

Harnessing the Potential of Artificial Intelligence in Working Capital Management: Some Considerations

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Efficient working capital management (WCM) creates value for both management and shareholders by enhancing cash flows and reducing investment in receivables and inventory. It supports liquidity and minimizes financial distress risks, aligning with the goal of shareholder value maximization. However, traditional manual approaches to WCM are no longer sufficient due to the rapid and complex changes in economic and business environments. As a result, firms increasingly rely on artificial intelligence (AI) in WCM. AI offers advanced capabilities in prediction, monitoring, and problem-solving by processing vast data, identifying variable relationships, and adapting to change faster than human cognition. This paper explores the fundamentals of WCM and AI, their interconnections, and the strategic opportunities AI introduces to optimize WCM in modern enterprises.

Keywords: working capital management (WCM), artificial intelligence (AI), value creation, liquidity

Introduction

Efficient working capital management (WCM) benefits both management and shareholders thanks to value creation. Decrease in working capital (WC) generates high cash flows and reduced investments in receivables and inventory (Boisjoly, Conine Jr, & McDonald IV, 2020). According to Jensen and Meckling (1976), the components of working capital (cash, accounts receivable, inventory, and accounts payable) are part of the instruments to achieve the objective of maximizing shareholder value by the management of the firm. The WCM strategy also allows firms to keep an adequate level of liquidity to repay short-term liabilities when they become due and, in doing this, WCM also optimizes cash flow levels (Umeorah, Adelaja, Ayodele, & Abikoye, 2024) and minimizes the risk of financial distress.

However, traditional and manual techniques are no longer efficient and effective in WCM. At present time, WCM implies complex activities of prediction, monitoring, and revision at a speed which is hardly compatible with human capabilities of analysis and reaction. In fact, nowadays, macroeconomic, microeconomic, and business factors change rapidly. The impact of their interrelated connections on enterprises cannot be appropriately foreseen and managed by human brains, which instead need to rely on artificial intelligence (AI) systems. These AI systems are able to process large amounts of data, create relationships between multiple variables, forecast, solve difficult WCM problems, and monitor the WC situation, by mimicking the human reasoning, analysis, and learning, at the required pace and accuracy.

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Therefore, the aim of this work is to discuss the fundamentals of WCM and AI, to then highlight the relationships between the two concepts and explain the opportunities arising from AI in WCM.

The rest of the work is developed as follows. Section 2 deals with the importance and criticalities of WCM. In section 3, a discussion of the dimensions of AI is provided. Section 4 explains the opportunities deriving from AI in WCM. Section 5 offers some final conclusions.

Working Capital Management: Importance and Criticalities

WC is the difference between current assets and current liabilities of a firm and the main purpose of WCM is to balance current assets and current liabilities to ensure that a company has enough cash to cover its short-term obligations, so as to lower the risk of bankruptcy (Habib, Yang, & Cui, 2024). WCM includes four main managerial components: inventory, receivables, payables (Prasad et al., 2019), and cash. The WC cycle or cash conversion cycle implies the purchase of raw materials and other production factors, their use to make finished goods, the sale of goods, and the subsequent collection of receivables (Kiymaz, Haque, & Abir, 2024).

An optimal WCM avoids shortage of funds preventing firms from undertaking daily operations, minimizes the risk of an inability to cope with outstanding short-term liabilities and refrain unnecessary investment in short-term assets, and reduces the need for external financing (Aamir & Shah, 2015) and external cash. Rephrasing the three motives for having cash, initially identified by Keynes (1936), there are three main reasons for holding cash: to make operating payments (for goods, machinery, repayments of debt, etc.), to make speculative investments (in securities, currencies, real assets), and to generate a reservoir of cash. A reservoir of cash can be considered a “financial parachute”, allowing firms to face unexpected payments or lower inflows. It is not simply composed of cash and cash equivalents, but it is rather a financial approach to avoid bankruptcy. Hence, a reservoir of cash is, of course, available cash, but also, for example, the possibility of stretching payables or using a bank credit line if it is not fully employed.

There are two alternative methodologies in WCM. An aggressive WCM is considered to be risky and, at the same time, achieve a higher performance. It implies financing fixed assets with long-term debt and equity, and covering current assets with current liabilities. The wide use of short-term debt entails a lower cost of capital at the expense of an increase in liquidity risk. On the contrary, a conservative WCM means relatively high cash and cash equivalents, marketable securities, receivables, and inventory. The conservative WCM approach increases the financial costs of a firm because of its higher proportion of long-term debt, thus decreasing its profitability, but reducing the risk of financial distress (Akbar, Jiang, & Akbar, 2022).

WCM employs indicators to verify its effectiveness, that is the current and quick ratio (Brealey, Myers, Allen, & Edmans, 2023). According to the conservative WCM approach, the current ratio—measured as the ratio of current assets to current liabilities—should be greater than one for the value corresponding to the amount of inventory that is the most illiquid part of the current asset. Therefore, inventory should be financed through long-term sources of financing, such as long-term debt and equity. Besides, under the same approach, the quick ratio—measured by the ratio between cash and cash equivalents, marketable securities and receivables, and current liabilities—should be equal to around one (but not less than one), because this shows the ability of a firm to repay its short-term obligations by using cash arising from its liquid or very liquid assets. Hence, it is very likely that the firm will be able to repay its current liabilities when they become due.

Despite the importance of an effective WCM, the traditional WCM methodologies undergo several criticalities that can prevent enterprises from adequately managing their short-term assets and liabilities.

Cash flow management means planning, tracing, and controlling the changes in cash in (inflows) and out (outflows) of a business. Manual cash flow management takes a significant amount of time, as those in charge of the financial management are continuously engaged in updating spreadsheets, tracking invoices, reconciling accounts, and recording data into various systems. When the operations and amount of data to be recorded and checked grow, the risk of errors increases. This implies giving up profitable opportunities and a decrease of overall profitability (Umeorah et al., 2024).

Owing to a poor inventory control, a firm can hold high or low levels of stock, causing, respectively, excess or insufficient availability of inventory. High stock levels arise because too much stock has been purchased, through inappropriate forecasting, monitoring, or controls. Stockouts result from holding too little stock for the production process or sale, because the forecasts, monitoring, or controls are inadequate (Wild, 2017). Poor inventory management system negatively affects the profitability of an organization (Atnafu & Balda, 2018). In fact, overinvestment in inventory increases operating costs (such as warehouse rent, insurance, and security expenses) and capital and opportunity costs (Setianto & Pratiwi, 2019), whereas underinvestment in stock causes missed sales and profits, in case of a sudden rise in the demand for the firm's products and a switch to the competitor brands on the part of customers (Sah & Füredi-Fülöp, 2022).

Manual receivables management means a labor-intensive, time-consuming, low-value tasks such as data extraction, manual worklist creation, and correspondence with non-critical customers (Nanda, 2018). Moreover, an overestimation of collections implies more debt financing and related costs, whereas an underestimation of collections leads to opportunity costs, as the capital remains unemployed (Kureljusic & Metz, 2023). In the subsequent phase of the management of debtors, a firm must ensure that the repayment of credits is done when they become due and with the minimum administrative cost to the company. Besides, an ineffective creditworthiness evaluation of potential debtors creates challenges of credit collection and use of time of the debt management staff in monitoring the recovery of the receivables (Adusei, 2017).

Conventional management of payables might not fully leverage credit terms, leading to premature payments that can affect liquidity. Thus, effective payables management is essential. It requires carefully scheduling supplier payments to ensure sufficient liquidity, while avoiding late payment fees. Failing to take advantage of available credit terms means a potential loss of cash flow benefits that could be employed for other operational needs (Umeorah et al., 2024).

The Dimensions of Artificial Intelligence

AI can be defined as “the intelligence shown by machines and systems that perceive and analyze a set of inputs to maximize their ‘chances’ to resolve a problem” (Piras, Lahmar, & Mandas, 2025, pp. 2-3).

John McCarthy, who was professor emeritus of computer science at Stanford University, established AI as a field in 1956. He organized the Dartmouth conference at Dartmouth College in Hanover, which marked the beginning of AI as a discipline. McCarthy believed that systems would eventually evolve to exhibit human-like intelligence (Soni, Sharma, Singh, & Kapoor, 2020). In fact, the conference was based on the conjecture that “every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it” (McCarthy et al., 2006, p. 1).

Since 1955 researchers from diverse academic disciplines have contributed to the field of AI (Bharadiya, Thomas, & Ahmed, 2023) and the destiny of AI has been characterized by the so-called “Summers” and “Winters”. An AI Summer refers to a period marked by a significant increase in investments and interest in AI,

accompanied by optimism for scientific breakthroughs. During an AI Summer, most, if not all, major advancements in AI occur. The development and application of AI technologies attract more funding, fueled by expectations of upcoming scientific progress. These promising forecasts about the future of AI inspire further investments in the market. In contrast, AI Winters are periods marked by a decline in interest and funding for AI. The onset of an AI Winter is usually due to a combination of factors, such as hype, overestimation of AI capabilities, economic conditions, institutional limitations, and a shortage of innovative and creative talent (Groumpos, 2023).

Nowadays, AI enhances the technological advancements of Industry 4.0, representing the edge of the industrial revolutions that occurred throughout the last centuries: The first industrial revolution took place in the 1780s thanks to the transition from manual labor to mechanization (Industry 1.0); the second industrial revolution, in the late 19th century, saw the transition from mechanization to electrification (Industry 2.0); the third industrial revolution happened from the end of 1960s and refers to the change from analog to digital technologies (Industry 3.0); lastly, from the 2000s, there has been the shift from digitalization to automation, implying the evolution of digital technology and the creation of real-time connections, which have transformed machines into self-aware entities capable of learning and interacting with their surroundings to improve performance (Islam, Ahmed, Al Bashar, & Taher, 2024).

Social scientists have also debated the ethical and legal implications of AI (Bharadiya et al., 2023); however, these issues go beyond the purpose of this work. On the contrary, it is worth noting here that there are four main areas for usage of AI: healthcare, logistics, civil engineering, and management and business (Buntak, Kovačić, & Mutavdžija, 2021). The opportunities created by AI for business finance will be discussed in the next paragraph.

When it comes to examine more in depth the characteristics of AI, it is important to clarify that AI is a general domain, while machine learning (ML) and deep learning (DL) are subfields of AI, although they are often used interchangeably. Specifically, ML is a subset of AI that concentrates on data algorithms, allowing machines to mimic human learning processes and gradually enhance their accuracy. DL, a subfield of ML, creates complex network structures that delve deeply into layers of information to produce comprehensive outputs (Keshari & Gautam, 2025). Therefore, using ML techniques, empirical data are gathered, knowledge is generated and stored, and with each new learning cycle, problem-solving becomes increasingly efficient and effective (Buntak et al., 2021). DL is a type of neural network (NN) and one of the most in-demand and valuable skills in AI, due to its ability to process large volumes of data, identify intricate patterns, and generate precise predictions (Groumpos, 2023). Hence, DL is similar to the ML with difference when learning DL creates NN (Buntak et al., 2021). An artificial NN is inspired by biological neural networks that form animal brains. Also known as a connectionist system, it consists of interconnected nodes linked by directed connections. Each linked connection is assigned a weight that influences signal transmission. When a node receives a signal, it processes it and sends it to another node. In typical artificial NN configurations, the signal between artificial neurons is represented as a real number, and each neuron's output is determined by a non-linear function of the summed inputs. As learning progresses, the weights adjust, altering the signal strength accordingly (Pallathadka et al., 2023). Artificial NN methods are very many (Abiodun et al., 2018) and include supervised approaches, such as decision trees, and unsupervised approaches, like clustering. The supervised learning creates a model based on a pre-categorized input-output set. The most popular supervised approach is classification. Unsupervised learning refers to a learning that has not an anticipated output for a given input. It is used for grouping the inputs into categories and this is possible thanks to the fact that this AI automatically learns from data based on similarity measures (Li et al., 2023).

The Opportunities Arising From Artificial Intelligence in Working Capital Management

Inventory Management

AI and in particular ML significantly and positively impact inventory management practices worldwide (Islam et al., 2024). A key application of AI in inventory management is demand forecasting. AI algorithms are highly effective at analyzing complicated datasets to anticipate future product demand (Singh & Adhikari, 2023a); hence they help eliminate additional costs related to stock shortages, lost revenue, and surplus inventory. AI technologies enable rapid analysis of extensive and diverse datasets, significantly enhancing the accuracy of demand prediction. Moreover, incorporating AI into inventory management streamlines the process, making it more efficient and adaptable, lowering operational costs while ensuring faster customer response times and richer contextual insights (Ünal, Erkeyman, & Usanmaz, 2023). Artificial NN models can optimize inventory levels, improving the ordering system and addressing lot-sizing challenges. They achieve this by effectively balancing high holding costs caused by excessive stock levels with elevated shortage costs associated with low inventory levels (Šustrová, 2016). ML models, trained to predict market demand more accurately, help reduce capital expenditure on inventory maintenance and minimize manual labor. Enhanced forecasting techniques decrease both overstock and stock-outs, ultimately increasing profitability (Praveen et al., 2020). The integration of AI and Internet of Things (IoT) in inventory management signifies a transformative shift in the tracking, analysis, and management of inventory. AI and IoT function together, with IoT delivering a continuous flow of real-time data from connected devices, while AI analyzes this data to facilitate informed decision-making and accurate predictions (Singh & Adhikari, 2023b).

Receivables Management

Utilizing AI and ML presents a promising approach to more effectively classify customer risk, allowing for proactive strategies to reduce defaults and enhance cash flow. Additionally, AI-driven systems can deliver customized recommendations for credit terms and automate follow-up initiatives based on the predicted risk profiles of individual customers (Tíryakí & Kavak, 2024). Through AI models of receivables management, customer segmentation, indicators for risk assessment, and warning thresholds can be adjusted at any time (Peng & Tian, 2024). Furthermore, the collections process, from the sales to the effective collection of payments, can be facilitated, thanks to a reduction in the delinquency rate (Paredes-Chirinos, Caballero-Carpio, & Quiroz-Flores, 2024). Lastly, by implementing AI solutions to automate the management of large volumes of email inquiries, operational efficiency is enhanced, leading to cost savings and more effective resource allocation (Arora et al., 2024) and decision tree algorithm models can predict invoice payment timing, thus accelerating cash conversion cycle (Ramanei, Abdullah, & Khim, 2021).

Payables Management

Poor management of payables is a major problem. Outdated practices often prevent businesses from fully utilizing credit terms, and this causes early payments that can worsen a firm's liquidity. The use of AI techniques appears to be vital in managing payables effectively, by strategically timing supplier payments to ensure liquidity equilibrium, while avoiding penalties for late payments (Umeorah et al., 2024). AI is also helpful when it comes to monitor procurement activities and process the related data to avoid duplication of payments and vendors (Cangemi & Taylor, 2018).

Conclusions

Effective WCM is crucial for any business seeking to maintain operational efficiency and profitability. However, traditional WCM methodologies face significant limitations. These conventional methods often rely heavily on manual processes, which can lead to inefficiencies, human errors, and missed opportunities. In an age of increasing data complexity and speed, the drawbacks of manual WCM are becoming more apparent, especially in the core components of cash flow, inventory, receivables, and payables management.

AI introduces a transformative approach to cash flow management. By automating repetitive tasks, identifying trends in real-time data, and improving forecasting accuracy, AI systems enable businesses to manage cash flows more efficiently and proactively. This shift reduces human error, increases the organization's responsiveness to financial changes, and decreases the likelihood of financial distress.

In the context of inventory management, AI and ML models significantly enhance forecasting capabilities by analyzing large and diverse datasets. These models predict demand more accurately, helping businesses maintain optimal stock levels. AI also automates order planning and inventory categorization, reducing manual oversight and minimizing costs associated with holding or missing stock.

AI-driven systems enhance receivables management by automating processes and offering more accurate risk analysis. ML algorithms evaluate customer creditworthiness using historical data and behavioral patterns, enabling businesses to segment customers by risk level. AI tools also automate payment reminders and track customer communications, reducing delinquency rates and accelerating the cash conversion cycle.

AI can significantly enhance payables management by analyzing payment terms, identifying optimal payment times, and preventing late fees. By leveraging data analytics, AI ensures companies utilize available credit terms efficiently, maintaining liquidity without jeopardizing supplier trust.

On the whole, the integration of AI into WCM presents a powerful opportunity for businesses to overcome the limitations of traditional financial practices. From enhancing cash flow forecasting and inventory control to optimizing receivables and payables, AI and its related technologies like ML, DL, and IoT offer real-time, data-driven insights that help firms improve efficiency, reduce costs, and drive profitability. As financial environment becomes more complex, embracing AI in WCM is no longer an optional but has become a strategic necessity.

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