

Digital Tools for Working Capital Optimization in Road Construction: An Empirical Analysis Based on Financial Statements

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Abstract. *This study examines the relationship between digital maturity and working capital management in the road construction sector, drawing on a documentary analysis of the published annual financial statements of the five largest Bulgarian road construction companies by net revenue for the period 2022-2024. The sector is characterised by long project development cycles, capital-intensive operations, and milestone-based payment arrangements that create distinct working capital challenges. The methodology is based on a descriptive quantitative analysis of secondary accounting data and the computation of key financial ratios - days sales outstanding (DSO), days inventory outstanding (DIO), and return on assets (ROA) - combined with comparative intertemporal and interfirm analysis. The empirical findings indicate that, over the observation period, no clear short-term association is established between the level of digital intangible assets and working capital efficiency. The results suggest that contractual arrangements, project execution patterns, and prevailing market conditions exert a stronger short-term influence on financial performance than observable digitalisation.*

Keywords: working capital, digitalisation, financial statements, road construction, construction projects.

Introduction

Working capital management plays a central role in companies operating in the road construction sector. The nature of road construction creates unique challenges for the effective management of working capital, especially regarding to cash flows and liquidity. Road construction projects are characterised by exceptionally long development cycles-typically between 18 and 48 months for regional roads, and often exceeding 60 months for highways and complex infrastructure projects. During this period, companies are required to make significant investments in the acquisition of specialised equipment, the purchase of asphalt and other road construction materials, earthworks, as well as the payment of labour costs, before receiving all cash inflows from the contracting entities.

The payment structure in road construction is specific and introduces additional complexity in working capital management. In the implementation of infrastructure projects for government and municipal clients, a payment typically follows a structure that includes: an advance payment upon contract signing (usually 10-30% of the contract value); interim payments based on approved bills of quantities and valuations for completed works by project stages; retention of a guarantee amount (usually 5-10%) until the expiry of the warranty period; and final settlement following project acceptance and the issuance of a completion certificate. In projects financed by European funds, additional complexity arises owing to specific documentation requirements and longer verification and payment timelines imposed by the managing authorities.

Studies of the financial statements reveal significant variation in the effectiveness of working capital management across the sector. The Cash Conversion Cycle (CCC) in the construction sector is often considerably longer than in most other industries - typically between 150 and 250 days, while the manufacturing sector typically averages 60-90 days. As a result, construction companies must finance their operating cycle over a significantly longer timeframe, which puts pressure on liquidity and demands careful financial planning.

Research carried out by the authors has found that working capital management in road construction companies in Bulgaria often relies on disconnected or fragmented information systems information systems. The finance team may use an accounting system, while construction project managers use separate construction management software, and materials are tracked in yet another system. In practice, this results in delayed identification of issues with contract receivables from clients or construction material inventories; limited real-time visibility into the cash position of individual projects; suboptimal decision-making due to the absence of integrated information across the different infrastructure projects in the portfolio; and considerable time spent on manually collecting and consolidating data from various construction sites and projects.

As the construction sector continues to digitalise, an important question arises as to whether the adoption of digital tools can meaningfully improve working capital management. Current technological solutions for the sector include: specialised ERP systems that integrate financial accounting, construction project management, material procurement, and portfolio of infrastructure projects management within a single platform; project management tools that enable developers to monitor the progress and financial status of each project; predictive models for forecasting cash flows specific to individual construction projects; and automated systems for managing contract receivables.

This study examines the relationship between the level of digitalisation and working capital management in the construction sector, drawing on a systematic analysis of financial statements. The research pursues three objectives: (1) to determine whether a relationship exists between the degree of digitalisation of construction management processes and working capital management indicators; (2) to examine the effectiveness of working capital management across road construction companies with varying levels of digital adoption; and (3) to develop a methodological framework for working capital analysis based on financial statements, specifically applicable to the construction sector.

Literature review

Working Capital Management in the Construction Sector: Theoretical Foundations

Working capital management is a foundational concept in corporate finance and has evolved alongside the development of modern financial theory. Empirical research specifically focused on working capital management in road construction remains scarce in the global academic literature (Asare et al., 2023). The latest studies examine the broader construction or infrastructure sector. This is not a limitation unique to the present study - it reflects a gap in the field, as road construction constitutes a distinct sub-sector within the wider construction industry and shares its fundamental financial and operational characteristics - including extended project cycles, milestone-based payment structures, and high working capital intensity.

Given that the construction industry is characterised by significant volatility in cash flows, there is a clear need to understand sector-specific working capital management practices (Asare et al., 2023). The need for companies in this industry to maintain effective financial management

practices arises from the substantial time lags between cash outflows and inflows that are inherent to construction projects.

Asare et al. (2023) provide a systematic thematic literature review of working capital management in the construction industry, analysing publications from 1990 to 2021. They observe that construction firms often underestimate the strategic importance of working capital management, which often leads to operational challenges, cash flow disruptions, and, in some cases, financial distress or business failure.

A defining characteristic of the construction sector is the extended project development cycle. Residential construction projects typically require between 18 and 36 months from project initiation to the sale of completed units, while more complex commercial real estate developments may span 36 to 60 months or longer (major highway and bridge projects may extend to 48 to 72 months or longer). This means that macroeconomic factors play a significant role in working capital management, as companies with longer development cycles tend to be more sensitive to economic fluctuations. In this context, Sobieraj et al. (2024) find that activity within the construction sector exhibits notable lag effects relative to economic cycles, suggesting that projects with longer time horizons are more vulnerable to macroeconomic conditions.

Empirical Research on Working Capital in Construction

The studies by Makori and Jagongo (2013) and Jaworski and Czerwonka (2022) provide consistent empirical evidence on the importance of working capital management for firm profitability. Makori and Jagongo (2013), examining listed construction and manufacturing firms in Kenya, find that a shorter cash conversion cycle and a shorter receivables collection period are associated with higher return on assets. Jaworski and Czerwonka (2022), using data from 326 companies traded on the Warsaw Stock Exchange over the period 1998-2016, establish a linear negative relationship between the cash conversion cycle and profitability, with the strength of the relationship varying across industries and macroeconomic conditions. Taken together, these findings reinforce the argument that efficient management of the operating cycle-particularly the receivables component-is a significant determinant of financial performance, a conclusion especially relevant for capital-intensive sectors such as road construction, where extended project durations and milestone-based payment structures generate structural pressure on the cash conversion cycle.

Kantianis et al. (2018) examine critical variables affecting working capital in infrastructure construction projects, focusing specifically on public works contractors. Through a case study of highway bridge construction in Greece, the authors develop a spreadsheet-based cash flow model to analyse the impact of contractual payment terms on working capital requirements. Their findings reveal that three factors significantly influence maximum working capital needs: retention percentages, front-end rate loading of bill of quantities items, and advance mobilisation payments from clients. The study demonstrates that the provision of advance payments at project start-up, combined with a latest-start-times execution schedule, results in the lowest working capital requirements for contractors. This research highlights the particular financial pressures faced by infrastructure contractors working under public procurement frameworks, where payment delays and retention provisions are common.

Paul et al. (2021) through a cross-industry analysis of current assets, current liabilities, and profitability, demonstrate that the relationship between working capital and profitability varies considerably across sectors. The construction sector is characterised by high capital intensity and pronounced cyclicity, making it especially vulnerable to macroeconomic fluctuations

(Matwiejczuk & Gorustowicz, 2017). In this context, a number of authors argue that in industries with long operational and investment cycles, effective management of current assets and liabilities represents a necessary condition for sustaining profitability. Supporting this view, Louw et al. (2022) identify a significant long-run relationship between working capital management components - proxied by indicators such as the CCC - and the profitability of construction firms in South Africa, based on panel data and causal analysis.

Working Capital Management in Construction Projects

Construction projects have specific characteristics that influence working capital management in ways that differ from other industries. In this sector the balance between aggressive and conservative working capital policies is particularly delicate. Nazir et al. (2009) analysed the impact of aggressive working capital management on firm profitability and conclude that more conservative approaches tend to be associated with higher corporate value. However, in capital-intensive, project-oriented industries such as construction, this balance is further complicated by the long development cycle and the scale of upfront investment required. Moreover, the project-based nature of construction means that each infrastructure project differs in terms of size, complexity, location, contractual arrangements, and implementation timelines.

Aik et al. (2019) examined working capital management, liquidity, and corporate profitability among listed construction firms in Malaysia. Their findings indicate that effective management of key working capital components - particularly receivables collection and inventory control - is significant for the financial performance of construction firms. In addition, maintaining an appropriate balance between cash conservation and good relationships with suppliers and subcontractors is a critical factor for the timely completion of construction projects. Ahmeti et al. (2022) corroborate these conclusions in a study of 98 small and medium-sized enterprises operating primarily in the manufacturing and construction sectors, showing that efficient working capital management contributes meaningfully to profitability. The results further highlight the greater sensitivity of SMEs to working capital management due to limited access to external financing and the need to balance liquidity with supplier relations during project execution.

Digitalisation in Construction Management

The digitalisation of the construction sector involves the implementation of specialised technological solutions aimed at addressing industry-specific challenges.

Han and Wang (2025) demonstrate that among listed construction companies, the use of digital technologies reduces financial risk in the supply chain by enhancing information transparency and operational efficiency. This enables firms to monitor receivables and payables more effectively and to manage liquidity in a way that supports cash flow stability and project execution. Complementing these findings, Kissabekov (2025) examines digital tools such as Building Information Modelling (BIM), cloud-based platforms, and integrated ERP systems, which facilitate coordination, planning, and control across construction projects. Beyond operational optimisation, these technologies enhance flexibility in working capital management - particularly important for small and medium-sized construction firms with limited access to external financing.

Integrated project management systems provide real-time visibility into the financial status of individual project within a company's portfolio. This enables managers to identify potential cash flow problems at an early stage and optimise the procurement of construction materials, thereby strengthening working capital management and overall firm liquidity. Additionally, Güngör and

Leindecker (2024) highlight the role of digital solutions for inventory and supply chain management in construction firms, showing that material tracking technologies, automated warehousing systems, and collaborative platforms between contractors and suppliers improve resource visibility, accelerate communication, and support more accurate forecasting of material and financing needs. This directly impacts working capital management, as firms can maintain lower inventory levels, optimise supplier payments, and reduce the risk of project delays, thereby strengthening the liquidity and financial stability.

Methodology

The present study employs a descriptive quantitative methodology based on secondary accounting data extracted from published annual financial statements. Given that the five companies under analysis collectively represent the dominant segment of the Bulgarian road construction market by net revenue - effectively constituting the full population of leading market participants rather than a statistical sample drawn from a broader population - the analytical approach centres on comparative intertemporal and interfirm analysis of financial ratios. Inferential statistical testing is not applied, as it presupposes a random sampling framework that is inconsistent with the census-based character of the study.

The methodology comprises the following stages, designed to account for the structural characteristics of road construction projects and to enable analysis based solely on publicly available financial data:

First, the group of enterprises under analysis was defined. The study covers the five road construction companies that recorded the highest net revenue in 2024 according to annual financial statements submitted to the Bulgarian Commercial Register. These five companies collectively represent the dominant segment of the Bulgarian road construction market and constitute the full population of leading market participants rather than a statistical sample. Their inclusion is therefore not subject to sampling error, and the results are descriptively valid for this segment without requiring generalisation through statistics.

Second, the financial statements for the period 2022-2024 were examined to identify intangible assets attributable to digitalisation and to assess their magnitude relative to total assets. Intangible assets unrelated to digitalisation - most notably concessions - were excluded. It is acknowledged that this proxy captures only capitalised digital investments (e.g. software licences, ERP platforms, construction management systems) and does not reflect digital tools recognised as operating expenses, such as cloud-based subscriptions. This limitation is inherent to the use of publicly available financial statements. However, the proxy is methodologically defensible: it captures the most strategically significant digital investments, those deemed sufficiently durable by management to warrant capitalisation; it is consistently defined across all five companies. Companies that favour subscription-based digital solutions will appear less digitalised under this measure, meaning the proxy is conservative rather than biased in one direction.

Third, key indicators of working capital management efficiency were computed: DSO, DIO, and ROA. The days payable outstanding (DPO) and the Cash Conversion Cycle ($CCC = DSO + DIO - DPO$) were also calculated, as the CCC is widely recognised as a comprehensive measure of working capital efficiency in the construction sector (Louw et al., 2022).

The association between the computed indicators and the level of digital intangible assets was assessed through descriptive intertemporal and interfirm comparison.

This approach is designed to account for the structural characteristics of road construction projects, which require continuous and active working capital management throughout the project lifecycle. The study does not pursue causal identification; rather, it aims to establish descriptive associations between observable proxies of digitalisation and working capital efficiency indicators, within the constraints of publicly available financial reporting.

The main research hypotheses (H), formulated specifically for the road construction sector in Bulgaria, are as follows:

H1: The road construction sector in Bulgaria exhibits a low level of observable digitalisation, as reflected in the limited recognition of digital intangible assets in the annual financial statements of the leading enterprises over the period 2022-2024. This hypothesis is consistent with the observation by Güngör and Leindecker (2024) that the construction industry faces particular difficulty in adopting digital technologies, owing to the complexity of building projects and the comparatively high failure rate of technology implementation in the sector.

H2: Greater investment in capitalised digital tools is reflected in a higher ratio of digital intangible assets to total assets, as reported in the annual financial statements of road construction enterprises. This hypothesis follows directly from the accounting treatment of software licences, ERP platforms, and construction management systems under applicable standards (Bulgarian National Accounting Standards and IFRS), whereby such investments are recognised as intangible assets when they meet the capitalisation criteria of identifiability, control, and future economic benefit.

H3: Higher levels of digitalisation are associated with shorter days sales outstanding (DSO) in road construction companies. Han and Wang (2025) provide theoretical support for this hypothesis by demonstrating that digitalisation reduces supply chain finance risk in construction companies through enhanced information transparency and improved operational efficiency. The empirical importance of the receivables collection period as a determinant of financial performance in the construction sector is established by Aik et al. (2019), whose findings indicate that a shorter collection period is the only working capital variable with a statistically significant positive effect on the financial performance of listed construction firms in Malaysia.

H4: Higher levels of digitalisation are associated with improved asset profitability (ROA) in road construction companies. Han and Wang (2025) provide the most direct empirical support available from the construction sector: studying listed construction firms, they find that digitalisation reduces supply chain finance risk through enhanced operational efficiency and information transparency. The connection between working capital efficiency and ROA - the channel through which digital tools are expected to improve profitability - is empirically established in the construction sector by Makori and Jagongo (2013), who find that a shorter cash conversion cycle is associated with higher return on assets among listed construction firms in Kenya.

Results and discussions

The empirical analysis covers the five road construction companies that recorded the highest net revenue in 2024 according to published annual financial statements, collectively representing the dominant segment of the Bulgarian road construction market. These enterprises exhibit varying levels of digital maturity over the observation period 2022-2024. The analysis addresses three interconnected dimensions: the recognition of digital intangible assets as an observable proxy for the degree of digitalisation; the efficiency of working capital management as measured by DSO,

DIO, DPO, and the Cash Conversion Cycle; and financial performance as measured by return on assets.

The operational measure of digital maturity employed in this study is the ratio of digital intangible assets to total assets, computed from balance sheet data. This indicator captures investments in software licences, ERP systems, construction project management platforms, and other digital solutions that have been capitalised in accordance with applicable accounting standards. It is acknowledged that digital expenditures recognised as operating costs - cloud-based subscriptions, software-as-a-service platforms, digital consulting fees - are not reflected in this ratio. Nevertheless, the measure is fully reproducible from publicly available financial statements, consistently defined across all five companies, and captures the most strategically significant digital investments, namely those deemed sufficiently durable by management to warrant capitalisation. It constitutes a methodologically defensible, if conservative, indicator of embedded digital maturity.

Digital maturity of the analysed enterprises

Table 1 presents the ratio of digital intangible assets to total assets of the analysed enterprises. The data reveal significant heterogeneity in the level of digitalisation across the different companies.

Table 1. Digital intangible assets to total assets (%)

Company	2022	2023	2024
TRACE GROUP HOLD PLC	0.02%	0.07%	0.03%
HYDROSTROY AD	0.15%	0.04%	0.01%
GP GROUP AD	0.00%	0.00%	0.00%
GBS-INFRASTRUCTURE CONSTRUCTION AD	0.10%	0.15%	0.09%
EVROPEISKI PATISHTA AD	0.00%	0.00%	0.00%

Source: Authors' own research.

The results confirm the first hypothesis regarding the low level of digitalisation in the sector. Two of the five analysed enterprises do not report any digital intangible assets throughout the entire period under review, which indicates either an absence of significant investments in digital tools or a predominant reliance on subscription-based cloud solutions that are recognised as operating expenses. In the two enterprises that report digital assets, a relatively low and declining share is observed, suggesting that investments in digitalisation are not a priority or that existing systems are amortised without being replaced with new solutions.

The second hypothesis, which postulated that greater adoption of digital tools would be reflected in a higher ratio of digital intangible assets to total assets, is not confirmed by the empirical data. On the contrary, the two enterprises that do recognise digital intangible assets - Trace Group Hold PLC and Hydrostroy AD - exhibit declining ratios over the observation period, while GBS-Infrastructure Construction AD, which records the comparatively highest ratio in the sample, also shows a declining trend. This trend admits two explanations. Companies may be shifting toward subscription-based cloud solutions that are expensed as operating costs and therefore do not appear as intangible assets in the balance sheet, implying that actual digital adoption is higher than the proxy indicates. Alternatively, existing capitalised digital systems may be amortised without equivalent reinvestment. Both explanations are consistent with the confirmed hypothesis one - that observable capitalised digitalisation in the sector remains low - and neither necessarily implies a reduction in the operational use of digital tools.

Working Capital Management Indicators

The analysis of the receivables collection period and inventory conversion period reveals substantial differences among the analysed enterprises. Table 2 presents the days sales outstanding (DSO), measured in days.

Table 2. Days sales outstanding - DSO (days)

Company	2022	2023	2024
TRACE GROUP HOLD PLC	183	152	174
HYDROSTROY AD	102	77	90
GP GROUP AD	134	62	63
GBS-INFRASTRUCTURE CONSTRUCTION AD	51	22	33
EVROPEISKI PATISHTA AD	143	324	324

Source: Authors' own research.

The data show significant heterogeneity in the receivables collection period. GBS-Infrastructure Construction AD demonstrates the most efficient management, with DSO ranging between 22 and 51 days, which represents an exceptionally strong performance for the construction sector. In contrast, Evropeiski Patishta AD reports a sharp deterioration, from 143 days in 2022 to over 324 days in 2023-2024, indicating serious difficulties in receivables collection. Trace Group Hold PLC maintains relatively high DSO levels between 152 and 183 days, which is characteristic of enterprises operating predominantly under staged or milestone-based payment arrangements.

A notable improvement is observed at GP Group AD, where DSO declines from 134.4 days in 2022 to approximately 63 days in 2023-2024. This represents a reduction of more than 50 percent and suggests a change in financial policy or contractual terms with clients. Despite the absence of reported digital intangible assets at this company, the improvement may stem from the introduction of stricter payment conditions or more effective receivables collection procedures.

Table 3 presents the days inventory outstanding (DIO), which is particularly relevant for the construction sector given the significant investments in construction materials and work in progress.

Table 3. Days inventory outstanding - DIO (days)

Company	2022	2023	2024
TRACE GROUP HOLD PLC	20	20	25
HYDROSTROY AD	130	93	71
GP GROUP AD	32	18	22
GBS-INFRASTRUCTURE CONSTRUCTION AD	23	12	27
EVROPEISKI PATISHTA AD	18	14	5

Source: Authors' own research.

The analysis of DIO indicates that most of the analysed companies maintain relatively low inventory levels. This is characteristic of construction companies operating predominantly as subcontractors in infrastructure projects, where materials are delivered on a just-in-time basis and work in progress is recorded by the main contractor. Trace Group Hold PLC, GP Group AD and GBS-Infrastructure Construction AD demonstrate stable values between 17 and 27 days over most of the period.

An exception is observed at Hydrostroy AD, which reports a DIO of 130 days in 2022. This may be due to accumulated material inventories resulting from delays in construction projects or to a strategy of advance purchasing in anticipation of rising construction material prices. The

subsequent reduction to 71 days in 2024 suggests a normalisation of inventory management or the completion of projects involving accumulated materials.

Evropeiski Patishta AD exhibits a downward trend in DIO, from 18 days in 2022 to only 5 days in 2024, which correlates with the deterioration in DSO and declining profitability. Low inventory levels combined with increasing receivables may indicate a shortage of active projects or cash flow constraints limiting its ability to acquire materials.

Table 4 presents the days payable outstanding (DPO), which measures the average number of days companies take to settle their obligations to suppliers and subcontractors.

Table 4. Days payable outstanding - DPO (days)

Company	2022	2023	2024
TRACE GROUP HOLD PLC	78	56	63
HYDROSTROY AD	113	41	52
GP GROUP AD	222	78	95
GBS-INFRASTRUCTURE CONSTRUCTION AD	23	19	17
EVROPEISKI PATISHTA AD	155	382	424

Source: Authors' own research.

The DPO data reveal substantial variation in supplier payment behaviour. GBS-Infrastructure Construction AD maintains the shortest DPO (17-23 days), consistent with a conservative financial policy and strong liquidity position. GP Group AD records the highest DPO in 2022 at 222 days, declining to 95 days in 2024, suggesting heavy reliance on supplier financing in the earlier period. The most concerning pattern is observed at Evropeiski Patishta AD, where DPO increases from 155 days in 2022 to 424 days in 2024. Combined with the simultaneous deterioration in DSO, this indicates a liquidity crisis: the company is financing its operations by severely delaying payments to suppliers and subcontractors because it cannot collect its receivables.

Table 5 presents the Cash Conversion Cycle (CCC = DSO + DIO – DPO), which integrates the three components of working capital efficiency into a single indicator reflecting the net number of days a company finances its operating cycle from its own resources.

Table 5. Cash conversion cycle - CCC (days)

Company	2022	2023	2024
TRACE GROUP HOLD PLC	125	117	136
HYDROSTROY AD	119	130	109
GP GROUP AD	-56	2	-10
GBS-INFRASTRUCTURE CONSTRUCTION AD	51	16	43
EVROPEISKI PATISHTA AD	6	-44	-95

Source: Authors' own research.

The CCC data require careful interpretation. Trace Group Hold PLC and Hydrostroy AD maintain positive CCC values in the range of 109-136 days, characteristic of construction companies operating under staged payment arrangements. GBS-Infrastructure Construction AD demonstrates the most balanced working capital cycle, with CCC declining to 16 days in 2023, reflecting simultaneously efficient receivables management and timely payment of obligations. GP

Group AD records a negative CCC throughout most of the period (−56 days in 2022, −10 days in 2024), driven by its exceptionally extended DPO. This negative value reflects effective use of trade credit as a source of financing rather than an operating cycle efficiency. Evropeiski Patishta AD presents the most structurally problematic case: its CCC deteriorates to −95 days in 2024, which at first glance appears favourable. However, this is attributable entirely to the extreme DPO of 424 days, itself a consequence of an inability to pay suppliers due to uncollected receivables (DSO = 324 days). This configuration signals severe financial distress rather than working capital efficiency, and this highlights why CCC components must be read individually rather than relying on the aggregate indicator alone.

Financial Performance

Table 6 presents return on assets (ROA), which reflects the efficiency with which assets generate profit.

Table 6. Return on assets - ROA (%)

Company	2022	2023	2024
TRACE GROUP HOLD PLC	2.37%	4.96%	7.36%
HYDROSTROY AD	3.26%	7.84%	13.70%
GP GROUP AD	3.38%	10.66%	13.71%
GBS-INFRASTRUCTURE CONSTRUCTION AD	8.46%	24.15%	8.40%
EVROPEISKI PATISHTA AD	3.98%	1.32%	1.01%

Source: Authors' own research.

The results reveal considerable variation in profitability among the analysed enterprises. Three of the five companies exhibit increasing profitability over the period 2022-2024. Hydrostroy AD and GP Group AD achieve the highest profitability in 2024, with ROA of 13.70 per cent and 13.71 per cent, respectively, representing more than a fourfold increase compared to 2022. Trace Group Hold PLC also demonstrates sustained growth, rising from 2.37 per cent in 2022 to 7.36 per cent in 2024.

A notable case is GBS-Infrastructure Construction AD, which reports exceptionally high profitability of 24.15 per cent in 2023, followed by a decline to 8.40 per cent in 2024. Such volatility is characteristic of project-based enterprises, where the completion of one or several large projects may lead to a concentration of profits within a single financial year. This highlights the specific nature of the construction sector, in which financial performance is closely linked to project execution stages and acceptance milestones.

The company with deteriorating profitability is Evropeiski Patishta AD, where ROA declines from 3.98 per cent in 2022 to only 1.01 per cent in 2024. This trend correlates with the substantial deterioration in the DSO indicator, suggesting that the accumulation of receivables has a negative impact on the company's financial efficiency.

The empirical results does not establish a clear association between the level of digital intangible assets and working capital efficiency over the observation period. The fourth hypothesis, which postulated a positive relationship between digitalisation and ROA, is not supported by the data: Hydrostroy AD and GP Group AD attain the highest profitability in 2024 despite declining or negligible digital intangible assets. This finding does not, however, invalidate the theoretical argument underpinning hypothesis four. It reflects a well-documented characteristic of construction sector financials: profitability is determined in the short term primarily by the project execution cycle, milestone-based revenue recognition, and the terms of individual contracts

(Kantianis et al., 2018; Sobieraj et al., 2024). The benefits of digitalisation on profitability - through reduced coordination costs, improved cash flow forecasting, and more effective receivables collection - are structural and expected to materialise over a longer horizon than the three-year observation window. Moreover, the proxy captures only capitalised digital assets; cloud-based tools expensed as operating costs remain invisible in the financial statements, which may systematically underestimate digitalisation for companies that favour subscription-based solutions.

With regard to receivables management, hypothesis three is likewise not supported by the data. GBS-Infrastructure Construction AD demonstrates the most effective DSO management throughout the observation period, yet it has the comparatively highest, though still limited, ratio of digital intangible assets in the sample. Conversely, Evropeiski Patishta AD exhibits a severe deterioration in DSO - rising from 143 days in 2022 to 324 days by 2024 - in the complete absence of recognised digital assets. The divergence between the two companies indicates that receivables collection efficiency in road construction is determined primarily by the structure of contractual payment terms, client creditworthiness, and the administrative rigour of the invoicing and collection process, rather than by digital maturity.

The absence of a clear association between digitalisation and DSO is consistent with the structural characteristics of receivables collection in public infrastructure contracting. Kantianis et al. (2018), in a study of highway bridge construction in Greece, establish that the primary determinants of working capital requirements are retention percentages, advance mobilisation payments from clients, and front-end rate loading of bill of quantities items - all of which are defined by the contractual and procurement framework. On this basis, the present analysis suggests that digital tools such as construction management platforms and ERP systems may improve the administrative efficiency of invoicing and receivables monitoring, but cannot alter contractually determined payment schedules or accelerate the verification and approval processes imposed by managing authorities in EU-funded projects. This distinction between administrative efficiency - which digitalisation can address - and structural contractual constraints - which it cannot - offers a plausible explanation for why the impact of digital maturity is not detectable in aggregate DSO figures over a three-year observation period.

Inventory management also shows no discernible association with digital maturity in the present analysis. Most companies maintain comparatively low DIO values regardless of their degree of digitalisation, reflecting the operational profile of road construction subcontractors: materials are typically procured on a project-specific, just-in-time basis. An exception is Hydrostroy AD, which recorded a DIO of 130 days in 2022, declining to 71 days by 2024. In the absence of supplementary operational data, this trajectory cannot be attributed to digitalisation; it is more plausibly explained by the completion of projects requiring advance procurement or by normalisation following supply chain disruptions. From a CCC perspective, the low DIO values across most companies confirm that inventory is not a material source of working capital pressure; the extended receivables collection period constitutes the principal bottleneck in the operating cycle.

Overall, the results indicate that, in the Bulgarian road construction sector, digitalisation has not yet reached a level at which its impact on working capital management is unambiguously reflected in aggregated financial statement indicators over a three-year horizon. This is consistent with the theoretical expectation that the returns on digital investment materialise gradually, as firms progress through implementation, staff training, and process integration. The findings carry practical implications for the management of road construction companies. First, given that DSO

constitutes the principal source of working capital pressure across the sample, targeted investment in digital receivables management tools - automated invoicing, electronic approval workflows, integrated monitoring of contract payment milestones - represents the area of highest potential return. Second, in companies where inventory levels have historically been elevated, digital procurement planning systems could improve alignment of material purchases with project schedules, reducing tied-up working capital. Third, integrated ERP platforms consolidating project management, financial accounting, and cash flow forecasting would enhance real-time visibility into the cash positions of individual projects, supporting proactive liquidity management across the portfolio.

Conclusion

The present study examines the relationship between digital maturity and working capital management in the road construction sector through a systematic comparative analysis of the annual financial statements of the five leading Bulgarian enterprises by net revenue, covering the period 2022-2024. It was established that the level of observable digitalisation in the sector is low, with two of the five analysed companies reporting no digital intangible assets throughout the entire period, and the remaining companies exhibiting declining ratios over the observation window. All companies with recognised digital intangible assets exhibit declining ratios, suggesting either a shift toward subscription-based digital solutions expensed as operating costs, or amortisation of existing systems without equivalent reinvestment.

The empirical analysis does not establish a clear short-term association between the level of digital intangible assets and working capital management efficiency. Companies with negligible or declining digital assets achieve the highest profitability and, in some cases, the most efficient receivables management, confirming that short-term financial performance in road construction is predominantly determined by project execution patterns, contractual payment structures, and prevailing market demand. This finding is consistent with the broader literature, which emphasises the primacy of contractual factors (Kantianis et al., 2018) and macroeconomic conditions (Sobieraj et al., 2024) in shaping construction sector financial outcomes. The absence of a detected association should be interpreted not as evidence against the long-term value of digital tools, but as a reflection of the structural characteristics of the sector and the limitations of a three-year observation window.

The findings should be interpreted in light of the study's methodological limitations. The use of digital intangible assets as a proxy for digitalisation may not capture the full scope of digital transformation, particularly in the case of companies that rely on cloud-based solutions recognised as operating expenses. Moreover, the short observation period of three years may be insufficient for the long-term effects of digital investments to emerge, as such investments typically require time for implementation, staff training, and process optimisation.

The substantial heterogeneity observed across enterprises illustrates the importance of firm-specific contractual portfolios, project mix, and operational strategies in determining financial performance. The present study contributes to the literature in several respects: it provides a systematic financial statement analysis of the relationship between digital maturity and working capital management focused specifically on Bulgarian road construction; it develops and operationalises a reproducible methodological framework based solely on publicly available financial data; it documents the structural dominance of receivables as the principal driver of extended cash conversion cycles in the sector; and it identifies targeted areas where digital

investment is most likely to yield measurable working capital improvements. Digitalisation should therefore be viewed by construction company management as a strategic lever for strengthening receivables collection, improving inventory planning, and enhancing the transparency of project financial management.

In conclusion, the absence of a clear short-term association between observable digital maturity and working capital efficiency in the Bulgarian road construction sector does not diminish the transformative potential of digital technologies for the industry. Rather, the findings point to the need for more granular longitudinal research - one that combines quantitative financial indicators and operational data, firm-level survey measures, and a sufficiently extended horizon to detect the gradual returns on digital investment. Future research directions include the extension of the observation period, the incorporation of alternative proxies for digitalisation such as survey-based measures of digital tool usage, and a broader comparative analysis encompassing smaller road construction enterprises for which working capital constraints and the marginal impact of digitalisation may be more pronounced.

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