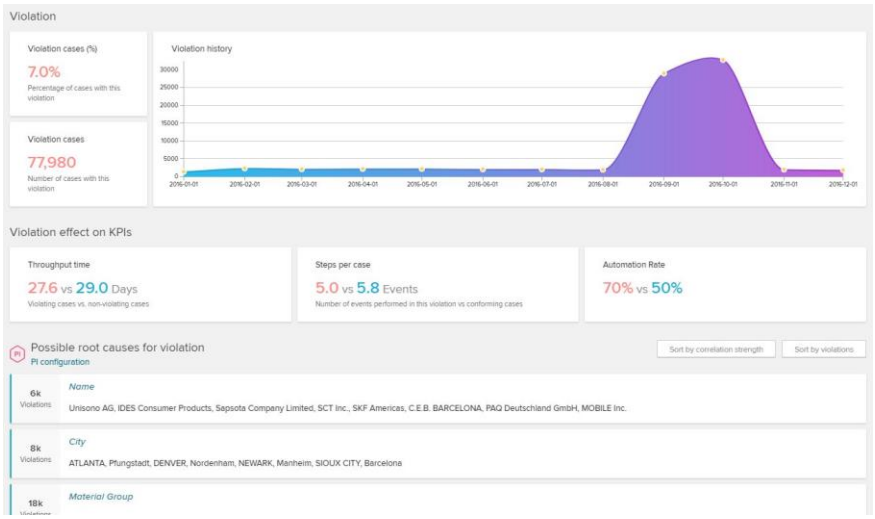

Fig. 2. Detailed information about a process violation through maverick buying, including the conformance trend over time (upper right), process KPIs (in the middle), and a list of root causes for this violation (at the bottom).

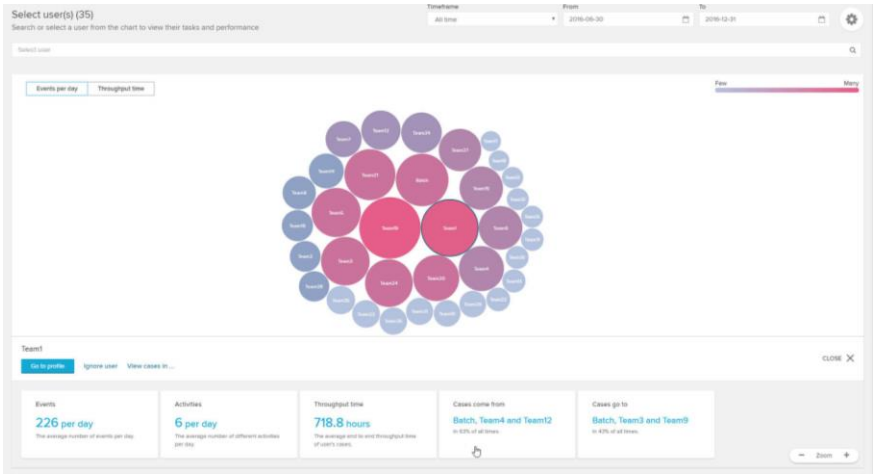

Fig. 3. Performance analysis of the process participants using PI Social.

PI Companion embeds Celonis in the front end of the business application, e.g., in the SAP Business Client as shown in Figure 4. This enables users to include insights from process mining into their daily operational business. While working in SAP, PI intelligently creates selections based on the input made by the SAP user and shows real-time insights into the process data. For instance, when purchasing a new material, users can immediately evaluate the delivery performance of the vendors in the side panel to choose the best performing vendor.

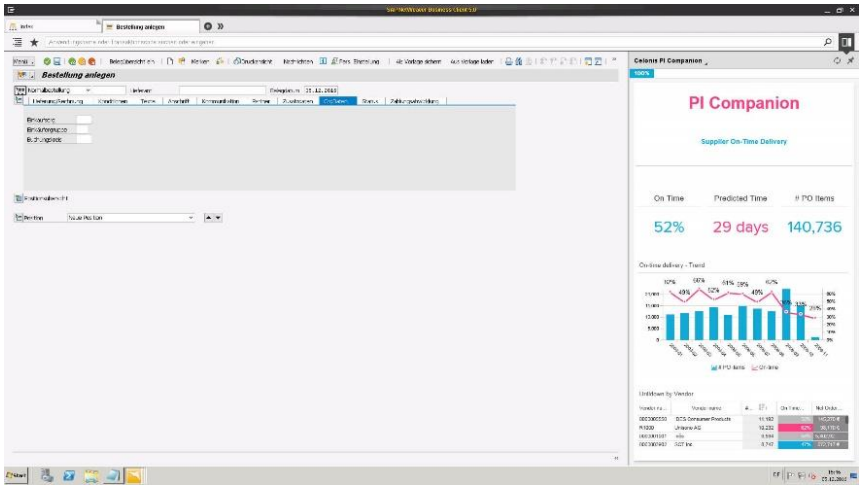

Fig. 4. Process analysis executed directly in the business application using PI Companion in the side panel of the SAP Business Client.

3 Maturity, screencast, and demo license

PI is available in Celonis Process Mining since December 2016. The new functionalities have already been applied by hundreds of users, including Fortune 1000 leaders like Siemens, SAP, or Vodafone. Customers and industry experts confirm the power of Celonis PI as the next generation of process mining:

- Prof. Wil van der Aalst (TU Eindhoven). https://youtu.be/prynsvWJMng
- Romana Engler (Siemens AG). https://youtu.be/HQqHRJfNcag
- Bastian Nominacher (Celonis SE). https://youtu.be/wwh58wObNJo

A full screencast demonstrating Celonis and the new PI features is available as download [4]. A free demo license including PI features is offered for academic users via the Celonis Academic Cloud [5].

References

1. van der Aalst, Wil M.P. et al.: Process Mining Manifesto. In: Business Process Management Workshops 1, pp. 169-194 (2011).
2. van der Aalst, Wil M.P.: Process Mining – Data Science in Action. 2nd edn., Springer, Heidelberg (2016).
3. van der Aalst, Wil M.P., Weijters, A.J.M.M: Process Mining: A Research Agenda. In: Computers in Industry 53, pp. 231-244 (2004).
4. Kohlbacher, Markus. In: Business Process Management Journal 16(1), pp. 135-152 (2010).
5. Celonis SE, PI Webinar, https://goo.gl/FKyZYQ
6. Celonis SE, Academic Cloud, https://academiccloud.celonis.com