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Earned Value Management Implementation in Small Construction Enterprises: A Comparative Case Study of Concrete Floor Projects

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Abstract

Research background: Small and medium-sized construction enterprises in Central European markets lack formalized project controlling systems, making them vulnerable to undetected cost overruns and schedule deterioration. Earned value management has demonstrated efficacy in larger project environments but remains underadopted among SME contractors, with empirical evidence from Czech SME construction contexts absent from literature.

Purpose of the article: This study examines whether EVM produces analytically meaningful performance indicators when applied retrospectively to completed contracts of a small Czech construction enterprise specializing in concrete floor systems, and whether cross-contract comparison reveals structurally distinct trajectories.

Methods: A retrospective case study was applied to two residential building contracts (Verechov and Zelezna Ruda) executed within the same twelve-month period. Cost performance index, schedule performance index, cost variance, and schedule variance were calculated at phase-boundary checkpoints and visualized as S-curves.

Findings & Value added: Both contracts confirmed measurable EVM deviations with structurally distinct trajectories. Verechov maintained favourable performance across all four metrics, while Zelezna Ruda exhibited early schedule advancement followed by pronounced deterioration driven by workforce reduction and a scope modification, a decline captured by schedule variance but undetectable from cost performance index alone. The study demonstrates that the informational prerequisites for EVM adoption already exist within enterprises of this type, that Schedule variance provides critical diagnostic information the schedule performance index cannot supply due to convergence towards unity at project completion, and that S-curve visualization constitutes an accessible monitoring tool.

Keywords: earned value management; construction SMEs; project control; comparative analysis; performance monitoring

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1. Introduction

The construction industry today faces growing pressure from skilled labour shortages, material cost volatility, and rising demands on delivery time and quality, conditions that make effective project management essential for the survival of construction enterprises (Alsharef et al., 2024). Skilled labour shortages represent a particularly significant risk factor, with measurable impacts on cost efficiency and schedule adherence, effects that vary across trades, with concreting and ironworking among the most critically affected (Elbashbishy and El-adaway, 2026).

Small and medium-sized construction enterprises face disproportionate pressures, as SME contractors frequently lack structured management systems and rely on informal rather than formalized controlling methodologies, undermining long-term business performance (Sogaxa, 2024). Standardized project management approaches can substantially enhance contract success rates within resource-constrained contexts (Nagyova et al., 2021), with retention strategies contributing to personnel stability (Mrvova and Krizanova, 2025).

Continuous cost and performance control through formalized methodologies contributes to budgetary stability even within smaller organizational structures (Panquet et al., 2024), making concrete floor construction a particularly suitable context for evaluating practical EVM implementation.

Despite demonstrated efficacy across diverse project contexts, EVM implementation within small and medium-sized construction enterprises remains inadequate, particularly in Central European contexts (Samajova et al., 2025).

This research addresses the gap through practical application of EVM in two concrete floor contracts within a Czech small enterprise, assessing whether measurable benefits in budgetary control and schedule adherence can be achieved within resource-constrained environments.

Two hypotheses guide the empirical analysis:

H1: Retrospective EVM application will reveal measurable deviations in both CPI and SPI from unity in at least one reporting period in each contract, confirming that cost and schedule performance deterioration is quantifiably present in the data generated by the enterprise's existing administrative records.

H2: The two contracts will exhibit structurally distinct performance trajectories, differing in the timing, magnitude, or phase-specific pattern of CPI and SPI deviation, reflecting different underlying risk drivers rather than a uniform performance profile across both cases.

2. Literature Review

2.1. Earned value management in construction

Earned Value Management integrates scope, cost, and time into a unified project control methodology, enabling calculation of cost and schedule variances, performance indices, and completion forecasts (Anbari, 2003; Fleming and Koppelman, 2016). Building on this, Ibrahim et al. (2024) situate CPI, SPI, and related metrics within a broader shift toward integrated performance assessment combining cost, schedule, and non-financial indicators. S-curve visualisations support early identification of performance deterioration (Rehman et al., 2023), and sigmoidal planning models have been shown to yield coefficients of determination exceeding 0.984 (Ojeda et al., 2025). Applied to real construction projects, EVM-based monitoring enabled proactive corrective interventions yielding cost savings of 15.36% and schedule efficiency improvements of 10.42% (Ates and Eirgash, 2025), while further extensions have introduced quality indicators into the traditional framework (Xin et al., 2025).

Methodological refinements have clarified when EVM variants perform best. Elsaid et al. (2025) demonstrated across 30 projects that Earned Schedule outperforms in early stages while Earned Duration is more reliable near completion, building on de Andrade et al. (2019), who showed that forecast accuracy improves when schedule performance and adherence are considered simultaneously. AI-based extensions further strengthen forecasting: ANN models predicted SPI, CPI, and TCPI with accuracies up to 90.83% (Mohammed et al., 2021), while a Bi-RNN-GCN architecture achieved substantially higher CPI forecast accuracy than static benchmarks (Mostofi et al., 2026), though such tools remain beyond the operational reach of most SMEs, reinforcing the relevance of foundational EVM implementation.

The assumed co-directional relationship between cost and schedule performance deserves scrutiny: empirical evidence from infrastructure projects identifies counterintuitive dynamics, including crisis-driven schedule acceleration under cost pressure, cautioning against mechanistic cross-context application of EVM benchmarks (Precious, 2025).

Digital integration amplifies EVM's operational value considerably. The RealCONs framework (Radman et al., 2025), combining QR-code site capture, BIM, Oracle P6, and Power BI, reduced decision latency from weeks to minutes and achieved 97 % of planned reporting targets against 69% under traditional methods. BIM–EVM integration in bridge construction produced significant gains in both SPI and CPI (Elseufy et al., 2026). Govindasamy and Bekker (2024) confirmed a positive PPC–CPI correlation in mining projects under the Last Planner System, though EVM improvements were not consistently realised when LPS was introduced mid-construction, underscoring the importance of early implementation and clearly defined baselines.

2.2. Implementation challenges and performance risks in SME contexts

Implementing formalized project controlling methodologies in small and medium-sized construction enterprises faces barriers rooted in organizational, resource, and contextual factors. EVM adoption remains inadequate among Central European SMEs despite demonstrated performance benefits (Samajova et al., 2025), reflecting challenges including limited financial resources, insufficient technical expertise, and perceived complexity of EVM frameworks. Liquidity constraints are a primary risk factor for smaller enterprises: when cash flow deteriorates, delays and cost escalation tend to compound each other (Namjan et al., 2026), and enterprises without systematic controlling cannot detect the problem before it becomes critical.

Cost overruns and delays are well documented across project types and markets. Systematic reviews identify poor planning, inadequate risk management, and contractual ambiguities as dominant cost overrun drivers (Abdelalim et al., 2025), while delays are driven primarily by contractor financial difficulties, slow material delivery, and poor site coordination (Sanni-Anibire et al., 2022). Labour shortages, variation orders, and financial constraints further amplify escalation (Namjan et al., 2026), with scope ambiguity, improper planning, and inefficient site management identified as dominant cost overrun clusters (Ammar et al., 2026). Multi-dimensional monitoring frameworks integrating quality, schedule, and safety dimensions improve delivery reliability and support timely intervention (Shen et al., 2026). In the Czech context specifically, deficiencies in tender documentation are systematically underestimated by investors relative to their actual impact on cost and schedule performance (Mikulik and Hanak, 2024), reinforcing the case for systematic EVM-based monitoring in SME environments.

2.3. Workforce challenges and sector-specific considerations

Skilled labour shortages exert measurable impacts on cost efficiency and schedule adherence across construction segments. Elbashbishy and El-adaway (2024) identified concreting, ironworking, electrical installation, plumbing, and masonry as the most severely affected trades, with statistically significant correlations between shortage severity and cost performance deterioration, effects particularly pronounced when personnel instability coincides with critical path activities. Gbiengu et al. (2025) show that workforce attributes such as equity, health and well-being, and workplace connectivity reduce attrition among fieldworkers, with personnel instability representing a quantifiable productivity risk.

The scale of workforce-related delays is documented by Aldossari (2025), who found that approximately 95% of higher education construction projects in Saudi Arabia were completed behind schedule by an average of 160%, with worker shortages as the primary driver. The institutional context differs from Central Europe, but the scale of disruption Aldossari documents points to a mechanism that is not market-specific.

Concrete floor construction is a demanding segment where methodological rigor directly influences quality and financial outcomes. Material selection and consumption efficiency represent critical performance dimensions, with initial cost decisions substantially influencing long-term financial outcomes (Anvari et al., 2024). Lean construction research demonstrates that identifying non-value-added activities and involving workers in process improvement can yield labour productivity increases exceeding 24% (Jiang et al., 2024). Ergonomic planning and targeted training help mitigate the growing shortage of experienced workers (Tao et al., 2025; Kim and Olsen, 2024).

Despite the documented importance of concrete floor construction and the well-established impacts of workforce challenges on project performance, empirical research integrating EVM-based performance monitoring with this context remains limited, a gap the present study addresses through retrospective application to two completed contracts of a small Czech construction enterprise.

3. Methodology

This study employs a retrospective case study design, applying Earned value management post-execution to two completed concrete floor construction contracts of a small Czech enterprise specialising in floor systems. Both contracts were selected purposively on the basis of data availability, project type comparability, and the enterprise's consent to participate.

The study addresses two research questions:

RQ1: What cost and schedule performance patterns emerge when EVM is applied retrospectively to concrete floor contracts in a small Czech enterprise?

RQ2: Do the two contracts exhibit comparable performance trajectories, and what project-level factors account for observed divergences?

3.1. Case description and data sources

The two contracts, the Verechov residential building and the Zelezna Ruda residential building, were executed sequentially within the same twelve-month period, enabling cross-contract comparison under comparable organisational conditions. Primary data were drawn from project documentation comprising signed contracts, itemised work schedules, daily site logs, material delivery records and purchase invoices, and handover protocols confirming scope acceptance.

Neither contract had been formally tracked using EVM during execution; all performance data were reconstructed retrospectively from existing administrative records. Where minor discrepancies arose in the attribution of shared transport costs, a conservative allocation rule was applied. The enterprise owner provided supplementary clarification on scheduling and workforce decisions through a semi-structured interview conducted prior to the analysis phase.

3.2. EVM analytical framework and calculation procedure

The EVM framework operates with three core input quantities measured at each reporting period t, defined here as a discrete phase-boundary checkpoint rather than a continuous interval:

- PV (Planned Value / Budgeted Cost of Work Scheduled, BCWS): the portion of the total contract budget corresponding to the work planned to be completed by time t.
- EV (Earned Value / Budgeted Cost of Work Performed, BCWP): the budgeted value of work actually completed by time t, irrespective of the cost incurred.
- AC (Actual Cost / Actual Cost of Work Performed — ACWP): the total cost actually incurred for work performed by time t.

From these three quantities, four performance metrics are derived. The index-based metrics capture relative efficiency, while the variance metrics express absolute deviation in monetary units, a distinction that matters when comparing projects of different scale.

Cost performance index (CPI) measures cost efficiency of work performed:

$$CPI = \frac{EV}{AC} \tag{1}$$

A CPI > 1.0 indicates that work is being accomplished at less than the budgeted cost; CPI < 1.0 signals cost overrun; CPI = 1.0 denotes exact conformance to the cost baseline.

Schedule performance index (SPI) measures schedule efficiency relative to plan:

$$SPI = \frac{EV}{PV} \tag{2}$$

An SPI > 1.0 indicates that more work has been accomplished than planned for the period; SPI < 1.0 signals schedule delay; SPI = 1.0 denotes exact conformance to the time baseline.

Cost variance (CV) expresses the absolute cost deviation in monetary units:

$$CV = EV - AC \tag{3}$$

Schedule variance (SV) expresses the absolute schedule deviation in monetary units of budgeted work:

$$SV = EV - PV \tag{4}$$

Negative values of CV and SV indicate overrun and delay; positive values indicate favourable performance. Analysing indices alongside variances enables richer interpretation: CPI and SPI reveal the rate of efficiency, while CV and SV reveal the cumulative magnitude of deviation. Notably, SPI converges towards 1.0 in the final project stages as PV approaches its maximum, potentially masking late-project schedule deterioration that SV continues to reflect accurately.

For each contract, the performance measurement baseline was constructed by distributing the total contract budget across six work phases, substrate preparation, moisture barrier installation, reinforcement placement, concrete pouring, surface finishing, and final quality inspection, proportionally to estimated labour and material content. EV was determined by the fixed-formula percent-complete method: the proportion of each work package completed, as documented in site logs, was multiplied by its budgeted value. AC was derived from verified invoice records for the corresponding period.

Cumulative PV, EV, and AC were plotted as S-curves across the project timeline, enabling visual identification of divergence between planned, earned, and actual cost trajectories. For each contract, results are presented as a table of EVM parameters and an S-curve visualisation, complemented by a comparative summary at project completion.

4. Results

The EVM analysis was applied to both contracts using the methodology described in Section 3.2, with CPI, SPI, CV and SV derived at each phase-boundary checkpoint. Results are presented contract by contract, followed by a cross-contract comparison. A positive CV indicates work performed below budgeted cost; a positive SV indicates schedule advancement.

4.1. Contract 1: Verechov residential building

The Verechov project involved the installation of concrete floor systems, thermal insulation, reinforcement, concrete screeds and surface finishing, in a three-storey residential building with basement in Verechov, Plzen region. Execution ran from 24 May to 23 June 2023, covering 12 reporting periods. The total contract budget was CZK 335,523.

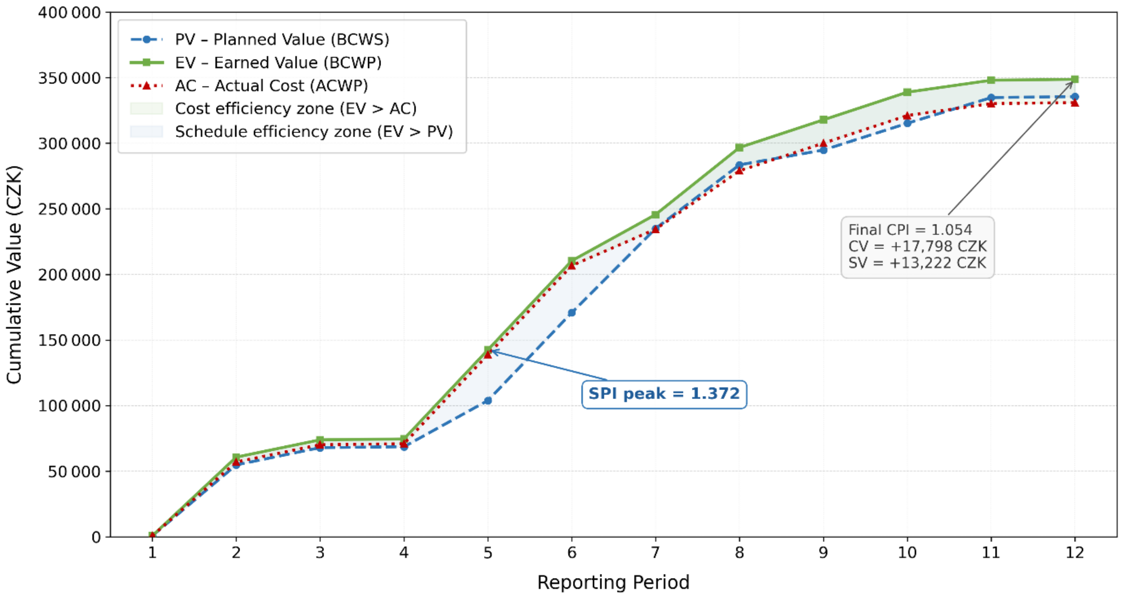
Table 1: EVM performance parameters by reporting period; Contract 1 (cumulative values, CZK)

Per.	Phase	PV	EV	AC	SPI	CPI	SV	CV
1	Offer	750	750	750	1.000	1.000	0	0
2	Material procurement	54,787	60,721	57,017	1.108	1.065	5,934	3,704
3	Material transport	67,987	73,929	70,217	1.087	1.053	5,942	3,712
4	Substrate preparation	68,662	74,579	70,892	1.086	1.052	5,917	3,687
5	Installation 2nd floor	103,852	142,479	138,792	1.372	1.027	38,627	3,687
6	Installation 1st floor	170,814	210,379	206,692	1.232	1.018	39,565	3,687
7	Installation basement	235,009	245,639	234,503	1.045	1.047	10,63	11,136
8	Reinforcement + labour	283,509	296,739	278,993	1.047	1.064	13,23	17,746
9	Concrete pour 2nd floor	294,797	317,819	300,021	1.078	1.059	23,022	17,798
10	Concrete pour 1st floor	315,185	338,907	321,109	1.075	1.055	23,722	17,798
11	Concrete pour basement	334,773	347,995	330,197	1.039	1.054	13,222	17,798
12	Invoice	335,523	348,745	330,947	1.039	1.054	13,222	17,798

Source: own elaboration

CV stabilized at +CZK 3,687 through Periods 4–6 before rising further during the concrete phases, while SV peaked at +CZK 39,565 in Period 6 before contracting as the project approached completion. The S-curve in Figure 1 visualizes this consistently favourable profile: EV runs above PV throughout, with AC tracking below EV.

Figure 1: S-curve of cumulative PV, EV and AC; Contract 1



Source: own elaboration

Throughout the entire project both CPI and SPI remained consistently above 1.0, indicating simultaneous cost efficiency and schedule advancement. The most pronounced schedule performance occurred in Period 5 (SPI = 1.372), reflecting the high productivity of the four-member crew during the most labour-intensive phase. Cost efficiency was strongest in the material procurement phase (CPI = 1.065), driven by a 20% discount on polystyrene insulation and the return of seven unused boards.

SPI declined progressively from its peak of 1.372 in Period 5 towards 1.039 at project completion, a structural characteristic of the metric as EV approaches the total budget in the final periods. SV provides a more stable picture: remaining positive throughout, it reached +CZK 39,565 at its maximum in Period 6 before settling at +CZK 13,222 at completion, confirming unambiguously that the project was never behind schedule at any phase boundary. At project completion, CPI = 1.054 indicates delivery at approximately 5.4% below budgeted cost, with CV = + CZK 17,798.

4.2. Contract 2: Zelezna Ruda residential building

The Zelezna Ruda project involved a three-storey recreational-residential building with basement in the Sumava mountain area, Plzen Region. Execution ran from 5 to 30 August 2024 across 13 reporting periods. The total contract budget was CZK 589,236. Two complicating factors distinguished this contract from Verechov: a mid-project workforce reduction caused by illness of one of the two assigned workers during insulation installation, and a scope modification discovered on site, screed thickness was increased from 6 cm to 8 cm to meet structural load requirements, requiring additional cement delivery and extended labour.

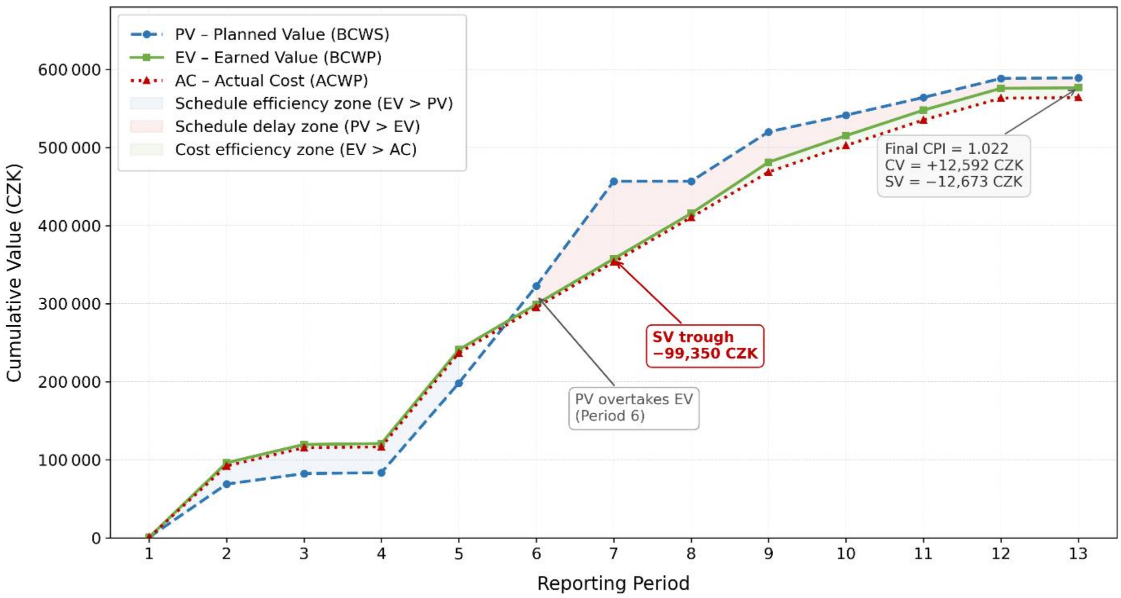
Table 2: EVM performance parameters by reporting period; Contract 2 (cumulative values, CZK)

Per.	Phase	PV	EV	AC	SPI	CPI	SV	CV
1	Offer	750	750	750	1.000	1.000	0	0
2	Material procurement	68,887	96,241	92,031	1.397	1.046	27,354	4,21
3	Material transport	82,367	119,721	115,511	1.454	1.036	37,354	4,21
4	Substrate preparation	83,492	120,846	116,636	1.447	1.036	37,354	4,21
5	Installation 2nd floor	198,348	241,096	236,886	1.216	1.018	42,748	4,21
6	Installation 1st floor	322,61	299,275	295,065	0.928	1.014	−23,335	4,21
7	Installation basement	456,804	357,454	353,244	0.783	1.012	−99,350	4,21
8	Installation (cont.)	456,804	415,633	410,581	0.910	1.012	−41,171	5,052
9	Reinforcement + labour	520,084	481,233	468,641	0.925	1.027	−38,851	12,592
10	Concrete pour 2nd floor	541,484	515,233	502,641	0.952	1.025	−26,251	12,592
11	Concrete pour 1st floor	564,135	547,833	535,241	0.971	1.024	−16,302	12,592
12	Concrete pour basement	588,486	575,813	563,221	0.978	1.022	−12,673	12,592
13	Invoice	589,236	576,563	563,971	0.978	1.022	−12,673	12,592

Source: own elaboration

The early SV advantage of +CZK 42,748 in Period 5 was rapidly eroded from Period 6, reaching a trough of −CZK 99,350 in Period 7 as workforce reduction slowed progress. CV remained positive throughout this deterioration, illustrating precisely the diagnostic gap CPI alone cannot close. The S-curve in Figure 2 makes the crossover point visually explicit.

Figure 2: S-curve of cumulative PV, EV and AC; Contract 2



Source: own elaboration

Periods 2–5 show strong schedule advancement (SPI peaking at 1.454 in Period 3), reflecting the productivity of the two-worker team during preparatory phases. From Period 6 onwards SPI fell sharply below 1.0, dropping to a minimum of 0.783 in Period 7, as the reduced workforce slowed installation while planned value continued to accumulate at the originally scheduled rate. CPI behaved differently throughout: it remained above 1.0 in every period, ranging from 1.012 to 1.046, as the labour cost reduction during the illness period partially offset the additional expenditure from the scope modification.

The CPI–SPI divergence is analytically significant and illustrates the complementary value of the variance metrics. At Period 7, CPI = 1.012 would have signalled a project under adequate cost control; yet simultaneously SV reached –CZK 99,350, the largest absolute schedule shortfall of either project, indicating that nearly CZK 100,000 worth of planned work remained unexecuted at that checkpoint. CV remained positive throughout (+CZK 4,210 through Periods 1–7), further reinforcing the deceptively healthy financial picture that CPI alone would have projected. Recovery was achieved through accelerated execution in the concrete pouring phases, reducing SV to –CZK 12,673 at project completion, where CPI = 1.022 and CV = +CZK 12,592.

4.3. Cross-Contract Comparative Analysis

Table 3 summarizes the terminal EVM indicators for both contracts alongside the reference benchmark, enabling direct cross-contract comparison across all four metrics.

Table 3: Comparative EVM summary at project completion

Indicator	Verechov	Zelezna Ruda	Benchmark
Final CPI	1.054	1.022	1.000
Final SPI	1.039	0.978	1.000
CV (CZK)	17,798	12,592	0
SV (CZK)	13,222	−12,673	0
Duration (periods)	12	13 (+1)	—

Source: own elaboration

Both H1 and H2 are supported. H1 is confirmed: measurable deviations from unity are present across both contracts in multiple periods. H2 is strongly supported: the trajectories are structurally distinct. Verechov maintained positive CPI and SPI throughout, with all four metrics consistently favourable. Zelezna Ruda displayed an early high-performance phase followed by a pronounced SPI and SV deterioration from Period 6, with CPI remaining misleadingly stable throughout.

5. Discussion

The results confirm both hypotheses and reveal performance dynamics that warrant closer examination.

The Verechov contract represents a case of consistently favourable performance, both CPI and SPI remained above 1,0 throughout, and all four metrics closed positively at completion. The final cost saving of CZK 17,798 would have remained invisible without a formalized measurement framework, under the informal approach used during execution, the project was simply perceived as completed on time. Under the informal controlling approach actually used during execution, the project was simply perceived as completed on time, the quantified extent of schedule advancement and cost efficiency remained uncaptured. This observation directly supports the argument of Ates and Eirgash (2025), who demonstrated that EVA enables early detection of deviations and empowers project managers to implement timely corrective actions, a capability the enterprise in the present study possessed in latent form but did not activate.

The Zelezna Ruda contract tells a more instructive story precisely because its performance profile is less straightforward. CPI remained above 1.0 throughout the entire project, a reading that, in isolation, would have suggested adequate financial control at every checkpoint. Yet SV reached – CZK 99,350 in Period 7, representing a schedule shortfall of nearly one hundred thousand crowns worth of unexecuted planned work. This divergence between cost and schedule metrics reflects a genuine operational dynamic: the workforce reduction caused by illness reduced labor expenditure and simultaneously slowed progress, producing a temporarily favourable cost picture alongside material schedule deterioration. The partial recovery achieved in the concrete pouring phases reduced the final SV to –CZK 12,673, but this required the crew to absorb additional workload in the closing phases. Elbashbishy and El-adaway (2026) identified concreting and ironworking as among the most critical trades in terms of skilled labour shortage impacts, noting that schedule criticality generally surpasses cost criticality, a pattern directly consistent with the Zelezna Ruda findings, where SPI and SV deteriorated while CPI remained favourable throughout.

The CPI–SPI divergence observed in the Zelezna Ruda contract has a direct implication for how SME operators interpret project performance data. A manager monitoring only CPI would have had no basis for detecting the schedule deterioration until it had already accumulated to its maximum magnitude. The combination of SV and CPI provides a materially richer signal: SV identifies that a problem exists and quantifies its scale, while CPI contextualizes whether that schedule pressure is also generating cost consequences. Ates and Eirgash (2025) frame this as EVM's core value proposition, not passive reporting, but proactive decision support. The present study demonstrates that this value is accessible even in retrospective application, provided all four metrics are computed simultaneously.

A further observation concerns the role of scope ambiguity as a performance risk driver. The Zelezna Ruda project encountered a mid-execution specification change, screed thickness increased from 6 cm to 8 cm, that generated additional cost and schedule pressure without being priced into the original baseline. Mikulik and Hanak (2024) identified precisely this mechanism in Czech construction practice: deficiencies in technical specifications of tender documentation affect project performance primarily through cost and schedule channels and are systematically underestimated by investors relative to their actual impact. Atapattu et al. (2023) identified inadequate tender documentation as the third most critical cost overrun driver in transportation infrastructure projects, confirming this is not a Czech-specific problem. In the present case, the scope modification produced a compound effect, additional material, repeated transport, extended labour, and reduced crew availability, that accumulated into the largest SV trough observed across either contract. Had a formal EVM baseline been in place at contract commencement, the financial implications of the thickness change would have been immediately quantifiable, enabling earlier renegotiation with the client.

The S-curve visualizations presented in Figures 1 and 2 deserve specific discussion as an analytical and communication tool. Szostak and Konior (2025) demonstrated on a dataset of residential buildings that cumulative financial spend and physical progress exhibit statistically significant correlation, and that the S-curve inflection point provides the most reliable basis for final cost estimation. The present study corroborates this at the SME level: in the Verechov contract, the EV curve runs consistently above PV throughout, with AC tracking below EV, a profile that communicates project health intuitively even without knowledge of the underlying index values. In the Zelezna Ruda contract, the crossover of PV above EV in Period 6 is immediately visible in Figure 2 as the moment the project transitioned from schedule advancement to schedule delay. Szostak et al. (2024) further demonstrated, across 45 construction projects, that cumulative cost curves follow predictable polynomial forms that can be used for CAPEX prediction, reinforcing that S-curve analysis is not merely a visualization technique but an analytically grounded forecasting tool. For SME operators without dedicated controlling functions, the S-curve communicates project health without requiring specialist training.

A convergence property of SPI warrants explicit discussion. In both contracts, terminal SPI values understate the true performance story: in Verechov, SPI declined from its peak of 1.372 to 1.039 at completion; in Zelezna Ruda, SPI recovered from its trough of 0.783 to 0.978 at completion. Beck and Kovacs (2018) identified this as a structural characteristic of the SPI metric: irrespective of how work actually progressed during execution, SPI will always converge towards 1.0 at project completion, because EV necessarily approaches PV as the remaining planned value diminishes to zero. SV does not share this property, it retains its magnitude through the final periods and therefore provides the more reliable terminal indicator for schedule assessment. This distinction has practical consequences for SME performance reporting: a protocol that presents only final SPI would mislead the operator about both the magnitude of the Verechov schedule advantage and the severity of the Zelezna Ruda schedule deterioration. Embedding SV alongside SPI in even a simple spreadsheet-based EVM system would substantially improve the informational content of performance reports without increasing analytical complexity.

The retrospective design of this study is both a limitation and, paradoxically, a source of its core argument. The fact that both projects could be fully reconstructed from documentation generated in the ordinary course of contract administration demonstrates that the informational prerequisites for prospective EVM monitoring are already present in enterprises of this type. What was absent was not data but the integrative framework to consolidate it into performance indicators at phase-boundary checkpoints. Panquet et al. (2024) identified organizational process integration as the critical implementation barrier in EVM adoption, a finding directly consistent with the evidence from both contracts examined here, where the barrier was procedural rather than informational. The adoption threshold is lower than commonly assumed: converting existing documentation into a time-phased baseline and calculating four metrics at each billing cycle is a small procedural change, not a fundamental one.

6. Conclusions

This study applied Earned Value Management retrospectively to two concrete floor construction contracts of a small Czech enterprise, computing CPI, SPI, CV and SV at each phase-boundary checkpoint and visualizing cumulative PV, EV and AC as S-curves. Four substantive conclusions follow from the findings.

First, the informational barrier to EVM adoption in this context is organizational rather than fundamental. The data required for EVM computation were generated through routine contract administration; what was absent was the integrative framework to consolidate them into performance indicators. This confirms the finding of Panquet et al. (2024) that process integration, not data availability, is the primary implementation barrier, and suggests that the adoption threshold for SME-level EVM is lower than commonly assumed.

Second, monitoring CPI alone is insufficient for reliable project control. The Zelezna Ruda case demonstrates that CPI > 1.0 can persist throughout execution while a schedule shortfall of nearly CZK 100,000 simultaneously accumulates. SV provides the complementary signal CPI cannot: it quantifies the absolute magnitude of schedule deterioration and does not converge towards zero as the project approaches completion in the way SPI does, a structural limitation of the index formally identified by Beck and Kovacs (2018).

Third, S-curve visualization is a practical and accessible monitoring tool for owner-managed enterprises. The crossover of PV above EV in Period 6 of the Zelezna Ruda contract is immediately legible in Figure 2 without knowledge of the underlying index values, confirming the practical communicative value of cumulative cost curve representations documented by Szostak et al. (2024).

Fourth, scope ambiguity at the pre-contract stage is consistently underestimated. The screed thickness modification in Zelezna Ruda generated a compound performance impact undocumented in the original baseline, consistent with the findings of Mikulik and Hanak (2024) on Czech construction practice and with the international evidence of Atapattu et al. (2023).

The practical implication is direct: computing four EVM metrics and plotting an S-curve at each billing cycle represents an immediately adoptable improvement requiring no specialist software. The study contributes empirical evidence from a context absent from the EVM literature, small Czech construction enterprises, confirming that combined index and variance metrics retain diagnostic value in environments where informal controlling practices dominate.

The study is limited by its retrospective design, two-case sample, and non-uniform reporting periods. Future research should pursue prospective longitudinal studies with larger SME samples in Central European construction markets, and a systematic bibliometric review of the EVM literature stratified by firm size and geographic context.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Data Availability Statement

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to confidentiality restrictions concerning the enterprise's commercial project documentation.

Conflicts of Interest

The authors declare no conflict of interest.

Declaration of generative AI and AI-assisted technologies in the writing process

The authors declare that no generative AI or AI-assisted technologies were used in the writing or preparation of this manuscript.

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