Enhancing digital skills in accounting through o2c process analysis: the contribution of SAP Signavio to the industry 4.0 ecosistem

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Abstract: The integration of advanced technologies into the Industry 4.0 ecosystem is fundamentally changing the professional profile of accountants, shifting the focus toward digital, analytical, and technological skills that go beyond the traditional realm of financial recording and reporting. In this new framework, the analysis of economic processes, such as Order-to-Cash (O2C), becomes a critical component of the

accounting function, enabling the assessment of transaction accuracy, flow traceability, and operational impact on financial performance. This study explores the role of the SAP Signavio Process Intelligence platform in developing these skills, demonstrating how accountants can use process mining and process analytics to transform raw data from ERP systems into insights relevant to decision-making. Based on a real data set extracted from an SAP ERP system in the retail industry and processed in SAP Signavio, the research highlights the skills that a modern accountant needs to possess: understanding the logic of business processes, visually interpreting flows, detecting deviations, and assessing operational risks. The results of the study show that the use of intelligent tools leads to an increased ability to analyze O2C performance, supports internal control processes, and improves collaboration between financial, logistics, and operational functions. The paper argues that the development of digital skills - such as process intelligence literacy, data analysis, decision automation, and the use of advanced modeling platforms - is indispensable for adapting the accounting profession to the requirements of Industry 4.0 and for strengthening the strategic role of accountants in the governance of economic processes.

1. Introduction

The accelerated technological transformations associated with the Industry 4.0 paradigm are putting significant pressure on the accounting profession, redefining the necessary skills and the role of the financial specialist in the organizational architecture. In an environment characterized by intelligent automation, interconnectivity, and increased volumes of operational data, the modern accountant is no longer just an information processor, but an analyst of economic processes, an evaluator of data flows, and a key player in supporting management decisions. In this context, digital skills become fundamental to ensuring the accuracy of processes, interpreting the results generated by complex IT systems, and integrating the financial perspective into the governance of business processes.

The Order-to-Cash (O2C) process is a prime area for developing these skills, as it combines commercial, logistical, and financial dimensions in an extensive operational flow with a direct impact on the company's revenue, organizational performance, and liquidity. From an accounting perspective, analyzing the O2C process is essential for ensuring transaction accuracy, identifying operational and financial discrepancies, and assessing the risks generated by deviations or delays. However, traditional analysis mechanisms - based on static reports or manual checks - are no longer sufficient in the face of the complexity of real processes and the need for end-to-end visibility. Process intelligence tools, such as SAP Signavio, provide an advanced technological infrastructure that meets this need for a deep understanding of processes. Using process mining and process analytics techniques, accountants can reconstruct actual activity flows from ERP data, automatically identify deviations from the standard path, and understand how different operational behaviors influence financial performance. This type of analysis requires an extensive set of digital skills - from interpreting process visualizations to understanding transaction logic and

assessing operational risks - reinforcing the accountant's role as a data- and process-oriented professional. Therefore, this paper investigates how the use of SAP Signavio in O2C process analysis contributes to the development of accountants' digital skills, both in terms of understanding economic processes and interpreting operational data. The study starts from the premise that Industry 4.0 is not only a technological change but also a catalyst for redefining the accounting profession, and that integrating process intelligence into accounting activities is essential for adapting to the new requirements of the contemporary economic environment.

2. LITERATURE REVIEW (DIGITAL ACCOUNTING + INDUSTRY 4.0 + PROCESS MINING)

Order-to-Cash (O2C) analysis using process intelligence tools (SAP Signavio) is part of a general shift in how organizations understand the „reality„ of processes: from ideal descriptions (as designed) to behavior observed in data (as executed). Recent literature on digitization and BPM shows that Industry 4.0 is shifting managerial decision-making toward an evidence-based regime, in which the quality of evidence depends on digital infrastructure (ERP), data governance, and advanced analytical capabilities. At the same time, this shift is reshaping the accounting profession: the role is shifting from transactional processing to analysis, control, governance, and continuous optimization, which requires a reform of the curriculum and professional training (Moll & Yigitbasioglu, 2019; Rikhardsson & Yigitbasioglu, 2018; Tiron-Tudor et al., 2025).

The pressure of Industry 4.0 on the firm: from intuition to "proof" highlights the fact that in Industry 4.0, competitive and technological pressure stimulates the digitization of economic processes and raises expectations regarding traceability and "real-time" performance measurement. An important result of the BPM literature is the anticipation of future capabilities focused on digitization: transparency, systematic analysis of execution, integration of operational data with governance and compliance data (Kerpedzhiev et al., 2021). In the area of accounting/management accounting, digitization also has ambivalent effects: it can reduce ambiguity through automation and better data, but it can amplify role tensions (e.g., "watchdog" vs. "business partner"), which supports the idea that the transition is not only technical but also organizational (van Slooten et al., 2024).

With regard to the "digital backbone": ERP + data governance, the literature shows that process mining/process intelligence is fragile if data requirements are unclear, if logs are incomplete, or if there is no solid bridge between business meaning and data structures. The concept of Process Mining Data Canvas is proposed precisely as a method for identifying data requirements and understanding the process before collection / preprocessing - a critical step in O2C projects, where events are dispersed between sales, delivery, invoicing, and collection (Brock et al., 2023). The literature on object-centric process mining emphasizes that a realistic analysis requires a representation that captures the interaction between objects, otherwise indicators (e.g., waiting times, bottlenecks) can become misleading (Park & van der Aalst, 2025).

When discussing process intelligence/process mining (as-executed): from ideal flows to actual behavior, we can highlight that a major contribution in the area of process mining is clarifying the difference between the designed and executed processes, as well as extending methods beyond simple workflows. van der Aalst, Reijers, and Maruster (2024) summarize this direction: modern process mining must explain variation, exceptions, complex relationships, and the operational reality that produces financial impact (van der

Aalst et al., 2024). In addition, Park & van der Aalst (2025) show how object-centric operational monitoring supports the detection of problems in processes with interconnected objects - exactly the type of complexity encountered in O2C.

About end-to-end visibility: governance, compliance, performance—including in auditing, the authors of this scientific article emphasize that the specialized literature in the field of Accounting Information Systems shows that process mining extends the function of accounting information beyond reporting to an operational tool for governance, control, and continuous improvement. In this paradigm, end-to-end visibility into the actual execution of processes allows for the assessment of deviations, compliance, and the effectiveness of internal controls, with direct implications for assurance. Consistently, Werner, Wiese, and Maas (2021) advocate the integration of process mining into financial statement auditing, arguing that event logs can connect process behavior („as executed") with audit objectives and control testing.

About the transformation of the profession + education: the hybrid accountant – the literature refers to the fact that the changing role of the accountant is documented as an effect of digital technologies and data orientation. Moll & Yigitbasioglu (2019) discuss how internet-related technologies (cloud, big data, automation, AI) are reshaping accounting work and opening up new avenues of research; Rikhardsson & Yigitbasioglu (2018) substantiate the transition to business intelligence & analytics in management accounting – a direct basis for the analytical skills required by process mining (Rikhardsson & Yigitbasioglu, 2018; Moll & Yigitbasioglu, 2019). At the educational level, Dzuranin et al. (2018) propose a framework for integrating data analytics into the accounting curriculum, and Tiron-Tudor et al. (2025) explicitly point to the need for future-ready digital skills in the AI era, correlating market requirements with student expectations. Together, these works justify „process literacy" as an emerging professional literacy: the ability to read processes (variants, exceptions, operational causalities) and link observations to financial/fiscal impact - exactly the mutation described in the central text of your article (from transactional operator to analyst / strategic partner).

3. UN FRAMEWORK CONCEPTUAL AL COMPETENȚELOR CONTABILE DIGITALE

The evolution of the Industry 4.0 ecosystem is leading to a profound reconfiguration of the skills required for the accounting profession, shifting the focus of financial specialists from repetitive operations to analytical activities, process evaluation, and strategic support for organizational decisions. In this context, traditional accounting skills - such as knowledge of regulations, recording transactions, and preparing financial statements - remain essential, but are complemented by an extensive set of digital and technological skills. The conceptual framework proposed in this paper includes four main dimensions of digital accounting skills relevant to the analysis of O2C processes using SAP Signavio:

With regard to fundamental technological skills, this dimension concerns accountants' ability to interact effectively with ERP systems and modern digital platforms. It includes: understanding ERP data structures and logic, navigating applications such as SAP S/4HANA, SAP ECC, or SAP Fiori, using automation and data analysis tools, and familiarizing oneself with Industry 4.0 technologies (automation, cloud, APIs). These skills provide the necessary foundation for integrating accountants into the enterprise's information ecosystem.

- Analytical and procedural interpretation skills

To understand the actual behavior of the O2C flow, accountants must be able to: interpret process mining models, identify deviations, bottlenecks, and exceptions, assess the operational impact on financial indicators, and integrate quantitative and qualitative data into the economic process analysis. This dimension transforms the accountant into a process analyst, not just an interpreter of accounting data.

- Process governance and internal control skills

Process intelligence enables rapid detection of inconsistencies and operational risks. Accountants must be able to: assess the compliance of O2C flows, identify internal control risks, propose improvement measures, and correlate process changes with reporting and audit requirements. This dimension strengthens the accountant's role in ensuring the quality of business processes.

- Strategic and decision-making skills

Using SAP Signavio generates insights that can guide decisions related to performance, costs, and operational efficiency. Thus, accountants must be able to: make data-driven recommendations, contribute to the optimization of O2C processes, participate in organizational transformation projects, and build financial analysis models integrated with logistics flows. With these skills, accountants become strategic partners to management, contributing to the governance of the organization through their analytical and procedural expertise..

4. METHODOLOGY ADAPTED TO THE NEW TREND – DIGITAL ACCOUNTING SKILLS

The dataset used in the analysis was compiled based on operational data extracted from the SAP ERP ECC system, covering the essential activities of the Order-to-Cash (O2C) flow. The dataset includes a total of 4,642 sales orders, each representing a distinct case in the event log, which allows for the complete reconstruction of the operational path of each document flow. In total, 16,074 events were recorded, corresponding to the activities carried out during the life cycle of an order – from its initiation to the completion of the financial process.

The average time to complete a sales order, as reported by SAP Signavio, is 1 week and 5 days, an indicator that reflects the level of operational complexity and maturity of the processes within the analyzed organization. These volume and time indicators provide the necessary basis for applying process discovery, variant analysis, and performance investigation techniques, ensuring the robustness of interpretations of O2C process behavior. The three indicators presented in the SAP Signavio dashboard provide a clear picture of the magnitude and pace of the O2C process. The relatively high volume of sales orders (4,642) suggests an active operational flow, specific to an organization in the manufacturing or distribution sector, where commercial processes run continuously and have a direct impact on the financial function. The total number of 16,074 events reflects the granularity of the process and the diversity of activities performed, thus providing a solid basis for identifying dominant paths, deviations, and bottlenecks. The average time of 1 week and 5 days to complete an order may indicate both the logistical complexity of the organization (e.g., production processes integrated with delivery processes) and possible variations in intermediate activities, which are worth analyzing in detail using the performance indicators available in SAP Signavio. In the context of Industry 4.0, this type of analysis is crucial because it allows for the assessment of operational efficiency, the

impact on the cash conversion cycle, and the extent to which processes can be automated or optimized. Overall, the dataset highlights an O2C process that is sufficiently complex and volatile to offer relevant opportunities for analysis through process intelligence, particularly in terms of developing accountants' digital skills and their ability to interpret operational indicators in relation to financial performance.
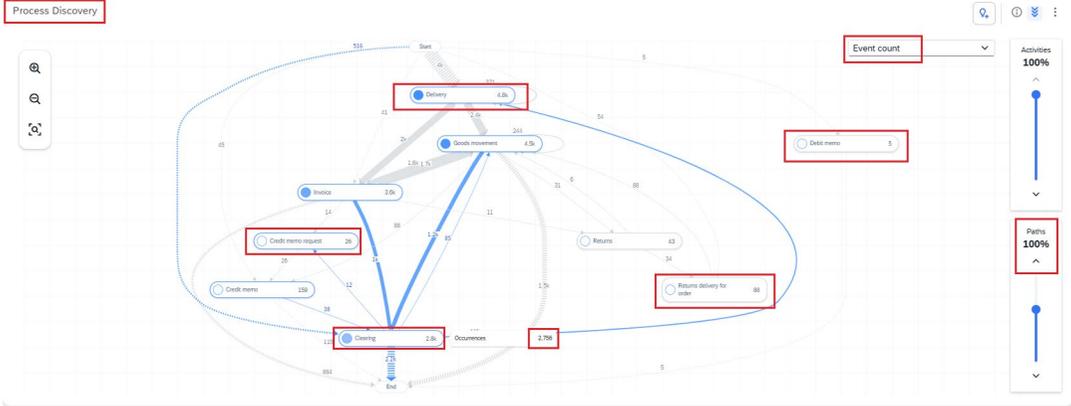
Figure no. 1 Process discovery model for the Order-to-Cash flow using the "Event count" criterion in SAP Signavio

The figure shown (Figure no. 1) illustrates the Process Discovery model for the Order-to-Cash (O2C) flow, obtained through SAP Signavio, using the Event count criterion and the 100% activities / 100% paths visualization setting. This representation allows for a complete visualization of the process behavior, including both frequent and rare paths, which can reveal risks, exceptions, or potential operational non-conformities. Predominantly, as is the case, is the logistics flow in the O2C process structure. The largest operational volumes are concentrated in the logistics area of the process, particularly in the activities: Delivery – 4,809 events, Goods movement – 4,548 events, which confirms the intensity of the physical activities of handling, preparing, and delivering products. This behavior is characteristic of manufacturing or distribution organizations, where the logistics component has a significant operational volume and determines the overall pace of the O2C process.

This observation reinforces the need for accounting professionals to understand logistics processes, as variations or bottlenecks in this area have a direct impact on the recognition of revenues, costs, and cash flows. We also highlight invoicing as a critical node in the process, with 3,640 events representing a central node in the flow, connecting the logistics side with the financial side. The behavior of the process indicates: a dominant logistics-financial flow, the existence of loops and exceptions before or after invoicing, multiple alternative routes that can generate variations in time or process quality.

The large number of events associated with invoicing indicates a high degree of automation, but also an operational diversity that deserves to be investigated in depth through performance indicators (cycle time, throughput, waiting times). Regarding financial activities: Clearing as an indicator of cash cycle performance, we can mention that the Clearing activity, with 2,756 events, represents the completion of the financial process, by offsetting invoices with payments made by customers. The presence of routes

that close quickly suggests: reasonable efficiency in debt collection, predictable customer behavior, and an adequate level of financial control.

However, the difference between the volume of invoices (3,640) and the number of clearing entries (2,756) may signal: invoices still outstanding, late payments, incomplete processes within the analyzed period.

This analysis provides accountants with direct insights into operational cash flow and credit risks. Regarding the routes considered by SAP Signavio as exceptions: Credit memo, Returns, and Debit memo, we are dealing with the fact that, in addition to the main flow, there are activities with low volume but relevant for the assessment of operational risks: credit memo request – 26 events, credit memo – 159 events, returns delivery for order – 88 events, returns – 43 events, debit memo – 5 events.

These signal financial adjustment processes, returns, and commercial corrections. Although low in percentage terms, these routes may indicate: delivery non-conformities, billing errors, customer complaints, and logistical or commercial processes that need to be reviewed.

For the accounting profession, these events are sensitive areas because they affect indicators such as revenue accuracy, customer satisfaction, and internal control quality. Interpreting paths in the context of digital accounting skills using SAP Signavio as an intelligence tool aims to provide a complete view of paths (100% paths), highlighting the real complexity of the process and the need for advanced skills, such as: process literacy, the ability to analyze deviations and exceptions, the ability to correlate operational variations with financial impact, understanding interdepartmental flows and how they affect accounting.

In the context of Industry 4.0, accounting professionals are no longer limited to documentary checks, but must use intelligent tools such as SAP Signavio to analyze the actual behavior of the process and identify opportunities for optimization.

Analytical conclusion on the diagram

The Process Discovery diagrams obtained through SAP Signavio provide an extremely detailed picture of the O2C process execution, revealing:

4. the logistics route as the main flow,
5. invoicing as a critical node,
6. clearing as an indicator of financial performance,
7. exceptions as sources of risk and opportunities for improvement,
8. the need to develop accountants' digital skills for the correct interpretation of processes.

This analysis demonstrates the added value of process intelligence tools in the accounting profession and their relevance for the governance of economic processes in the Industry 4.0 era.

5. CONCLUSIONS FOCUSED ON TRAINING FUTURE ACCOUNTANTS

The results of analyses performed with SAP Signavio on the Order-to-Cash (O2C) process highlight a profound transformation in how economic processes are understood and evaluated in the context of Industry 4.0 technologies. These transformations have major implications for the accounting profession and how future specialists need to be trained to meet market demands. In an organizational ecosystem where automation, data analysis, and end-to-end visibility are becoming the norm, traditional accounting skills are no longer sufficient; they must be complemented with advanced digital, analytical, and

technological skills. First and foremost, the accountants of the future must be able to interpret complex processes using intelligent process intelligence tools such as SAP Signavio. They will not be limited to checking accounting documents, but will need to understand how operational flows work, identify deviations, bottlenecks, and sources of non-compliance, and correlate these phenomena with the financial and fiscal impact on the organization. This process-oriented approach requires the development of a new form of professional literacy - process literacy - which combines accounting knowledge with operational behavior analysis.

Furthermore, accountants must possess strong data analysis skills. Technologies such as process mining, process variant analysis, execution time evaluation, and exception path identification require fundamental knowledge of data structures, indicator interpretation, and the ability to draw conclusions based on empirical evidence. In this regard, professional training must include familiarization with ERP systems, visualization tools, data preprocessing techniques, and intelligent automation solutions. Thirdly, future accounting professionals must actively contribute to the optimization of economic processes. Based on the results obtained through SAP Signavio, accountants can identify areas with potential for improvement - reducing process times, eliminating unnecessary steps, increasing data quality, and optimizing cash flow.

The role of the accountant is thus evolving from a simple transaction operator to a performance analyst and strategic management partner. Finally, adapting the profession to the requirements of Industry 4.0 requires educational institutions and training programs to systematically include emerging digital skills: working with modern ERP systems, using process mining tools, understanding process architecture, integrating logistical and financial information, and the ability to interpret complex automations. Only by cultivating these skills will future accountants be able to contribute effectively to the governance of economic processes and the improvement of organizational performance. In conclusion, the analysis of the O2C process through SAP Signavio demonstrates not only the need to modernize internal processes, but also the importance of redefining professional training in the field of accounting. Future accountants must become hybrid specialists, combining financial expertise, digital skills, and analytical abilities, ready to operate in a deeply digitized and data-driven economy.

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