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Letnik 72, št. 3, 2026

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International Trade Agreements and Corporate Sustainability Performance in Austria, Germany and Switzerland

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Abstract

The paper examines whether exposure to international trade agreements is associated with firm-level ESG performance and whether the answer depends on model specification. A balanced panel of 30 firms headquartered in Austria, Germany and Switzerland is observed annually from 2015 to 2025, giving 330 firm-year observations. Panel regression on an observed ESG composite and structural equation modelling with a latent ESG factor are combined, and the trade path is re-estimated across a crossed design of measurement framework and covariate set. Trade agreement exposure is positively associated with ESG performance in both frameworks under the reduced covariate set and in neither once institutional and firm-level controls enter. The sample is purposive and confined to large listed firms. The association is thus specification-dependent as opposed to measurement-dependent, which explains conflicting results in the literature.

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Introduction

Firm-level ESG performance has become an important dimension of corporate behaviour in highly integrated economies. International trade is not merely a channel through which goods are exchanged. It also carries regulatory expectations, buyer requirements, investor scrutiny and governance norms across jurisdictions (Kim & Yang, 2026). The key question is therefore not whether firms trade more, but whether the institutional rules embedded in international economic relations reshape the incentives affecting ESG performance.

The empirical evidence on that question is inconclusive, and the reasons are identifiable. ESG ratings disagree across providers to a degree that makes the dependent variable provider-specific, since Berg et al. (2022) report correlations between the major raters of around 0.54. Trade exposure is operationalised at different levels of aggregation, from firm export ratios to country-year agreement coverage. Studies also differ in the covariate sets on which they condition, and where a trade measure varies only across country-year cells, institutional controls absorb much of the variance it would otherwise carry.

It is based on this background that the current paper examines the association between trade agreement exposure and ESG performance on a balanced panel of firms headquartered in Austria, Germany and Switzerland between 2015 and 2025. The empirical contribution is firm-level evidence for a highly integrated European setting across eleven years, drawn from harmonised value-chain indicators as opposed to gross trade volumes. The methodological contribution is a direct test of the explanation usually offered for the conflicting findings. Composite ESG scores are held to

attenuate effects through aggregation and measurement error, which implies that a latent specification should recover an association a composite conceals. Crossing the measurement framework with the covariate set shows that the divergence lies in the covariate structure instead.

The theoretical background develops the hypotheses, the methodology describes the sample, the data sources and the construction of the exposure index, and the results report the findings together with the specification sensitivity analysis. The discussion and the conclusions set out the implications and the limitations.

Theoretical Background

International trade can influence firm-level ESG performance through several mechanisms. Institutional theory holds that organisations exposed to the same regulatory and normative field converge on similar structures (DiMaggio & Powell, 1983). Stakeholder theory adds that firms operating internationally answer to investors, lenders and supply-chain partners whose expectations increasingly reference sustainability standards (Freeman, 1984). Global value chain research shows that governance requirements travel across borders along production relations, through contracting hierarchies and certification regimes (Gereffi et al., 2005).

Trade Exposure and ESG Performance

These perspectives locate the pressure differently. Institutional theory locates it in regulatory expectation, since agreements containing trade and sustainable development provisions raise the standards attached to market access, so that firms headquartered in economies embedded in such agreements operate under the resulting compliance

environment whether or not they trade with the partner country directly. Global value chain governance locates it in the buyer relationship, in which lead firms transmit requirements downward through certification and supplier codes, which raises the reputational cost of non-compliance. Both channels predict the same sign, although integration can also be associated with weaker effects under symbolic compliance (Adardour et al., 2025). This paper tests the following hypothesis:

H1: Trade exposure is positively associated with firm-level ESG performance.

Measurement and Specification Sensitivity

ESG performance is a multidimensional construct, and a composite score summarises dimensions that need not move together (da Cunha et al., 2025). The design of the rating instrument shapes what such a score records (Christensen et al., 2022). Classical measurement theory gives a clear expectation for what follows. Where a variable is measured with error the estimated coefficient is attenuated towards zero, and where an outcome aggregates dimensions carrying dimension-specific noise, the shared variance to which the theory refers is diluted. A latent specification addresses this by estimating the common factor behind the three indicators and assigning the residual variance to the indicators (Kline, 2016). A null result under a composite would thus be consistent with a positive association under a latent model.

The same divergence has a second possible source. Two specifications can differ in the representation of ESG and in the covariate set at the same time, and the second difference is sufficient on its own to change the estimate, since institutional controls defined at the country level compete for the variance of a trade measure defined at the same

level. The two are distinguishable only if they are varied independently. Based on this background this paper tests the following hypothesis:

H2: The estimated association between trade exposure and ESG performance differs across specifications, and the difference is attributable to the covariate set as opposed to the measurement framework.

Institutional Context

Although the three countries belong to a closely integrated European setting, their national institutional environments differ, and comparative capitalism research treats these differences as systematic. Business systems differ regarding patterns of ownership, the role of banks as a source of corporate finance and the enforcement capacity of the regulatory apparatus (Whitley, 1999). Matten and Moon (2008) suggest that in coordinated economies sustainability obligations are implied by regulation but articulated explicitly by companies in more liberal settings. Explicit disclosure matters for ESG scores, as rating providers interpret explicit disclosure. The reporting architecture in Europe became denser and more prescriptive across the panel window (Hummel & Jobst, 2024), but regarding company-level consequences, mandatory disclosure effects vary with the regulatory and market environment as opposed to a uniform pattern (Krueger et al., 2024). Austria and Germany apply the same EU regulations but differ in enforcement capacity, size and international orientation of the respective listed sector, and Switzerland sits outside that regime yet achieves disclosure through investor expectation (Christensen et al., 2021). Regarding the institutional view, this paper tests the third hypothesis:

H3: Institutional context is significantly associated with firm-level ESG performance.

Methodology

Sample and Selection Criteria

The panel covers 30 firms, ten in each country, observed annually from 2015 to 2025, giving 330 firm-year observations. Firm-year is the unit of analysis. A mixture of sectors is purposely chosen to account for the settings where the level of trade-related pressure differs, i.e., environmental compliance pressure in carbon-intensive industry and utilities, governance and investor pressure in the banking and insurance sector, and value-chain diffusion in the manufacturing and consumer goods sector. The sample is the firms from the largest markets in the three countries, listed on the respective stock exchanges, that conduct continuous as well as complete ESG reporting and have export market share, which is the case for each firm. Sector is not explicitly controlled for because the number of firms within individual country-sector cells is too small to estimate stable industry effects. The list of firms is given in Appendix A.

This means the sample consists mostly of multinationals with rigorous reporting procedures; results apply to this range of firms, not to SMEs or unlisted firms. Net revenues range from EUR 4.5 billion to EUR 74.7 billion. The balanced construction rules out the possibility of entry and exit as a source of variation at the cost of a smaller number of observations.

Data Sources and Variables

The panel variables are drawn from three sources. Firm-level ESG measures are taken from CSRHub, which aggregates the ratings of several providers onto a uniform 0 to 100 scale: ESG_total_proxy, the weighted composite; ESG_E_proxy, ESG_S_proxy and ESG_G_proxy, its constituent scores; and governance_oversight_proxy and disclosure_quality_proxy, CSRHub's separate indicators of board-level oversight and reporting transparency. Total assets, leverage, return on assets and firm export intensity are taken from Orbis (Kalemli-Özcan et al., 2024), and the country-year value-chain indicators from the OECD Trade in Value Added database and the World Input-Output Database (Yamano et al., 2023). Appendix B documents every variable.

The aggregation rule behind the composite is the provider's own, and its relation to the three component proxies is close but not exact: the mean deviation from their arithmetic average is -0.109 index points, with a maximum absolute deviation of 10.179. That gap is one reason for estimating the latent specification alongside it, and the estimates below are conditional on the CSRHub scale (Berg et al., 2022).

Construction of the Trade Agreement Exposure Index

The trade agreement exposure index is the key explanatory variable and is constructed at the country-year level, so that every firm

headquartered in the same country carries the same value each year. Its inputs are trade agreements containing sustainability-related provisions, including trade and sustainable development chapters or comparable environmental and labour references, that were in force for the respective country-year, including agreements concluded before 2015 and still in force. For Austria and Germany these are the agreements concluded under the common commercial policy of the European Union, and for Switzerland the EFTA agreements together with the bilateral agreements between Switzerland and the European Union. Appendix E lists them with their entry into force. German supply chain due diligence legislation is institutional context and does not enter the index. The index captures trade-weighted exposure to the agreements in force in each country-year rather than the simple number of agreements. The index is calculated as the sum of partner trade shares covered by sustainability-related agreements in force in each country-year, using WIOD and OECD TiVA weights and expressed on a 0-1 scale. Partner trade shares from the World Input-Output Database and OECD TiVA tables determine the contribution of each covered partner, so changes in the trade structure can offset the entry into force of additional agreements. Austria and Germany are subject to the same EU agreement coverage, and differences between their index values therefore arise from the partner weights. The agreements entering the index are listed in Appendix E, while Appendix F reports the realised values for all 33 country-year cells. The index has a mean of 0.619 and a standard deviation of 0.023, with values ranging from 0.572 to 0.657. Its limited dispersion reflects the relatively stable agreement environment and the importance of changes in partner trade weights over the observation period.

Estimation Strategy

The analysis compares two models that differ in their representation of ESG. The first is a panel regression in which `ESG_total_proxy` is the dependent variable and `trade_agreement_exposure_index` the focal regressor, with country-level export intensity, the foreign value-added share, firm size, leverage, return on assets, firm export intensity, an EU dummy and year indicators as controls. The second is a structural equation model in which ESG is a latent factor measured by the three component proxies and predicted by the trade and value-chain measures. A mediation extension adds the governance and disclosure proxies as intervening variables, and a multi-group extension tests the equality of the structural coefficients across countries.

The two models differ in the representation of ESG and in the covariate set at once, so the trade path is also estimated in the two remaining cells of the crossed design, the observed composite with the reduced covariate set and the latent specification with the full control set. The observed-variable models are estimated by ordinary least squares over the pooled firm-year observations, and the dependence structure of the panel is examined separately through a baseline linear mixed model with a first-order autoregressive covariance structure across years. The analyses were computed in IBM SPSS Statistics, IBM SPSS Amos and jamovi (IBM Corp., 2024; The jamovi project, 2025), and the structural models were estimated with lavaan (Rosseel, 2012). Robustness and specification sensitivity are assessed through the crossed four-specification design, collinearity diagnostics, and the auxiliary linear mixed model used as a panel

robustness diagnostic.

Empirical Results

Descriptive Statistics

Appendix C reports descriptive statistics. The composite averages 72.976 on a 0 to 100 scale and ranges from 60.881 to 84.798, and each component proxy is more dispersed than the composite, which is what aggregation across three partly independent dimensions produces. The trade agreement exposure index is the least dispersed variable, and its standard deviation of 0.023 across 33 country-year cells is the binding constraint on identification.

Measurement Validation

Table 1 reports the reliability and factor diagnostics for the three ESG dimension indicators.

Table 1

Reliability statistics, factor diagnostics, and component loadings for the ESG dimension indicators (N = 330)

Statistic or indicator	Value	
Cronbach's alpha (3 items)	0.623	
Kaiser-Meyer-Olkin measure	0.645	
Bartlett's test of sphericity	$\chi^2(3) = 114.027, p < 0.001$	
Component 1 eigenvalue	1.715	
Variance explained	57.178%	
	Communality	Component loading
ESG_E_proxy	0.555	0.745
ESG_S_proxy	0.553	0.744
ESG_G_proxy	0.607	0.779

Source: Authors' calculations.

Cronbach's alpha of 0.623 falls below the conventional threshold of 0.70 and should not be

read mechanically, since ESG is not a unidimensional construct whose components behave interchangeably. The value indicates coherence sufficient for joint modelling while confirming that the dimensions are not substitutable.

The first component accounts for 57.178 per cent of the total variance, so that a substantial share of the variance in each dimension is explained by a common factor and a substantial share is not. That residual justifies the latent specification.

Cross-Country Comparison

The assumption of homogeneity of variances is violated, so cross-country differences were tested with a Welch one-way ANOVA and Games-Howell post hoc comparisons, which Table 2 reports.

Table 2

Group statistics and Welch's ANOVA of ESG_total_proxy across countries (N = 330)

Country or comparison	N	Mean	SD	SE
Austria	110	71.7	3.94	0.376
Switzerland	110	73.1	3.64	0.347
Germany	110	74.1	4.25	0.405
Welch's ANOVA: $F(2, 217) = 9.780, p < 0.001$				
Games-Howell, Austria vs Switzerland: mean difference = -1.420, $p = 0.016$				
Games-Howell, Austria vs Germany: mean difference = -2.419, $p < 0.001$				
Games-Howell, Switzerland vs Germany: mean difference = -0.999, $p = 0.149$				

Notes: Group means and standard deviations are reported at the precision of the group descriptives; the Games-Howell mean differences are computed on unrounded values and therefore do not reproduce exactly from the rounded means. Source: Authors' calculations.

Austrian firms score below Swiss and German firms, while the gap between Switzerland and Germany is not significant. Austria and Germany operate under

the same EU reporting regime, so the gap between them cannot be attributed to the regime itself and is more plausibly a matter of enforcement capacity and of the size and international orientation of the listed sector, which is smaller and more domestically anchored in Austria. German firms additionally operate under supply chain due diligence legislation whose consequences for sustainability governance are documented (Buttke et al., 2024), which is institutional context as opposed to trade agreement exposure. Switzerland

reaches German levels of disclosure without the EU directive, which is what Matten and Moon (2008) would predict where investor expectation substitutes for mandate. H3 is supported.

Panel Regression Results

The baseline panel regression uses the observed composite as the dependent variable, estimated on all 330 observations with year indicators, and Table 3 reports it.

Table 3

Panel regression of ESG_total_proxy on trade exposure and controls (N = 330)

Predictor	Estimate	SE	t	p	Std. β	VIF
Intercept	64.117	16.364	3.918	< 0.001	-	-
trade_agreement_exposure_index	30.923	20.136	1.536	0.126	0.176	4.551
export_intensity_country	-5.405	12.817	-0.422	0.674	-0.100	19.384
tiva_foreign_value_added_share	-28.787	18.391	-1.565	0.119	-0.356	17.932
ln_assets	0.874	0.527	1.658	0.098	0.116	1.698
leverage	-6.665	3.565	-1.870	0.062	-0.114	1.295
ROA	9.060	21.549	0.421	0.674	0.026	1.279
export_intensity	-0.736	3.841	-0.192	0.848	-0.015	2.094
EU	-4.919	1.591	-3.092	0.002	-0.572	11.870

Notes: $R = 0.323$; $R^2 = 0.104$. Year indicators are included and none is significant. VIF values are on the classical scale

Source: Authors' calculations.

The model accounts for 10.4 per cent of the variation in observed ESG performance. Trade agreement exposure is not significant, and neither country-level export intensity nor the foreign value-added share reaches conventional levels. The EU indicator is negative and significant, which shows that institutional affiliation captures systematic variation the trade measures do not. It is not evidence that EU membership lowers ESG performance, since the dummy pools Austria and Germany despite the gap documented in Table 2.

The collinearity diagnostics are the substantive finding of this stage. The firm-level controls are

unproblematic, with variance inflation factors between 1.279 and 2.094, while the country-year predictors are not: export_intensity_country reaches 19.384, tiva_foreign_value_added_share reaches 17.932 and the EU dummy reaches 11.870. All three vary across the same 33 country-year cells as the trade index. The inflation is a property of the panel structure as opposed to an error in the specification, so the individual significance tests carry little information. Read on its own, the regression does not support H1; read together with the diagnostics, it shows that the observed specification has limited power to test H1 under institutional controls.

A baseline linear mixed model was estimated on the same panel as a diagnostic of that structure, with the firm as the clustering unit, the year as the repeated measure and a first-order autoregressive covariance structure, fitted by restricted maximum likelihood. The fixed intercept of 72.968 (SE = 0.251) reproduces the sample mean, the autoregressive parameter is small but significant ($p = 0.128$, Wald $Z = 2.218$, $p = 0.027$) and the firm-level random intercept variance is estimated at approximately zero. ESG scores therefore carry year-to-year persistence within firms while the between-firm component is already absorbed by the observed covariates, which is why year indicators are retained, and no firm-level random effect is added to the specification. The significant autoregressive term also implies that the standard errors in Table 3 understate the sampling variability to some degree,

which reinforces rather than weakens the reading of the individual tests given above.

Structural Equation Modelling Results

Structural equation modelling re-estimates the relationship with ESG as a latent construct reflected by the three-dimension indicators, estimated by maximum likelihood. With three indicators and a single factor the measurement model is just identified, so its global fit indices are perfect by construction and carry no diagnostic information (Kline, 2016; Cheung et al., 2024); it is assessed through its loadings, which are 0.570, 0.567 and 0.658, each significant at $p < 0.001$. The structural models in Table 4 have four and seven degrees of freedom, so their fit statistics are interpretable in the ordinary way.

Table 4

Structural equation models: fit indices and structural paths (N = 330)

Model and path	Estimate	SE	Std. β	p
Direct-effects model: $\chi^2(4) = 4.810$, $p = 0.308$; CFI = 0.993; TLI = 0.985; RMSEA = 0.025; SRMR = 0.019				
trade_agreement_exposure_index $\rightarrow$ ESG	38.400	14.170	0.262	0.007
tiva_foreign_value_added_share $\rightarrow$ ESG	11.900	6.380	0.176	0.063
Covariance of the two predictors	-	-	-0.674	< 0.001
Mediation model: $\chi^2(7) = 18.500$, $p = 0.010$; CFI = 0.967; TLI = 0.929; RMSEA = 0.071; SRMR = 0.037				
trade_agreement_exposure_index $\rightarrow$ governance_oversight_proxy	24.103	21.444	0.062	0.261
trade_agreement_exposure_index $\rightarrow$ disclosure_quality_proxy	-12.980	12.085	-0.059	0.283
governance_oversight_proxy $\rightarrow$ ESG	0.220	0.031	0.792	< 0.001
disclosure_quality_proxy $\rightarrow$ ESG	-	-	-0.005	0.901
trade_agreement_exposure_index $\rightarrow$ ESG, direct	-	-	0.038	0.380
Indirect effect via governance_oversight_proxy	5.298	4.772	-	0.267
Indirect effect via disclosure_quality_proxy	0.034	0.277	-	0.902
Total effect	9.461	-	-	0.160

Notes: Loadings in the direct-effects model are 0.588, 0.555 and 0.652, and differ from the measurement-only solution because the predictors enter jointly.

Source: Authors' calculations.

Trade agreement exposure has a positive and significant path to latent ESG in the direct-effects model, where the panel regression returned no

significant coefficient. The magnitude is modest. An increase of one standard deviation in the index, 0.023 points, corresponds to an estimated 0.88

points of ESG performance, which is roughly a fifth of the standard deviation of the composite.

The mediation model does not support a governance or disclosure channel, since neither path from trade exposure to the two mediators is significant and both indirect effects are indistinguishable from zero. Governance oversight is the strongest correlate of latent ESG, which should be read as a relationship between two governance-related measures: the governance loading rises to 0.887 there while the environmental and social loadings fall to 0.434 and 0.430.

The multi-group extension tests whether the structural coefficients are equal across the three countries; Appendix D reports both models and the tests of the restrictions.

The fit statistics of the constrained model are close to their theoretical maxima, and that appearance requires explanation rather than endorsement. TLI is non-normed and exceeds 1.000 whenever the model chi-square falls below its degrees of freedom, which is the case here, and RMSEA is bounded below at zero for the same reason. The conclusion rests on the comparison of the two models: constraining the five structural coefficients does not significantly worsen fit under either test. With ten firms per group these tests have low power, so the result is an absence of detected differences and not evidence of invariance.

Specification Sensitivity

The panel regression and the direct-effects model differ in two respects at once: the panel regression uses the observed ESG composite and includes the full control set, whereas the direct-effects model

represents ESG as a latent factor and does not include the full set of institutional and firm-level controls. The divergence cannot be attributed to the representation of ESG without the two remaining cells of the crossed design, which Table 5 reports.

Table 5
Specification sensitivity of the trade_agreement_exposure_index path to ESG performance

Measurement framework	Reduced covariate set	With full control set
Observed composite (ESG_total_proxy)	$\beta = 0.152$, $p = 0.042$	$\beta = 0.176$, $p = 0.126$
Latent factor (SEM)	$\beta = 0.262$, $p = 0.007$	$\beta \approx 0.11$, $p \approx 0.282$

Notes: The reduced-covariate models retain the two country-year predictors and omit the institutional and firm-level controls. The reduced-covariate observed model gives $b = 26.668$, $SE = 13.055$, $t = 2.043$, $R^2 = 0.016$, $F(2, 327) = 2.693$, $p = 0.069$. Controls: $\ln_assets$, $leverage$, ROA , $export_intensity$, $export_intensity_country$, EU dummy. Source: Authors' calculations.

The pattern is consistent across the two rows. Trade agreement exposure is significantly and positively associated with ESG performance in both frameworks under the reduced covariate set, and in neither once the full controls are added. The difference is thus located in the covariate set and not in the representation of ESG, and H2 is supported.

The structure of the trade variable explains why. The index is defined at the country-year level and is

entangled with the other country-year indicators, correlating negatively with $export_intensity_country$ in Austria ($r = -0.378$, $p < 0.001$) and in Germany ($r = -0.584$, $p < 0.001$), while the EU dummy separates the same countries once more. Conditional on EU membership, firm size and

country-level trade structure, the index explains no additional variation in either framework, so that H1 is supported under the reduced covariate specifications and not under institutional conditioning.

Discussion

Synthesis of Key Findings

The answer to the central research question is conditional. Trade agreement exposure is positively associated with firm-level ESG performance, and the association does not survive institutional controls in either framework, so that H1 holds only in reduced-covariate specifications. H2 is supported, with the crossed design locating the sensitivity in the covariate set. H3 is supported, since ESG performance differs significantly across the three countries.

These results describe a relationship that is real at the level of institutional context and not identifiable at the level of the individual firm. Trade agreements form part of the institutional environment that distinguishes countries from one another, and once that environment is controlled for directly, the agreement measure has nothing left to explain, which is consistent with evidence that institutional quality is itself a primary driver of ESG performance (Pinheiro et al., 2024). The multi-group result points the same way: the countries differ in the level of ESG performance while the structural relationships cannot be distinguished.

Theoretical and Methodological Contributions

The theoretical contribution relates to the level at which international trade should be modelled. Since trade agreements are better read as carriers of governance expectation and reputational discipline

than as flows of goods (DiMaggio & Powell, 1983; Gereffi et al., 2005), results support the former interpretation more than the latter and also add a note of caution as to identification, because an agreement measure that is a national attribute is observationally equivalent to the institutional environment itself.

The methodological contribution is more important. The standard explanation for null results in ESG research is measurement error and aggregation bias, which carries a seldom tested implication that a latent specification should recover what a composite conceals, yet does not in this sample. The trade relationship is identical under both representations. Changing the covariate set can alter the estimated relationship in ways that cannot be resolved simply by replacing an observed ESG composite with a latent measure. The measurement critique stays well founded (Berg et al., 2022), but measurement architecture and covariate structure are separate sources of sensitivity and should be tested separately.

Practical and Policy Implications

For corporate managers, the results have cautionary lessons. Managers should not pursue the ESG score as a target; governance oversight is most strongly related to the latent factor and the composite compresses dimensions that behave differently, such that the expectations embedded in trade agreements are met through integration across the three dimensions, as opposed to effort directed at a headline number.

The results give policymakers and trade negotiators reasons to be wary about reading firm-level sustainability performance improvements as having to do with the trade agreement where national

circumstances are not controlled for. Once national institutional context is held constant, the positive association disappears, which suggests that sustainability provisions work through the national regulatory and enforcement environment as opposed to independently of it. Evaluation frameworks that do not condition on that context will overstate the effect of the agreements.

For ESG rating agencies, the three dimensions share a common factor accounting for 57.178 per cent of the variance and retain substantial dimension-specific variance, which supports publishing component scores alongside any composite. Moving to latent models does not, on this evidence, change what an analyst would conclude about trade exposure; the gain lies in the transparency of the assumptions.

Conclusion

On a balanced panel of 30 firms observed over eleven years, trade agreement exposure is positively and significantly associated with ESG performance under the reduced covariate set, in the observed composite framework ($\beta = 0.152$, $p = 0.042$) and in the latent framework ($\beta = 0.262$, $p = 0.007$) alike, and is not significant in either once institutional and firm-level controls enter. H1 is supported in the reduced-covariate specifications but not supported once institutional and firm-level controls are introduced. H2 is supported, with the sensitivity located in the covariate set. H3 is supported.

The originality of the paper lies in the crossed design as opposed to either estimate on its own. Comparing a composite model against a latent model is common practice, and the comparison is uninformative when the two also differ in what they control for.

Several limitations qualify these conclusions, and each points to a specific extension.

Sample constraints: The sample is deliberately limited to 30 firms with continuous disclosure over the full eleven-year period. As a result, large listed multinationals are overrepresented in the sample, while SMEs and unlisted firms are not represented. The small number of firms in each country also limits the power of the multi-group analysis. A larger number of firms per country would provide a stronger basis for the country comparisons.

Measurement of trade exposure: Because the trade agreement exposure index is defined at the country-year level, the analysis contains only 33 distinct index values. The limited within-sample variation makes the trade effect difficult to distinguish from other country-year influences. Using firms' actual export destinations would make it possible to construct firm-specific exposure measures and separate trade exposure more clearly from national institutional conditions.

ESG measurement: The ESG measures are taken from one aggregation platform, which means that the estimates remain tied to the way that platform constructs and scales its ratings. The non-significant results should therefore be checked against ESG measures from other data sources before they are interpreted more broadly.

Endogeneity and causality: The analysis identifies associations rather than causal effects. Unobserved institutional or macroeconomic factors may still affect both trade-agreement exposure and corporate ESG performance. Designs with temporal lags, or with an exogenous change in agreement coverage, would address the direction and the timing of adjustment.

Data Availability: Findings in this paper are based on secondary databases and data sources described in Appendix B.

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Appendix

Appendix A: Firms in the Balanced Panel

Table A1

Composition of the balanced panel by country (30 firms, 330 observations)

Country	Firms included (10 per country)	Sectors represented
Austria	voestalpine AG, OMV AG, Verbund AG, Wienerberger AG, ANDRITZ AG, Raiffeisen Bank International AG, Mayr-Melnhof Karton AG, RHI Magnesita, A1 Telekom Austria AG, PORR AG	Steel, energy, utilities, construction materials, industrial engineering, banking, packaging, industrial materials, telecommunications, construction
Germany	Siemens AG, Volkswagen AG, BASF SE, BMW AG, Deutsche Bank AG, Allianz SE, SAP SE, Bayer AG, RWE AG, Mercedes-Benz Group AG	Industrial technology, automotive, chemicals, banking, insurance, software, pharmaceuticals, energy and utilities
Switzerland	Nestlé S.A., UBS Group AG, Novartis AG, Roche Holding AG, Zurich Insurance Group AG, Swiss Re AG, ABB Ltd., Holcim Ltd., Givaudan SA, Swisscom AG	Food and beverages, banking, pharmaceuticals, insurance, reinsurance, industrial engineering, construction materials, speciality chemicals, telecommunications

Note: Every firm is observed in each year from 2015 to 2025. Note: RHI Magnesita is classified as Austrian in the analysis on the basis of its Vienna-based administrative headquarters. Its corporate and listing structure changed during the observation period.

Source: Authors' compilation.

Appendix B: Variables, Definitions, and Data Sources

Table B1

Variables entering the empirical models

Variable	Definition	Level	Source
ESG_total_proxy	Weighted composite ESG score, 0–100	Firm-year	CSRHub
ESG_E_proxy, ESG_S_proxy, ESG_G_proxy	Environmental, social and governance component scores, 0–100	Firm-year	CSRHub
governance_oversight_proxy	Board-level governance oversight of ESG, 0–100	Firm-year	CSRHub
disclosure_quality_proxy	Depth and transparency of ESG reporting, 0–100	Firm-year	CSRHub
trade_agreement_exposure_index	Trade-weighted exposure to agreements with sustainability-related provisions in force, normalised to 0–1	Country-year	WIOD and OECD TiVA; official agreement registers
tiva_foreign_value_added_share	Foreign value added as a share of gross exports	Country-year	OECD TiVA
export_intensity_country	Total exports as a share of GDP	Country-year	OECD and World Bank
EU	Institutional dummy: 1 for Austria and Germany, 0 for Switzerland	Country	Authors' coding
total_assets, ln_assets	Total assets in EUR million and their natural logarithm	Firm-year	Orbis
leverage	Total debt divided by total assets	Firm-year	Orbis
ROA	Net income divided by total assets	Firm-year	Orbis
export_intensity	Export revenue divided by total revenue	Firm-year	Orbis

Source: Authors' compilation.

Appendix C: Descriptive Statistics

Table C1

Descriptive statistics of the variables entering the models (N = 330 firm-years)

Variable	Min	Max	Mean	SD
ESG_total_proxy	60.881	84.798	72.976	4.062
ESG_E_proxy	57.792	88.800	73.132	5.767
ESG_S_proxy	47.942	99.000	73.409	6.831
ESG_G_proxy	53.865	88.572	72.713	6.558
governance_oversight_proxy	47.845	97.405	72.794	9.012
disclosure_quality_proxy	64.826	90.598	78.452	5.078
total_assets (EUR million)	8,342.603	126,637.466	36,942.778	22,423.575
leverage	0.379	0.779	0.573	0.070
ROA	0.011	0.086	0.051	0.011
export_intensity	0.365	0.778	0.571	0.082
export_intensity_country	0.446	0.683	0.558	0.075
tiva_foreign_value_added_share	0.267	0.419	0.339	0.050
trade_agreement_exposure_index	0.572	0.657	0.619	0.023

Source: Authors' calculations based on CSRHub, Orbis, WIOD and OECD TiVA data.

Appendix D: Multi-Group Structural Equation Model

Table D1

Multi-group structural equation model across Austria, Germany, and Switzerland

Fit index or test	Unconstrained model	Constrained model
χ^2 (df)	21.500 (21)	28.600 (31)
p	0.431	0.591
CFI	0.999	1.000
TLI	0.997	1.011
RMSEA	0.014	0.000 [0.000, 0.064]
SRMR	0.045	0.057
Likelihood-ratio difference test: $\Delta\chi^2(10) = 7.100$, $p = 0.716$		
Constraints score test: $\chi^2(10) = 0.244$, $p = 1.000$		

Notes: 110 firm-years per country. The constrained model holds five structural coefficients equal across countries, which imposes ten restrictions.

Source: Authors' calculations.

Appendix E: Trade Agreements Entering the Exposure Index

Table E1

Agreements with sustainability-related provisions entering the exposure index

Institutional level	Agreement	In force	Applies to
EU common commercial policy	EU-South Korea FTA	2011	Austria, Germany
EU common commercial policy	EU-Canada CETA	2017 (provisional application)	Austria, Germany
EU common commercial policy	EU-Japan EPA	2019	Austria, Germany
EU common commercial policy	EU-Singapore FTA	2019	Austria, Germany
EU common commercial policy	EU-Vietnam FTA	2020	Austria, Germany
EFTA	EFTA-Canada FTA	2009	Switzerland
Bilateral	Switzerland-Japan FTEPA	2009	Switzerland
Bilateral	Switzerland-EU bilateral agreements	ongoing	Switzerland

Notes: The compilation is based on the official agreement texts and the European Commission and EFTA registers; the agreement with Japan is a bilateral agreement of Switzerland and not an EFTA agreement; partner weights from WIOD and OECD TiVA. Agreements under the EU common commercial policy apply to both member states in the sample, so index differences between Austria and Germany arise from the partner weights alone. German supply chain due diligence legislation is institutional context and is not counted. The table reports the agreements included in the construction of the exposure index and is not intended as an exhaustive inventory of all agreements in force during the observation period.

Source: Authors' compilation.

Appendix F: Realised Values of the Trade Agreement Exposure Index

Table F1

Trade agreement exposure index by country and year (33 country-year cells)

Year	Austria	Switzerland	Germany
2015	0.6248	0.5861	0.6282
2016	0.5958	0.6061	0.6057
2017	0.6021	0.5832	0.6363
2018	0.6114	0.5952	0.6110
2019	0.6031	0.5943	0.6412
2020	0.6292	0.5723	0.6521
2021	0.6189	0.5871	0.6504
2022	0.6247	0.6036	0.6544
2023	0.6206	0.6088	0.6421
2024	0.6409	0.6256	0.6547
2025	0.6460	0.6212	0.6574

Notes: The index is a country-year measure, so every firm headquartered in the same country carries the same value in a given year. Mean = 0.619, SD = 0.023, range 0.572 to 0.657.

Source: Authors' calculations from the agreements listed in Appendix E, with partner weights from WIOD and OECD TiVA.

Mednarodni trgovinski sporazumi in trajnostna uspešnost podjetij v Avstriji, Nemčiji in Švici

Izvleček

V članku preučujemo, ali je vpliv mednarodnih trgovinskih sporazumov povezan z uspešnostjo podjetij na področju ESG ter ali je odgovor odvisen od specifikacije modela. Uravnotežen panel 30 podjetij s sedežem v Avstriji, Nemčiji in Švici se opazuje letno od leta 2015 do 2025, kar daje skupaj 330 opazovanj. Kombinirata se panelna regresija na opazovani sestavljeni ESG-kazalnik in modeliranje strukturnih enačb z latentnim ESG-faktorjem, trgovinska pot pa se ponovno oceni v križni zasnovi merilnega okvira in niza spremenljivk. Izpostavljenost trgovinskim sporazumom je pozitivno povezana z uspešnostjo ESG v obeh okvirih ob zmanjšanem nizu spremenljivk, v nobenem od njiju pa ne, ko se vključijo institucionalne in podjetniške kontrolne spremenljivke. Vzorec je namensko izbran in omejen na velika podjetja, ki kotirajo na borzi. Povezava je torej odvisna od specifikacije in ne od merjenja, kar pojasnjuje nasprotujoče si rezultate v strokovni literaturi.

Ključne besede: okolje, družba in upravljanje (ESG), mednarodni trgovinski sporazumi, modeliranje strukturnih enačb, občutljivost na specifikacijo

Organisational Determinants of Employee Training and Development

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Abstract

In today's rapidly evolving, technology-driven business environment, companies must continuously enhance workforce competencies through training and development to remain competitive. However, in many organisations, employee training is either absent or conducted in an ad hoc and unsystematic manner. The purpose of this paper is to examine which organisational factors influence firms' decisions to engage in employee training. The research uses correlation analysis on a sample of Serbian companies drawn from the World Bank Enterprise Surveys conducted in 2019 and 2024. It examines the relationship between selected organisational factors and the incidence of employee training. The results show that organisations characterized by higher levels of management maturity and more developed strategic management practices are more likely to provide employee training in a regular and systematic manner. These findings support organisational transformation efforts aimed at establishing employee training and development as a continuous organisational activity.

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Introduction

The Fourth Industrial Revolution has profoundly transformed the labor market through accelerated automation, digitalization, and the application of artificial intelligence. This has reduced the demand for certain routine occupations while simultaneously creating new roles in high technology, data analytics, and the management of complex digital systems (Vrchota et al., 2019; Sony & Mekoth, 2022). Skills related to data management, programming, artificial intelligence, cybersecurity, and problem-solving in unpredictable contexts are particularly emphasized. Alongside technical competencies, so-called “soft skills” – such as creativity, emotional intelligence, teamwork, and adaptability – are gaining importance, as they enable employees to complement and enhance the role of technology in business processes (Hecklau et al., 2017; Vrchota et al., 2019; Beke et al., 2020; Saniuk et al., 2021; Kowal et al., 2022; Sony & Mekoth, 2022). Whereas the Fourth Industrial Revolution primarily emphasized digital and technical competencies, the transition to the Fifth Industrial Revolution is reshaping the skills profile by placing stronger emphasis on humanistic and socially responsible aspects of work. It is expected that, in addition to digital literacy and technical knowledge, interdisciplinary skills that bridge technology with ethics, sustainability, and social values will play an increasingly central role (Tomašević, 2023; Rial-Gonzalez et al., 2024).

Marimer et al. (2021) and Sony & Mekoth (2022), based on numerous empirical studies, found that a lack of skills may slow the benefits of advanced technologies and consequently affect company performance. Hortense et al. (2018) further highlighted the importance of skills in the modern

environment, emphasizing workforce development as one of the four key drivers of successful digital transformation. In addition, Pitić & Vučković (2021), in their study on a sample of enterprises from Serbia, unequivocally demonstrated that organisations which regularly implement employee training and development are also more likely to introduce innovations in both products and business processes.

Small open economies often face limited resources and investment capacity, which constrain their industrial development and long-term competitiveness. In an increasingly complex and turbulent business environment, these countries should strategically promote knowledge-based reindustrialization as a key driver of economic transformation (Vlačić, 2021). However, the successful implementation of such strategies depends largely on human capital, particularly the development of employee competencies, which enhance organisational performance (Stanton & Pham, 2014) and innovativeness (Capozza & Divella, 2019). Therefore, it is important to examine the organisational factors that encourage firms in small open economies to invest in employee training and development, thereby strengthening their long-term competitiveness and growth.

The subject of this research is the impact of organisational factors on decision-making regarding the implementation of employee training and development programs within a company. The study examines whether firm characteristics, human capital, strategic management practices, managerial and governance mechanisms, innovation activities, and sustainability-oriented practices are associated with the likelihood that an enterprise provides formal training to its employees. Specifically, the main hypothesis is that

organisations with a higher level of management maturity, a well-developed practice of strategic management, and a strong orientation toward innovation implement employee training more frequently. This research aims to emphasize the importance of internal organisational factors, particularly with regard to strategic management. The research was conducted using correlation analysis on a sample of enterprises in Serbia covered by the World Bank Enterprise Surveys carried out in 2019 and 2024. These are two datasets, one from 2019 and the other from 2024, and both are available online on the World Bank platform (The World Bank, 2019a; 2024a).

The first chapter of this paper provides an overview of previous research on organisational factors influencing the incidence of employee training within companies. This is followed by the presentation of empirical findings, where the authors conducted a correlation analysis on a sample of Serbian companies that participated in the World Bank Enterprise Survey in 2019 and 2024.

Literature Review

According to Susomrith and Coetzer (2015), factors within the internal work environment, rather than the industry sector, constitute the major barriers to training and development. Therefore, this chapter aims to identify existing findings regarding the role of organisational factors in the implementation of training and to reveal opportunities for further empirical research.

Anlesinya (2018) indicates that organisational culture, poor management commitment to training, inadequate promotion prospects, and a lack of transparency and fairness in trainee selection are among the most common barriers to employee

training and learning. These findings are further supported by Piperkova et al. (2021), who argue that the lack of applicants with adequate skills during the recruitment process, employees' low motivation to upgrade their skills, and insufficient employee training are among the most significant barriers to employee skills development. Coetzer and Perry (2016), in their study on a sample of small firms, identified four main categories of factors shaping employee learning: (1) elements of the external business environment; (2) characteristics of the work environment; (3) the learning potential inherent in the job itself; and (4) employees' learning orientations. Regarding work environment factors, the authors point to the organisation of work, employee workload, the complexity of knowledge and skills required in job performance, and the extent to which managers support and encourage learning. The importance of managerial influence is also emphasized by Al-Harthy and Yusof (2016), who argue that transformational leaders play a critical role in providing training opportunities, thereby improving both individual and organisational performance. Rida-E-Fiza et al. (2015) further add that managers who fail to interact regularly with their teams may struggle to identify training needs. The same authors note that a lack of team spirit and poor communication can undermine learning and development, as most forms of workplace learning occur through interaction between managers and employees.

Ganah & Rennie (2009) emphasize the importance of strategic management for employee training and development. According to these authors, in order to maximize the impact of training, organisations of all sizes must establish an effective training strategy that is explicitly linked to organisational objectives. Kulkarni et al. (2020), in their study conducted on a sample of 121 Indian startups, found that vision and

mission play a crucial role in shaping employee training. The authors conclude that it is important for company founders and management to create awareness among employees of the organisation's vision and mission, as well as of the importance of developing appropriate skill sets for the effective achievement of startup goals. Turcotte et al. (2003) highlighted a strong relationship between business strategy and employee training. Their findings indicate that firms that emphasize a human resources strategy or a research and development strategy are significantly more likely to invest in employee training than firms without a clearly defined strategy. Baldwin & Johnson (1995) found that firms that engage in innovation, are more technologically advanced, emphasize quality management, and implement human resources strategies are more likely to support employee training initiatives. According to Rabemenanjara & Parsley (2006), business strategy not only shapes the organisation of work but also determines the level of competencies within human capital required for firm performance. Across small enterprises, a consistent positive relationship is observed between the incidence of employee training and the strategic importance attributed to innovation and expansion, quality improvement, and human resources-based strategies.

Methodology

Employee training in companies operating in small open economies needs to become a continuous activity to help firms adapt to rapidly changing markets and maintain competitiveness despite limited resources. This paper presents a correlation analysis of fourteen organisational factors and the incidence of employee training programs, with the aim of identifying which factors influence this process. The aim of the analysis is to identify which

of these factors positively contribute to the decision to conduct training within enterprises. The analysis was carried out using two samples of companies in Serbia that were included in the World Bank Enterprise Survey (WBES) on the business environment in Serbia, conducted in 2019 and 2024. The WBES in Serbia covers a wide range of topics, including general firm information, infrastructure and services, sales and procurement, management practices, competition, innovation, capacity, management time allocation, land and permits, crime, finance, business-state relations, labor force, business environment, performance, and the green economy. The survey sample consists of firms divided into six industry categories: manufacturing, retail trade, wholesale trade, construction, hospitality, and services. The WBES sample was selected using stratified random sampling, with stratification based on industry, firm size, and region. Data were collected through face-to-face interviews with managers, owners, or directors of enterprises, using standardised questionnaires developed by the World Bank (The World Bank, 2019; 2024).

The 2019 and 2024 WBES datasets are used as complementary cross-sectional sources rather than for direct comparison of changes over time. The 2024 dataset was prioritised for variables covered in both survey rounds, as the more recent data provide a more current representation of organisational practices and are therefore more relevant to the objectives of this study. However, several factors relevant to the study were included in the 2019 questionnaire but were not available in the 2024 dataset. These factors were therefore retained from the 2019 dataset to provide a broader assessment of the internal organisational factors relevant to training decisions. The correlation analysis for 2024 was conducted on a sample of 502

firms, while the analysis for 2019 was carried out on a sample of 361 firms. For the purposes of this study, two WBES samples were analysed, as the questionnaires differed between 2019 and 2024, and several important questions included in the 2019 survey were omitted in 2024. These factors were therefore retained from the 2019 dataset in order to provide a broader assessment of organisational characteristics relevant to employee training. Given that the World Bank Enterprise Survey covers data on numerous factors related to both the internal and external organisational environment, the authors selected fourteen factors for the purposes of the correlation analysis, focusing on general organisational characteristics as well as contemporary strategic management practices. The selection of these organisational factors was guided by the theoretical and empirical literature reviewed in this study and by their relevance to the organisational context in which employee training decisions are made. The factors cover several complementary dimensions: firm characteristics and human capital, strategic management and organisational formalisation, managerial and governance practices, innovation, and sustainability. This selection reflects the premise that training is not determined by a single organisational characteristic, but is embedded in the broader way in which firms plan, manage, develop capabilities, and respond to organisational change. The selected variables therefore provide a focused empirical representation of the organisational dimensions identified in previous

research as relevant to employee learning and development.

The correlation analysis was performed in SPSS 13 using the Chi-square coefficient and Cramer's V test. Fourteen organisational characteristics, serving as independent variables, were selected from the questionnaires based on a review of relevant literature (similar studies) and the assumption that these factors may influence the implementation of training and development programs. The dependent variable was whether or not the enterprise conducted training and development activities for employees in the past year. All variables included in the correlation analysis were categorical, since all survey questions were closed-ended.

Analysis of Results

This chapter presents the results of the correlation analysis between selected organisational factors and the incidence of employee training organised by firms. In addition, the results are interpreted and discussed. Table 1 presents the results of the correlation analysis based on data collected through the World Bank Enterprise Survey conducted in Serbia in 2024. In Table 1, an asterisk (*) denotes correlations with a statistical significance level below 0.05, while a double asterisk (**) indicates correlations significant at the 0.01 level. Brackets indicate the response options provided in the questionnaire for each organisational characteristic.

Table 1

Results of the correlation analysis between organisational factors and the incidence of employee training, based on data from the 2024 World Bank Enterprise Survey (WBES)

Incidence of employee training Organisational factors	During the past year, did this establishment have formal training programs for its permanent, full-time workers? (Yes / No)	
	Chi-square	Cramer's V
How many permanent, full-time individuals work in this establishment? (1 to 19 employees / 20 to 99 employees / more than 100 employees)?	7.025*	0.122
During the past year, what was this establishment's main activity, that is, the activity that represented the largest proportion of annual sales? (Manufacturing / Retail trade / Wholesale trade / Construction / Hotel / Restaurant / Services)	14.486*	0.175
What percentage of this firm is owned by each of the following? (Private domestic individuals, companies or organisations / Private foreign individuals, companies or organisations / Government or State / Other)	8.548**	0.130
Does this establishment have an internationally recognized quality certification? (Yes / No)	14.938**	0.172
During the past year, did this establishment have production targets? (Yes / No)	0.886	0.052
Who was aware of those targets at this establishment? (Only senior managers / Most managers and some production workers / Most managers and most production workers / All managers and most production workers)	19.354**	0.249
During the past year, what best describes what happened at this establishment when a problem in the production process arose? (We fixed it but did not take further action / We fixed it and took action to make sure it did not happen again / We fixed it and took action to make sure that it did not happen again, and had a continuous improvement process to anticipate problems like these in advance / No action was taken)	3.085	0.103
During the past year, how many performance indicators were monitored? (1-2 indicators / 3-9 indicators / 10 or more indicators)	7.031*	0.161
Over the last three years, did this establishment adopt any energy management measures to reduce emissions, waste, or pollution? (Yes / No)	30.193**	0.246
During the last three years, has this establishment introduced new or improved products or services? (Yes/No)	23.472**	0.216
During the last three years, has this establishment introduced any new or improved process? (Yes/No)	51.994**	0.322

Source: The World Bank, 2024a; Authors' calculation

The correlation suggests that company size is an important determinant of investment in employee training. Larger enterprises are more likely to implement formal training programs, likely due to greater financial resources, structured HR departments, and a higher need for standardised skill development across a diverse workforce. In contrast, smaller firms may rely on informal, on-the-

job learning, reflecting both resource constraints and less formalized organisational structures.

The results indicate that service-oriented companies are more likely to implement formal training programs compared to firms in other sectors. This may stem from the service sector's reliance on human capital as a primary driver of value creation, where employee knowledge, skills, and customer interaction directly affect performance outcomes. Unlike manufacturing or construction, where productivity is more equipment-driven, service industries depend heavily on continuous skill upgrading to maintain competitiveness and service quality.

The analysis shows that enterprises with foreign ownership, even when partial, are more likely to provide formal training programs compared to fully domestic firms. This tendency may reflect the transfer of managerial practices from foreign parent companies, particularly those from Western economies where structured employee development is more established. Foreign investors often emphasize standardised skill development to ensure alignment with global quality and performance standards, while domestic firms may face financial or organisational barriers to implementing similar programs.

The correlation indicates that establishments holding internationally recognized quality certifications are more likely to conduct formal training programs. This relationship is expected, as maintaining certification standards typically requires continuous employee upskilling and adherence to standardised procedures. Certified firms face stronger external pressures to document competencies and ensure compliance, which fosters a culture of systematic training.

The absence of correlation between the presence of production targets and the provision of formal training suggests that goal-setting practices and employee development initiatives are not systematically linked in Serbian enterprises. This may indicate that firms view production targets primarily as short-term performance management tools, while training is perceived as a longer-term investment not directly tied to immediate output objectives.

The results show that establishments where production targets are widely communicated among managers and workers are more likely to implement formal training programs. Broad awareness of goals reflects a participatory management style, where transparency and employee involvement are prioritized. In such environments, training serves as a complementary tool to align workforce skills with organisational objectives, ensuring that employees not only understand targets but are also equipped to contribute effectively to their achievement.

The absence of correlation between problem-solving approaches and the implementation of formal training suggests that Serbian enterprises do not systematically link continuous improvement practices with employee development. Even firms adopting proactive or preventive measures in production processes did not necessarily invest more in training, indicating that problem resolution may rely on managerial interventions, technical adjustments, or external expertise rather than workforce upskilling. This points to a gap in integrating training as a strategic component of organisational learning and process improvement.

The analysis reveals that firms monitoring a larger set of performance indicators are more likely to conduct formal training programs. Tracking 10 or

more indicators reflects a higher level of organisational sophistication and commitment to systematic performance management, which often requires employees to possess broader skills and adaptability. Training in such contexts becomes essential to ensure that workers can meet diverse performance expectations and contribute to continuous improvement.

Companies that adopted energy management measures over the last three years were also more likely to conduct formal employee training. This correlation suggests that both practices are part of a broader ESG (Environmental, Social, and Governance) approach, in which firms committed to sustainability also prioritize human capital development. By linking environmental responsibility with workforce training, these companies demonstrate an integrated strategy that aligns ecological goals with employee empowerment and organisational learning.

The correlation analysis indicates that establishments which introduced new or improved products, services, or processes over the last three years are more likely to have formal training programs for their permanent, full-time employees. Innovation in products and processes typically requires the adoption of new technologies, methods, or organisational routines, which in turn necessitates the continuous upgrading of employee skills and knowledge. Formal training becomes a critical mechanism through which firms ensure that their workforce can effectively implement innovations, adapt to change, and maintain operational efficiency. At the same time, this relationship can be interpreted in the opposite direction: companies that already invest in structured training programs tend to innovate more

frequently because a skilled, knowledgeable, and adaptable workforce is better equipped to generate new ideas, absorb external knowledge, and successfully execute innovation initiatives. In this sense, training and innovation may reinforce each other, forming a mutually supportive cycle in which employee development enables innovation, and innovation further increases the demand for systematic training.

As previously noted, the questionnaires used in the WBES surveys for 2024 and 2019 contain certain differences. Accordingly, the 2019 survey was additionally used to examine organisational factors that were relevant to the research framework but were not included in the 2024 questionnaire. Table 2 presents the results of the correlation analysis based on data collected through the World Bank Enterprise Survey conducted in Serbia in 2019, with the results presented in the same format as in Table 1.

Companies with a formalized, written business strategy that includes clear key performance indicators were more likely to conduct formal training programs. This correlation suggests a close connection between strategic planning and employee development, as firms with structured strategies recognize the need to align workforce skills with long-term objectives. In such organisations, formal training is part of a systematic approach designed to ensure that employees have the skills and competencies required to achieve strategic goals.

Companies that are members of business associations were more likely to conduct formal training programs.

Table 2

Results of the correlation analysis between organisational factors and the incidence of employee training, based on data from the 2019 World Bank Enterprise Survey (WBES)

Incidence of employee training Organisational factors	During the past year, did this establishment have formal training programs for its permanent, full-time workers? (Yes / No)	
	Chi-square	Cramer's V
Does this firm have formalized, written business strategy with clear key performance indicators? (Yes / No)	14.270**	0.206
Is this firm part of a business membership organisation, trade association, guild, chamber of commerce, or other business support group? (Yes / No)	7.862**	0.153
What percentage or how many of this establishment's permanent full-time employees have a university degree? (Less than 20% / more than 20%)	8.550**	0.228

Source: The World Bank, 2019a; authors' calculations

This correlation indicates that participation in such networks exposes firms to best practices, knowledge exchange, and external pressures that encourage workforce development. Membership often provides access to training resources, industry standards, and collaborative initiatives, which can lower barriers to implementing structured employee development.

Companies with more than 20% of employees holding a university degree were more likely to conduct formal training programs. This correlation suggests that a more highly educated workforce creates both the demand for and the capacity to benefit from structured employee development. Firms with skilled human capital may prioritize continuous learning to maintain competitiveness and foster innovation, while employees with higher education levels are more receptive to advanced training opportunities.

Discussion

The results of the correlation analysis provide valuable insights into the determinants of employee

training and development in Serbian enterprises. Namely, in small open economies, employee training tends to be unevenly distributed across firms and strongly conditioned by organisational and institutional characteristics, as well as management practice.

First, the likelihood that enterprises implement formal employee training programs varies systematically with key organisational characteristics. Factors such as firm size, sectoral orientation, ownership structure, and the educational profile of the workforce define the broader organisational context in which decisions about training are made. Larger firms, service-oriented industries, the presence of foreign ownership, and a higher educational level of employees jointly signal a greater degree of organisational maturity, formalization, and long-term performance orientation. Such firms possess stronger financial and organisational resources, more developed HR functions, and face a greater need for the standardisation of knowledge and skills, whether due to scale, customer requirements, or integration into international business networks. At the same time, the service sector and a highly

educated workforce further reinforce the importance of human capital as a key source of competitive advantage, making investment in training a necessity rather than an option. In contrast, smaller, domestically oriented firms operating in less knowledge-intensive sectors tend to rely more on informal learning practices, reflecting resource constraints, shorter decision-making horizons, and a lower level of institutionalization of human resource management. Overall, training emerges not as an isolated HR practice, but as an outcome of a broader organisational configuration in which structural, sectoral, ownership-related, and human capital factors jointly shape firms' ability and willingness to invest systematically in competence development.

Second, the adoption of formal employee training programs is also shaped by managerial and governance-related organisational practices that reflect how firms plan, coordinate, and control their activities. Enterprises with written business strategies, clearly defined performance indicators, quality certifications, and advanced performance monitoring systems exhibit a more deliberate and systematic approach to management, within which training emerges as a complementary mechanism for achieving organisational objectives. In such firms, employee development is closely aligned with long-term strategic goals, standardised procedures, and external requirements, making training an integral part of organisational coordination rather than an ad hoc activity. Participation in business associations further reinforces this orientation by exposing firms to shared norms, best practices, and institutional pressures that legitimize and facilitate investment in structured workforce development. At the same time, the importance of how managerial practices are enacted becomes evident: while the mere

presence of production targets does not increase the likelihood of training, their broad communication across organisational levels is associated with a higher incidence of formal training programs. This suggests that inclusive and transparent management practices foster environments in which training supports collective goal achievement. Conversely, the lack of association between problem-solving approaches and training provision points to a fragmented understanding of learning and improvement, where operational issues are addressed through technical or managerial interventions rather than systematic skill development. Overall, these findings indicate that formal training is most prevalent in organisations characterized by strategic clarity, external embeddedness, standardised governance mechanisms, and participatory communication practices, whereas its absence reflects a weaker integration of human resource development into broader systems of performance management and organisational learning.

Third, the propensity to implement formal employee training programs is further influenced by firms' engagement in innovation and sustainability-oriented practices. Enterprises that introduce new or improved products, services, or processes tend to operate in more dynamic and knowledge-intensive environments, where continuous adaptation and learning are essential. In such contexts, formal training functions as a key organisational mechanism that enables employees to acquire the skills and competencies required to implement innovations effectively, absorb new technologies, and adjust to evolving operational demands. At the same time, investment in structured training strengthens firms' innovative capacity by fostering a skilled, adaptable, and knowledge-oriented workforce, suggesting a mutually reinforcing

relationship between employee development and innovation. A similar pattern emerges with respect to sustainability practices: firms that adopt energy management measures are more likely to provide formal training, indicating that environmental responsibility and workforce development are often embedded within a broader ESG-oriented managerial logic. Rather than being isolated initiatives, innovation, sustainability, and training appear to form an integrated strategic bundle in which organisational learning supports both technological advancement and responsible resource management. Overall, these findings highlight that formal training is most prevalent in enterprises that pursue continuous improvement, innovation, and sustainability as interconnected elements of long-term organisational development.

Taken together, the findings are broadly consistent with the theoretical and empirical perspectives presented in the literature review. The positive association between formalised business strategy and employee training supports the argument that training is more effective when linked to organisational objectives and strategic priorities (Ganah & Rennie, 2009; Turcotte et al., 2003; Kulkarni et al., 2020; Rabemenanjara & Parsley, 2006). Similarly, the association between innovation and training is consistent with findings that firms oriented towards innovation, technological development and quality management are more likely to invest in employee development (Baldwin & Johnson, 1995; Pitić & Vučković, 2021). The results concerning communication of organisational goals and managerial practices are also compatible with research emphasising management support, communication and interaction as important conditions for workplace learning (Coetzer & Perry,

2016; Al-Harthy & Yusof, 2016; Rida-E-Fiza et al., 2015). At the same time, the absence of significant associations for some operational practices, such as production targets and problem-solving approaches, indicates that individual management practices do not necessarily lead to systematic training. This distinction is important: the findings suggest that training is more strongly associated with an integrated organisational orientation towards strategy, learning, innovation and continuous development than with isolated operational practices.

Conclusion

The findings indicate that employee training creates substantial value only when embedded within a broader process of organisational transformation. Training implemented as an isolated HR activity is unlikely to enhance competitiveness. Instead, organisations that integrate training with strategic management, governance, innovation, and ESG practices are better able to align workforce competencies with long-term objectives, adapt to changing environments, and sustain competitive advantage. The results also reveal a mutually reinforcing relationship between organisational transformation and employee training. Mature organisations are more likely to invest in structured training, while training itself strengthens their ability to implement strategic change by developing the skills and adaptability needed for innovation, quality improvement, and sustainability. Thus, training should be viewed as a strategic enabler rather than a standalone HR practice. For smaller enterprises, limited training opportunities often reflect resource constraints rather than a lack of awareness. Collaboration through business associations, clusters, and other networks can help overcome these barriers by providing access to

shared knowledge and training resources.

Overall, the findings suggest that formal training reflects an organisation's strategic orientation and managerial maturity rather than isolated managerial decisions. The main hypothesis was confirmed: organisations with more developed strategic management, higher managerial maturity, and stronger innovation orientation implement employee training more frequently. Therefore, managers should approach employee training as a strategic organisational issue rather than merely as an operational or short-term HR activity, or as a response to immediate technological changes. Training should be incorporated into long-term business strategy and linked to organisational objectives, performance management, innovation, sustainability, and the systematic development of organisational capabilities. In this perspective, managers should identify future competency needs and develop training programmes proactively, rather than relying primarily on training when a new technology, process, or immediate skills gap emerges. Policymakers can support this approach through sectoral training initiatives, collaborative programmes and measures that encourage continuous skills development and organisational capability building. Such measures can help

position employee training as an element of long-term productivity, innovation and competitiveness rather than simply as a response to short-term operational needs.

This study has some limitations that should be considered when interpreting the findings. First, the cross-sectional nature of the data provides a snapshot of organisational factors and employee training at the time of the survey. Second, the analysis identifies associations between organisational factors and employee training, rather than causal relationships. Nevertheless, the findings provide useful evidence on the organisational factors associated with employee training in Serbian enterprises. Future research could extend these findings in several directions. Longitudinal studies could examine how organisational changes influence training decisions over time and provide stronger evidence regarding the direction of the observed relationships. Further research could also incorporate organisational culture, leadership styles, human resource practices, and the quality and intensity of training, which were not captured by the present analysis. Comparative studies across industries and countries would provide additional insight into whether the identified relationships are specific to particular institutional and economic contexts.

Data Availability: Findings in this paper are based on publicly available databases: The World Bank (2019a) and The World Bank (2024a).

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Organizacijski dejavniki usposabljanja in razvoja zaposlenih

Izvleček

V današnjem hitro spreminjajočem se, tehnološko usmerjenem poslovnem okolju morajo podjetja za ohranjanje konkurenčnosti nenehno izboljševati kompetence delovne sile prek usposabljanja in razvoja. Vendar v mnogih organizacijah usposabljanje zaposlenih bodisi sploh ne obstaja bodisi poteka ad hoc in nesistematično. Namen tega članka je preučiti, kateri organizacijski dejavniki vplivajo na odločitve podjetij o izvajanju usposabljanja zaposlenih. Raziskava uporablja korelacijsko analizo na vzorcu srbskih podjetij, izbranih iz raziskav Svetovne banke o podjetjih, izvedenih v letih 2019 in 2024. Preučuje razmerje med izbranimi organizacijskimi dejavniki in pogostostjo usposabljanja zaposlenih. Rezultati kažejo, da organizacije, za katere so značilne višje ravni zrelosti managementa in bolj razvite prakse strateškega managementa, pogosteje zagotavljajo usposabljanje zaposlenih na redni in sistematični način. Ti izsledki podpirajo prizadevanja za organizacijsko preobrazbo, usmerjeno v uveljavitev usposabljanja in razvoja zaposlenih kot stalne organizacijske dejavnosti.

Ključne besede: usposabljanje in razvoj zaposlenih, strateški management, organizacijski dejavniki, podjetja, raziskava, korelacijska analiza.

The Impact of Knowledge Management Processes on Business Processes as the Foundation of a Process-Based Organizational Structure

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Abstract

Within the modern business environment, the role of knowledge is becoming increasingly important, especially with the emergence and development of the knowledge economy, which has replaced the industrial economy. Thus, knowledge becomes a key resource on which a company's operations depend. By applying knowledge as a strategic resource, companies shape an appropriate organizational structure. The main objective of this paper is to determine the impact of knowledge management processes on the performance of business processes as the foundation of a process-oriented organizational structure in medium and large Bosnian-Herzegovinian (hereinafter B&H) companies operating in knowledge-based industries. To achieve this objective, a non-parametric Kruskal–Wallis test and multiple regression analysis were applied. The research results showed that knowledge management processes indeed affect the performance of business processes that form the foundation of a process-based organizational structure. The value of this paper lies in the fact that knowledge is increasingly being applied for practical purposes with the goal of improving business processes and, consequently, overall business performance.

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Introduction

The business environment came into focus in the second half of the 20th century with the emergence of globalization, technology, knowledge economy, hypercompetition, and demands for social responsibility. Changes occurring in the business environment began to have an increasingly strong impact on company operations. Many authors (Sardak & Movchanenko, 2018; Buble, 2006; Wong et al., 2014; Khalid et al., 2018) have confirmed the connection between company performance and the business environment, which is reflected in an interactive understanding of the relationship between the internal and external business environment. Any neglect of the influence of the business environment can have a negative impact on company operations. Companies can adapt more easily to the demands of the modern business environment if they possess an organizational structure that is not bureaucratic, inflexible, and burdened with multiple hierarchical levels of management and leadership. Research results show the prevalence of traditional, inflexible organizational structures in B&H companies (Halilčević, 2018).

To respond to the challenges of the modern business environment, there is an increasing demand for an organic design concept, which involves shaping a modern, flexible organization that can adapt to newly emerging conditions (Kesler & Kates, 2011; Galbraith, 2014).

One such flexible organizational structure is the process-oriented organizational structure, which, as the name suggests, is based on business processes. Business processes represent an organized group of related tasks and activities that enable the transformation of resources into

products/services, thereby creating value for customers.

Since the process-oriented organizational structure places strong emphasis on satisfying customer needs, it is considered one of the most suitable organizational structures capable of effectively responding to the challenges of the modern business environment. The modern business environment is characterized by the emergence and development of the knowledge economy, in which knowledge becomes the key strategic resource, that can be applied in companies through knowledge management processes.

There are studies that have investigated the interrelationship between knowledge management processes and business processes, proving that business processes can take place successfully through knowledge management processes (Paschek et al., (2018); Brajer-Marczak, (2016); Bitkowska, (2020); Tabares et al., (2016); Sobolewska, (2020); Martínez-Martínez et al., (2018); Bitkowska, (2016); Massingham & Holaibi, (2017); Chatterjee et al., (2020); Martín-Navarro et al., (2025); Berniak-Woźny & Szelagowski, (2024); Abuezhayeh et al., (2022)). Within this body of research, studies determining the impact of knowledge management processes on business processes stand out, demonstrating that knowledge management processes indeed affect business processes (Atkočiūnienė et al., (2023); Hegazy & Ghorab, (2014); Malewska et al. (2025)).

The research conducted in this paper is based on previous research and the study of the impact of knowledge management processes on business processes. The main objective of this research is to determine the impact of knowledge management processes on the performance of business processes

in medium-sized and large enterprises in Bosnia and Herzegovina whose activities are knowledge-based.

Cummings and Worley (2008) emphasize that a process-oriented organizational structure is most suitable for implementation within medium-sized or large enterprises operating in highly developed environments where customer demands and market conditions rapidly change. Based on this, medium-sized and large enterprises in Bosnia and Herzegovina whose activities are knowledge-based were selected as the core sample for this research.

To demonstrate the impact of knowledge management processes on business process performance, the non-parametric Kruskal–Wallis test and multiple regression analysis are applied. The significance of the research results lies in the fact that previous studies have focused more on determining the correlation between knowledge management processes and business processes, whereas the impact of knowledge management processes on business processes has been explored to a lesser extent. On the other hand, if it is proven that knowledge management processes have an impact on business process performance, the research results will also have a significant impact on business practice by demonstrating how business processes can be improved, both in enterprises in Bosnia and Herzegovina and beyond. In addition to the introduction, this paper contains a literature review that first describes the connection between the business environment and the process-oriented organizational structure, highlighting the similarities and differences between functional and process-oriented organizational structures, and presents business processes as the foundation of a process-oriented organizational structure characteristic of any

enterprise. Following this, the concept of knowledge management is explained, and knowledge management processes are described.

At the end of this section, previous research investigating the connection between knowledge management processes and business processes are presented.

The research methodology follows the literature review and includes the research subject and hypotheses. Furthermore, this section presents the research sample and the methods used for data collection and analysis. The research results are presented at the end of this section. Following the presentation of the research results, the paper highlights concluding remarks, research limitations, and recommendations for future research.

Literature Review

Business Environment and Process-Oriented Organizational Structure

The business environment has a significant impact on company operations, a fact that became especially evident in the 1960s; an era that marked the beginning of research into the business environment as a crucial factor in enterprise operations and performance within a dynamic market. There is a strong connection between company operations and the business environment, as confirmed by various authors. For instance, Sardak & Movchanenko (2018) define the business environment as a set of situational factors and actors characterized by different segments in which business takes place, forming the foundation for business development. Furthermore, Buble (2006) points out that new opportunities and threats for business are constantly created within the business

environment, making it necessary to systematically monitor business operations and environmental impacts, as to respond in a timely manner and according to the situation. Khalid et al. (2018) confirmed the connection between the business environment and enterprise operations in their study, emphasizing that the business environment should be the starting point for any study of company operations, given that the nature, condition, and circumstances of any business depend on its environment. Historically, it was believed that the internal business environment within an enterprise was the primary influence on its operations. However, a group of authors notes that a new, interactive understanding of the relationship between the internal and external business environment was established in the second half of the 20th century, driven by globalization, technological development, the emergence of the knowledge economy, hypercompetition, and demands for corporate social responsibility (Sundać et al., 2016).

On the other hand, Wong et al (2014) highlighted in their study that the nature of the business and the conditions of the business environment affect the overall performance of a given industry as well as the execution of business processes. To adapt to the modern business environment, enterprises must focus on improving business processes in accordance with the nature of their business and environmental conditions.

Consequently, an enterprise strives to improve business processes that focus on developing new

products and services, as well as new projects that generate added value with an emphasis on customer delivery. All of the above can be achieved through processes that cross the boundaries of traditional functional coordination laterally. While the functional structure or hierarchy is vertical, processes are lateral structures that range from informal and self-organizing processes to formal structuring, eventually formalizing into a process-oriented organizational structure.

The process-oriented organizational structure emerges as a result of addressing the weaknesses of the functional structure by breaking down "functional silos", i.e. the boundaries between functional organizational units (McCormack & Johnson, 2001), which becomes an imperative under conditions of high customer demands and radical advancements in information and communication technology. This structure finds its broadest application precisely in combination with the functional organizational structure, as the most prevalent organizational form. Unlike the functional organizational structure where sub-optimization often occurs due to an excessive focus on functions, the process approach centers on consumers by managing, measuring, and improving all processes within an enterprise. This is primarily achieved through cross-functional teams and employee empowerment (Vukšić, Hernaus & Kovačić, 2008). This group of authors provided a detailed overview of the similarities and differences between functional and process-oriented organizational structures.

Table 1*Similarities and differences between functional and process-oriented organizational structures*

Category	Functional Org. Structure	Process-oriented org. structure
ORGANIZATIONAL FOCUS		
<i>Main focus</i>	Business functions	Business processes
<i>Alignment with organizational goals and mission</i>	Misunderstanding of organization's mission and goals	Focus on organizational mission and goals
<i>Product</i>	Simple, standardized product	Flexible product adaptable to the customer
<i>Employee focus</i>	Employees functionally oriented towards satisfying superiors	Employees process-oriented towards satisfying customers
STRUCTURAL ELEMENTS		
<i>Basic organizational units</i>	Functions	Process teams
<i>Work tasks, jobs</i>	Precisely defined tasks and jobs	Broad and flexible tasks and jobs
<i>Management style</i>	Supervision (centralization)	Mentorship (decentralization)
<i>Key persona</i>	Department director (business functions)	Business process owner
<i>Organizational height</i>	Tall (hierarchy)	Flat
<i>Type of structure</i>	Bureaucratic	Organic
OPERATIONAL PROCESSES		
<i>Workflows</i>	Interrupted	Simplified/connected
<i>(Sub)optimization</i>	Suboptimization of operations due to optimization of individual functions	Process optimization even if it requires suboptimization of some functions
<i>Technology</i>	Specific	Flexible
<i>Responsibility determination</i>	Error subject	Error cause
<i>Purpose of control</i>	Error correction	Variation reduction
<i>Performance measurement</i>	Results	Results and processes
<i>Control implementation</i>	Post-control (after problem occurs)	Preventive control
<i>Resource allocation</i>	Competition	Shared resources
PEOPLE		
<i>Employee skills</i>	Individual and functional specialization	Skill integration (broad competencies)
<i>Reward system</i>	Based on functional contribution	Based on organizational contribution
<i>Flexibility</i>	No flexibility	Flexibility during changes
<i>Approach to people</i>	People management	People development
<i>Responsibility</i>	Narrow	Wide
COMMUNICATION		
<i>Direction</i>	Vertical	Horizontal
<i>Flow</i>	Barriers between departments	Boundaryless organization
<i>Most common form of communication</i>	Superior - subordinate	Supplier - customer
<i>Coordination between functions</i>	Functions do not cooperate	Cross-functional collaboration
<i>Speed</i>	Slow information flow	Fast information flow
<i>Job understanding</i>	Understanding only one's own function	Understanding connections with other functions
<i>Information distribution</i>	Information is not regularly shared between functions	Information of common interest is routinely shared between functions

Continuation of Table 1

Similarities and differences between functional and process-oriented organizational structures

Category	Functional Org. Structure	Process-oriented org. structure
CULTURE		
<i>Change</i>	Maintaining the status quo	Tendency to change
<i>Mindset</i>	Short-term thinking	Long-term thinking, providing support
<i>Culture type</i>	Individual culture	Teamwork

Source: Bosilj Vukšić, et al. (2008)

By comparing the functional organizational structure and the process-oriented organizational structure, it can simply be concluded that the process-oriented organizational structure is more adaptable to the modern business environment. These two organizational forms are analyzed through six categories: organizational focus, structural elements, operational processes, people, communication, and culture.

Based on the above, it can be concluded that through the process approach, the rigid vertical functional division within an organization is improved by a horizontal process-based organization. The shift toward flatter, more horizontal structures is necessary, given the conditions of the modern business environment where great importance is placed on customers. The process-oriented organizational structure is widely applied in organizations because it can serve as a complement to a functional or another type of organizational structure. It is also possible to apply process-oriented organization to all other types of organizational structures, as specific activities, i.e. business processes are carried out in every organization, forming the basis upon which a process-oriented organizational structure can be built.

Business Processes

Business processes form the foundation of a process-oriented organizational structure. A more modern approach to designing organizations within structural frameworks involves business process reengineering. A business process refers to an organized group of related tasks and activities that work together to transform inputs into outputs, creating value for customers (Hammer, 2002).

When identifying key business processes, it is essential to consider the complete process value chain, which begins with the innovation process, specifically, identifying customer needs and demands. In this regard, Porter's value chain can be useful, as it describes all business processes within an enterprise from customer needs analysis to product (or service) delivery. The chain of business processes that creates value for customers varies from enterprise to enterprise. Nevertheless, it is still possible to identify a generic value chain that can be adapted depending on the specifics of certain enterprises' business processes. Kaplan and Norton (1996) emphasize that there is a generic value chain consisting of three key business processes:

- Innovation process,

- Manufacturing process,
- Post-sale services.

The innovation process is based on market research aimed at determining existing and latent customer needs and requirements in order to create products and services that can satisfy those needs. To identify customer needs and requirements, the innovation process begins with identifying and researching new markets and new consumers, along with the possibility of determining the growing and latent needs of existing consumers. Market research, as the first phase of the innovation process, should enable the determination of market size and the characteristics of consumer needs, and provide specific information regarding the possible price of products and/or services. In accordance with the collected information about customer needs and demands, the creation and development of new products and services begins in order to satisfy the identified needs. Therefore, after the first phase of the innovation process, which involves market research, comes the next phase, which relates to the creation and development of new products and/or services to satisfy the identified customer needs. In this phase of the innovation process, the capabilities of existing technology to produce a new product are also examined, and efforts are made to introduce the new product and/or service to the market. In today's business environment, enterprises can achieve a competitive advantage based on the continuous development of innovative products and services, where the research and development process has become a more vital element of a business entity's value chain.

Following the innovation process is the manufacturing process, within which the production and distribution of products and services take place.

The modern business environment, characterized by increasing competition as well as the emergence of the Total Quality Management (TQM) concept, has influenced the shortening of production times. In such a business environment, enterprises that focus on reducing the duration of the production process are more likely to succeed, as this enables them to respond quickly to customer needs and requirements. Many customers highly value enterprises that manage to deliver products to customers within a short period from the moment an order is placed. In that case, the goal of every enterprise is to shorten the timeframe from the moment an order is received to the moment of product delivery, while ensuring reliable delivery within the promised timeframe.

The post-sale service process, as the third business process, includes activities related to providing post-sale services to customers, which encompass warranty periods, repair activities, handling product defects and returns of defective products, as well as payment-related activities. There are many customers for whom this aspect of a product is dominantly important, so an enterprise should pay special attention to these activities to gain a competitive advantage.

Although Porter's value chain is considered an older concept, it is still applied in both literature and practice (Porter, 1985). Thus, literature emphasizes the authors' view that the value chain is still considered useful and that every enterprise should re-examine its value chain, taking into account the opportunities offered by the application of modern information and internet technology. The application of these technologies can enhance the execution of both supporting as well as primary activities, thereby completely transforming an

enterprise's business model.

Knowledge Management

The concept of knowledge management appeared in the 1970s. Mathi (2004) points out that Nicholas Henry was the first to use the term "knowledge management" in 1974 in a manner similar to its current usage. Earlier, in 1964, Peter Drucker coined the term "knowledge worker," and in 1983, he stated that making knowledge work productive is the great management task of this century, just as making manual work productive was the great management task of the last century. Four years later, in 1987, the first book related to knowledge management was published in Europe by Sveiby & Lloyd, while in the United States, the first book was published three years later, in 1990 (Wiig, 1997).

Since then, numerous researchers have attempted to define knowledge management, resulting in a wide range of definitions. Below are some of the most notable ones:

Beckman (1997) considers knowledge management to be a formalized approach to experience, knowledge, and expertise that creates new capabilities, enables superior performance, encourages innovation, and increases customer value.

Sveiby (1997) defines knowledge management as the art of creating value from intangible assets. Davenport and Prusak (1998) confirmed that knowledge is used as a resource to create added

value, considering that knowledge management enables an organization to leverage its intangible assets to create value through improved business performances.

There are also authors who have established that knowledge management involves the application of appropriate processes.

Thus, Rastogi (2000) emphasizes that knowledge management is a systematic and integrative process of coordinating activities in the domain of acquiring, creating, storing, sharing, disseminating, developing, and using knowledge by individuals and groups to achieve major organizational goals.

Alavi and Leidner (2001) define knowledge management as a process involving distinct but interdependent processes for knowledge creation, storage/retrieval, transfer, and application.

Horwitch and Armacost (2002) defined knowledge management as the practice of creating, capturing, transferring, and accessing the right knowledge and information when needed, in order to make better decisions, take action, and deliver results to execute core business strategy.

There is a large number of authors who have conducted research on knowledge management processes. They have proposed various knowledge management processes within the organizational environment. Table 2 presents knowledge management processes according to different authors.

Table 2*Knowledge management processes*

Authors	Year	Knowledge management processes
Nonaka and Takeuchi	1995	Collection, codification and sharing
Davenport and Prusak	1998	Creation, codification, and transfer
Alavi and Leidner	2001	Collection, storage, research/searching, and transfer
Freeze and Robles	2005	Creation, codification, and transfer
Lee et al.	2005	Creation, accumulation, sharing, usage and internalization
Darroch	2005	Acquisition, sharing and responsibility
Park and Kim	2006	Acquisition and usage
Raghu and Vinze	2007	Storage, retrieval, sharing and synthesizing
King et al.	2008	Creation or acquisition; alignment (selection, filtering, purifying) and knowledge optimization for inclusion in various knowledge repositories
Pillania	2008	Creation, spreading and implementation
Sun	2010	Acquiring, creating, applying and sharing
Bahtijarević-Šiber	2014	Acquiring and creating knowledge, storing and preserving knowledge, transferring and sharing knowledge, using and applying knowledge

Source: Author's creation

Based on the presented knowledge management processes, we can identify the core knowledge management processes which intersect across various categories among other authors who have studied knowledge management processes. The core knowledge management processes are:

- Knowledge acquisition,
- Knowledge storage, transfer, and sharing,
- Knowledge application.

Since most authors view knowledge management as a set of processes used to create added value that meets customer needs, it can be concluded that added value cannot be achieved without business processes through which business activities are carried out; activities that are essential for creating that added value. This conclusion prompted the research to determine whether knowledge management processes indeed influence the creation of business processes used to execute strategies, achieve goals, and create added value for customers.

Thus, the knowledge management system begins with the process of knowledge acquisition, which depends on knowledge sources that can be internal (knowledge sources within the organization) and external (knowledge sources outside the organization). To successfully acquire new knowledge, these knowledge sources must continuously interact, with internal knowledge sources being constantly supplemented by acquiring necessary, updated knowledge from external sources. External knowledge sources include customers of the organization's products, services, and works, suppliers, business partners, competitors, and the broader environment. In addition to these, there is another source: the knowledge market, where knowledge can be purchased. New knowledge can be acquired by organizing, combining, and systematizing existing and newly received knowledge from both internal and external sources.

Following the process of knowledge acquisition, it is necessary to store and preserve that knowledge

in a way that allows for the smooth application of knowledge as a strategic resource. The main prerequisite for knowledge storage is knowledge codification, i.e. organizing and formatting knowledge in a unified manner and an understandable language that enables quick and simple access to knowledge for all employees in the organization.

The process of knowledge transfer and sharing involves moving and sharing knowledge from its sources and storage locations to knowledge users. This process is based on direct contact between users who are both recipients and carriers of the required knowledge. In addition to direct contact between individuals (instructor - audience), knowledge can also be transferred via information technology as well as literature containing the required knowledge. Managers play a crucial role in the process of knowledge transfer and sharing, as they must create and continuously develop an infrastructure that encourages and organizes knowledge transfer and sharing.

The processes of storage, transfer, and sharing of knowledge are followed by knowledge application, which represents the primary goal of the knowledge management process, as acquired, stored, and transferred knowledge only makes sense in its practical application. This process is not simple, because one must know how to use knowledge so that its application contributes to creating organizational structures adaptable to the modern business environment. In this case, it is necessary to extract information from knowledge that will have a significant impact on the successful execution of business activities, all with the aim of implementing business processes.

Therefore, knowledge management processes are key factors that determine the successful application of knowledge as a strategic resource used to shape an organizational structure adaptable to the modern business environment.

Overview of Previous Research

There are numerous studies that have examined the relationship between knowledge management and business processes. Presented below are the results of research which confirmed there is a significant connection between knowledge management processes and business processes.

Paschek et al., (2018) emphasize that in the era of digitalization, information has become the primary resource for business. The availability of mass data and cheap information has made knowledge and its utilization an essential activity for companies in the field of knowledge management (KM). They believe that this essential activity forms the foundation of a holistic approach to business process management (BPM), enabling business processes to be managed in the best possible way. The goal of knowledge management is to improve organizational capabilities as the foundation of business processes through better utilization of the organization's individual and collective knowledge resources. Therefore, it is necessary to interconnect business process management (BPM) and knowledge management (KM) to ensure competitiveness in times of rapidly changing baseline conditions and global competition.

Brajer-Marczak (2016) conducted research to determine whether elements of knowledge management improve business processes. She

found that the need to improve business processes currently stems, above all, from shifts in customer expectations and preferences, as well as competitive conditions that are changing faster than ever before. Regardless of the scope of changes taking place in process execution, their improvement requires knowledge resources that can be provided by a knowledge management system. Such integration makes it possible to achieve a synergetic effect by appropriately shaping knowledge resources, which, in turn, can translate into more efficiently implemented processes.

Business process management has a positive impact on knowledge management processes, concluded Bitkowska (2020), who considers that the identification, acquisition, presentation, and documentation of knowledge are not independent tasks, but are implemented within business processes with the goal of improving them. The implementation of knowledge management stimulates employee creativity and supports communication among employees, which significantly contributes to the better execution of business processes. Improved business processes build a process-oriented organization by using best practices and guidelines, thereby minimizing the risk of failure in projects aiming to improve organizational performance and implement knowledge management.

Tabares et al., (2016) propose a way to integrate knowledge management into business process management. Knowledge management is essential as a complement to the implementation of all steps defined in workflows to improve the consistency, coherence, and security of business processes, and subsequently enhance business process performances.

Networked organizations are established to perform specific tasks. Thus, Sobolewska (2020) conducted research finding that a networked organization can be formed by creating network collaboration, which is achieved through an organization's orientation toward both business processes and knowledge management.

Martinez-Martinez et al., (2018) conducted research examining the role of knowledge management as a tool for improving business processes in archaeological museums. The aim of this study was to investigate the importance of knowledge management as a process improvement tool in a context distinct from industrial organizations. An important implication of this paper is the presentation of a methodology for improving museum processes, focusing on reducing errors as well as increasing value for visitors.

Organizations in the modern business environment are placing increasing emphasis on knowledge acquisition, its proper sharing, and its application. Ever since the immense importance of the "knowledge-in-process" approach was recognized, it has become essential to develop systems that support the creation and application of knowledge within business processes. Based on this, Bitkowska (2016) conducted research covering knowledge management and business process management in modern organizations. She concluded that knowledge management in an organization is closely linked to business process management. Identifying, acquiring, presenting, and documenting knowledge are not independent tasks, but core components of economic processes. Therefore, the starting point for managing knowledge resources in an organization is understanding the processes occurring within it. Implementing a knowledge

management process model influences innovation development, stimulates staff creativity, and supports mutual communication, all of which contributes to the improvement of business processes.

Massingham & Moshary, (2017) conducted a study examining how knowledge management can be used to achieve business process improvements by embedding knowledge management within problematic processes. The paper identifies inefficiencies that can occur in workflow and knowledge flow, which are referred to as loss points. A conceptual knowledge management framework is then applied to determine why these loss points exist and how to find solutions. They concluded that knowledge management is embedded into business processes to eliminate loss points, enable the flow of knowledge, and improve workflow efficiency.

Because customer relationship management and artificial intelligence are gaining increasing importance in the modern business environment, Chatterjee et al., (2020) investigated the connection between customer relationship management (CRM) and artificial intelligence (AI) on one hand, and knowledge management (KM) and business processes on the other. The purpose of this paper was to identify the critical success factors for an AI-integrated CRM system aimed at better knowledge management in organizations in order to improve business processes. The study's results showed that top management support is crucial for the successful adoption of an AI-integrated CRM system for better knowledge management and business process improvement.

Martin-Navarro et al., (2025) explored the value of business process management systems (BPMS) for knowledge management from a user perspective.

This study aimed to evaluate the success of using BPMS as a knowledge management system (KMS) by assessing user satisfaction and perceived usefulness. The results confirm that service quality and the quality of information and knowledge significantly impact the use of BPMS as a KMS. This study contributes to new insights by clarifying the impact of service quality on system usage and revealing how this usage affects user satisfaction and the perceived usefulness of BPMS as a KMS. Furthermore, the paper advances theory by reversing the conventional causal order. Specifically, user satisfaction is positioned as a driver rather than a result of perceived usefulness, highlighting that positive user experiences shape perceptions of utility.

A study was also conducted to examine the role of knowledge transfer, knowledge integration, and business process modeling on the efficiency and effectiveness of business processes (Malewska et al., (2025)). The findings indicated that managers should pay attention to the effectiveness of implementing different stages of the knowledge management process, particularly knowledge transfer and integration, as they significantly affect business process efficiency by enabling better resource utilization, faster decision-making, continuous improvement, and adaptation to changing market conditions. Organizations should make greater use of business process modeling to enhance process effectiveness. The proper implementation of knowledge transfer and integration, combined with the use of business process modeling, affects the efficiency of business processes, and consequently, their overall effectiveness.

Berniak-Woźny & Szelągowski (2024) conducted research on business process management (BPM)

and knowledge management (KM) with the goal of identifying dominant themes and development trends within this domain. From a practical business perspective, this study serves as a valuable resource for managers and decision-makers, offering strategic guidelines on integrating BPM and KM within organizational contexts. The thematic research provides practical insights for organizations aiming to optimize the synergy between KM and BPM. Furthermore, this study allows practitioners to understand potential research challenges, limitations, and gaps in integrating business process management and knowledge management. Recognizing the essential interaction between technological advancements, theoretical frameworks, and practical tools becomes imperative for achieving synergy between knowledge and business processes in contemporary organizational settings.

The decision-making process can be improved through the application of knowledge management (KM) and business process management (BPM) activities. Accordingly, Abuezhayeh et al., (2022) conducted a case study within the construction industry in Jordan. A theoretical framework was developed and evaluated through a survey of decision-makers in the construction sector and interviews with experts. The results of this study show that the growing use of knowledge management and business process management, alongside their integration, can provide employees with task-related knowledge within business processes, enhance process performance, promote core competencies, and maximize and optimize business performance. This study provides a tool that enables enhanced decision-making through the application of knowledge and business processes. Most research to date has focused on establishing the mutual connection between business process

management and knowledge management, proving that business processes can run much better if knowledge is embedded into them and used to solve all problems that may arise during process execution. Such improved business processes can also build a successful process-oriented organizational structure. The connection between business process management and knowledge management can create network collaboration, through which a networked organizational structure can also be formed. Business processes can be improved through better knowledge management, which can be achieved by adopting a customer relationship management system integrated with artificial intelligence.

Among the literature exploring the link between business process management and knowledge management, three studies stand out for examining the impact of knowledge management processes on business processes.

Atkočiūnienė et al., (2023) investigated the impact of knowledge management on business processes from value-added creation and sustainability perspectives. The research results confirmed that every knowledge management process (KMP) positively affects individual business processes (BP), with knowledge creation having the most significant impact. The hypothesis that every knowledge management process (KMP) positively influences the value added (VA) created in an organization was partially confirmed, as knowledge sharing and creation had the strongest effect. The study showed that knowledge management processes (KMP) as a whole have a positive effect on business processes (BP), while changing (improving) business processes (BP) increases the value added (VA) created in organizations, with business processes (BP) acting as a mediator in the positive

correlation between knowledge management processes (KMP) and value added (VA). The effectiveness of individual knowledge management processes (KMPs) depends on the size of the organization. As a result, the study confirmed that knowledge management processes (KMP) in organizations cannot be carried out in isolation and must be integrated into business processes (BP) to maximize value added (VA).

In addition to the above, a study was conducted to investigate the impact of knowledge discovery, knowledge acquisition, knowledge sharing, and knowledge application on the effectiveness, efficiency, and innovativeness of business processes, as well as on employee learning, adaptability, and job satisfaction. Based on the reviewed literature and empirical research Hegazy & Ghorab (2014) concluded that knowledge sharing has the greatest impact on business processes and employee benefits. First, supporting knowledge sharing through a corporate portal is positively associated with business process innovation, as well as employee learning and adaptability. Second, supporting knowledge discovery is positively correlated with business process effectiveness, employee learning, adaptability, and job satisfaction, whereas knowledge acquisition is positively associated with business process efficiency, effectiveness, innovation, and employee learning. Finally, support for knowledge application showed the lowest positive correlation with business processes and employee outcomes.

In addition to the aforementioned literature, these three studies served as the foundation for conducting the research in this paper, aimed at determining whether knowledge management processes affect business processes and whether all

knowledge management processes affect business processes equally.

The theoretical contribution of this paper lies in linking two significant fields (knowledge management and business process management) that hold immense importance in the modern business environment. Since knowledge is considered a strategic resource that creates competitive advantage through the application of appropriate knowledge management processes, it is also viewed as the foundation that can serve to improve business processes. By improving business processes, an enterprise can survive in the modern business environment by creating a flexible, process-oriented organizational structure. Knowledge is an abstract concept that loses its meaning and significance without proper application. With the emergence and adoption of knowledge management processes, knowledge began to be utilized as a strategic resource. Knowledge management processes encompass knowledge acquisition, storage, transfer, sharing, and application. On the other hand, business processes comprise an organized group of tasks and activities that work together to transform inputs into outputs, thereby creating value for the customer.

Connecting these two areas, which were previously observed independently, creates a synergistic effect, wherein knowledge management is viewed as a complement to implementing all steps defined in workflows in order to improve the consistency, coherence, and security of business processes, subsequently enhancing business process performance.

Accordingly, knowledge management forms the

foundation of a holistic approach to business process management, enabling business processes to be executed in the best possible manner. The goal of knowledge management is to improve organizational capabilities as the foundation of business processes, through better utilization of the organization's individual and collective knowledge resources.

Thematic research provides practical insights for organizations aiming to optimize the synergy between knowledge management and business process management. This study offers practitioners the opportunity to understand potential research challenges, limitations, and gaps in integrating business process management and knowledge management. The contribution of interconnecting knowledge management and business process management is reflected in an increase in employee knowledge that can be applied to tasks within business processes, thereby improving business process performance, promoting core competencies, and ultimately optimizing overall business performance.

Furthermore, connecting knowledge with business processes significantly contributes to better decision-making.

Empirical Research Methodology

In today's business environment, which is characterized by frequent changes and an increasing number of competitors, enterprises can survive if they shape an organizational structure that can easily adapt to a changing business environment. Based on these characteristics, a process-oriented organizational structure, compared to a functional organizational structure as the most common one, is adaptable to the

modern business environment. Designing a process-oriented organizational structure depends on the implementation of key business processes, which include innovative, manufacturing, and post-sales business processes, as well as all activities taking place within these processes. Since knowledge is considered a strategic resource in enterprises operating in modern business environments, the research in this paper is based on proving the impact of knowledge management processes on the performance of business processes as key components of a process-oriented organizational structure.

To prove the impact of knowledge management processes on business processes, a central research hypothesis and two working hypotheses were formulated in this paper.

Central research hypothesis: "Knowledge management processes affect the performance of business processes."

First working hypothesis: "There is a statistically significant difference among enterprises in measuring business process performance depending on the application of knowledge management processes."

Second working hypothesis: "Knowledge management processes equally affect the performance of business processes."

To prove the impact of knowledge management processes and activities on business processes, appropriate statistical methods were applied: namely, the Kruskal-Wallis test as a non-parametric hypothesis testing technique, and multiple regression analysis.

The population in this research consists of medium

and large enterprises in Bosnia and Herzegovina belonging to knowledge-based economic activities. There are two reasons why large and medium enterprises in Bosnia and Herzegovina were selected for this study:

1. A larger number of employees.
2. A simpler process of designing a process-oriented organizational structure in large and medium enterprises, which consists of a higher number of business activities.

In accordance with the Law on Accounting and Auditing, enterprises were classified by size using the following criteria: the average value of business assets, total annual revenue, and the average number of employees. When determining knowledge-based economic activities, data from the Statistical Office of the European Communities (Eurostat) was used. Eurostat published Annex 3 - High-tech aggregation by NACE Rev. 2¹, in which it classified manufacturing industries according to their level of technological development. Within Annex 3 - High-tech aggregation by NACE Rev.2, Eurostat also defines knowledge-based service activities, as well as those service activities that are least knowledge-based, in a similar manner to manufacturing activities. The structure of the Classification of Economic Activities of Bosnia and Herzegovina KD 2010 by sector is fully aligned with the new version of NACE Rev. 2 (adapted from the EU NACE classification, chronology of development, and links between NACE Rev. 2 and

other classifications).

Thus, the total number of large and medium enterprises from knowledge-based manufacturing and service sectors in Bosnia and Herzegovina is presented in Table 3.

Table 3

Large and Medium-Sized Knowledge-Based Manufacturing and Service Enterprises in Bosnia and Herzegovina

No.	Type of Activity	Enterprises in Bosnia and Herzegovina
1	Manufacturing activities	523
2	Service activities	646
Total Number of Enterprises		1,169

Source: Authors

The total number of enterprises in this research is 1,169. Since the enterprises in the population are classified by type of activity, the research sample is formed accordingly, possessing all the characteristics of a stratified random sample.

The estimation of the sample size was carried out using the Raosoft calculator (www.raosoft.com/samplesize.html), which is used to estimate sample size. By applying the Raosoft calculator and entering the population value of 1,169 large and medium-sized B&H enterprises, the recommended sample size is 290 enterprises, with a 95% confidence level and a 5% margin of error. The stratified random sample is presented in Table 4.

¹ The abbreviation NACE (General Industrial Classification of Economic Activities within the European Communities) is an acronym used to designate various versions of statistical classifications of economic activities developed in the European Union since 1970. Since that period, NACE has undergone

several revisions: the revised version, called NACE Rev. 1, was established in 1990; a slightly updated version, NACE Rev. 1.1, was established in 2002; and the new NACE Rev. 2 was established in 2008 and remains in use today.

Table 4*Stratified random sample*

No.	Type of activity	Enterprises in Bosnia and Herzegovina
1	Manufacturing activities	130
2	Service activities	160
Total Number of Enterprises		290

Source: Authors

The total number of enterprises in the stratified sample is 290, consisting of 130 manufacturing enterprises and 160 service enterprises.

Conducting any research requires the collection of data, which is subsequently processed using appropriate methods. Accordingly, data collection within this research is carried out using a questionnaire as a research instrument. The questions in the questionnaire were designed based on previous research, from which relevant data and insights available in the literature are derived.

The questionnaire consists of three parts: the first part contains general information about the enterprise and the respondents, the second part contains questions related to knowledge management processes, and the third part consists of questions measuring business processes. Within the questionnaire, the questions were presented using a Likert scale with the aim of determining the respondents' level of agreement with specific statements. After designing the questionnaire, the reliability of the measuring instrument is determined to evaluate how well the selected variables and their component statements represent the intended concept (measuring instrument), whether they measure it at all in the

way the researcher believes they should, and whether a set of specific variables (a construct) can be considered a measuring instrument or a measurement scale. All of the above can be established by testing the reliability of the proposed measuring instrument.

The Cronbach's alpha coefficient represents, as previously mentioned, a measure of the internal consistency of a set of statements and can take values between 0 and 1; the closer this coefficient is to the value of 1, the more reliable the measurement scale is. The remainder of this section presents the reliability results of the measuring instrument used, which was determined by applying Cronbach's alpha coefficient to each domain, i.e., each sub-scale of the measuring instrument.

Table 5*Cronbach's Alpha Coefficient Values for Knowledge Management Processes and Business Processes*

No.	Section Title of the Questionnaire	Cronbach Alpha's value
1.	Knowledge Management Processes	
1.1.	Knowledge acquisition process	0.871
1.2.	Knowledge storage, transfer and sharing process	0.942
1.3.	Knowledge application process	0.942
2.	Business Processes	0.958

Source: Authors

Based on the reliability coefficient values (Cronbach's alpha coefficients) shown for all subscales within the measurement scales of knowledge management processes and business

processes which are integral parts of the questionnaire, it can be concluded that the questionnaire used for data collection represents a highly reliable measuring instrument.

After designing the questionnaire and establishing its reliability as a measuring instrument, the questionnaires were forwarded to large and medium-sized enterprises to be completed.

Out of a total of 290 enterprises that constituted the research sample, only 153 enterprises returned the completed questionnaires. Table 6 shows the number of enterprises that participated in the research relative to the total number of enterprises in the population and the stratified sample.

Table 6

Total number of enterprises that participated in the research relative to the population and stratified sample

No.	Type of Activity	Total Number of Enterprises		
		Population	Stratified Sample	Research Participants
1	Production Activities	523	130	55
2	Service Activities	646	160	98
Total		1,169	290	153
Representation of enterprises in the research		13.09	52.76	100.00

Source: Authors

Table 7

Basic characteristics of enterprises

No.	Basic characteristics of enterprises	Number and structure of enterprises	
		f	%
1	Type of enterprise activity		
1.1.	Manufacturing industry	55	35.95
1.2.	Information and communication	32	20.91
1.3.	Financial and insurance activities	19	12.42
1.4.	Professional, scientific and technical activities	41	26.80
1.5.	Administrative and support service activities	6	3.92
	TOTAL	153	100.00
2	Method of establishment and types of enterprise capital		
2.1.	Private/own capital	75	49.02
2.2.	Joint venture with a domestic partner	12	7.84
2.3.	Joint venture with a foreign partner	15	9.81
2.4.	State capital	11	7.19
2.5.	Foreign capital	40	26.14
	TOTAL	153	100.00
3	Years in operation		
3.1.	Less than 5 years	7	4.58
3.2.	5-10 years	24	15.69
3.3.	11-15 years	18	11.76
3.4.	16-20 years	20	13.07
3.5.	More than 20 years	84	54.90
	TOTAL	153	100.00

Continuation of Table 7*Basic characteristics of enterprises*

No.	Basic characteristics of enterprises	Number and structure of enterprises	
4	Market type		
4.1.	Domestic market	49	32.03
4.2.	Domestic and foreign market	86	56.21
4.3.	Foreign market	18	11.76
	TOTAL	153	100.00

Source: Authors

The total number of enterprises that participated in the research is 153. Relative to the total number of enterprises in the population, only 13.09% of enterprises participated in the research, whereas relative to the stratified sample, 52.76% of enterprises participated in the research.

Prior to applying statistical methods to test the established hypotheses, the basic characteristics of the enterprises and respondents were presented.

The basic characteristics of the enterprises are the type of activity, method of establishment, types of enterprise capital, length of existence of the enterprise, and market types. Table 7 presents the basic characteristics of the enterprises.

If we compare the number of production and service enterprises that participated in the research, it can be concluded that the majority of

enterprises belong to service activities (98 enterprises), while 55 enterprises belong to the knowledge-based manufacturing sector. The highest number of participating enterprises was founded using private capital and has been operating for a period between 5 and 20 years, indicating that these companies were established within the context of the modern business environment. Most enterprises operate in both domestic and foreign markets, in order to place their products, these companies need to follow modern business trends and innovate accordingly to meet the diverse needs of consumers in both markets.

Following the presentation of the basic characteristics of the enterprises, the basic characteristics of the respondents are also presented. Table 8 displays the basic characteristics of the respondents.

Table 8*Basic Characteristics of Respondents*

No.	Basic characteristics of respondents	Number and structure of respondents					
		Male		Female		Total	
		f	%	f	%	f	%
1	Gender and age of respondents						
1.1.	Up to 30 years old	15	14.56	8	16.00	23	15,03
1.2.	31-40 years old	52	50.49	24	48.00	76	49,68
1.3.	41-50 years old	27	26.21	15	30.00	42	27,45
1.4.	Over 50 years old	9	8.74	3	6.00	12	7,84
	TOTAL	103	100.00	50	100.00	153	100.00

Continuation of Table 8*Basic Characteristics of Respondents*

No.	Basic characteristics of respondents	Number and structure of respondents					
2	Gender and education level of respondents						
2.1.	Higher education	5	4.85	0	0.00	5	3,27
2.2.	University degree	64	62.14	27	54.00	91	59,48
2.3.	Master's degree	24	23.30	13	26.00	37	24,18
2.4.	Master of science	8	7.77	9	18.00	17	11,11
2.5.	Doctorate (Ph.D)	2	1.94	1	2.00	3	1,96
TOTAL		103	100.00	50	100.00	153	100.00
3.	Gender and position of respondents						
3.1.	Top management	52	50.49	18	36.00	70	45,75
3.2.	Middle management level	34	33.01	21	42.00	55	35,95
3.3.	Lower management level	6	5.82	4	8.00	10	6,54
3.4.	Non-managerial positions	11	10.68	7	14.00	18	11,76
TOTAL		103	100,00	50	100.00	153	100.00
4	Gender and length of work experience						
4.1.	Less than 5 years	9	8.74	4	8.00	13	8,50
4.2.	5-10 years	31	30.09	13	26.00	44	28,76
4.3.	11-15 years	23	22.33	12	24.00	35	22,87
4.4.	16-20 years	20	19.42	8	16.00	28	18,30
4.5.	Over 20 years	20	19.42	13	26.00	33	21,57
TOTAL		103	100,00	50	100.00	153	100.00

Source: Authors

The largest number of respondents (103 or 67.32%) are male, while a smaller number of respondents (50 or 32.68%) are female. The most numerous group of respondents consists of young to middle-aged people who hold a university degree, a master's degree, or a Master of Science degree. The largest number of respondents (135 or 88.24%) perform managerial positions at the top, middle, and lower levels of management. The smallest number of respondents (18 or 11.76%) perform non-managerial tasks. The majority of respondents (107 or 69.93%) have between 5 and 20 years of work experience, a smaller number (33 or 21.57%) have over 20 years of work experience, while the smallest number (13 or 8.50%) have less than 5 years of work experience.

The basic characteristics of the enterprises and the respondents show that the research was conducted

in companies operating in a modern business environment and that the respondents who participated in the study possess sufficient knowledge and expertise to provide objective answers to the questions posed.

Results and Discussion

In the modern business environment, the only organizations that can survive are those that emphasize the establishment and improvement of business processes which form the foundation of a process-based organizational structure. Key business processes can be established by applying knowledge as a strategic resource in knowledge-based enterprises.

To demonstrate the impact of knowledge management processes and activities on the

performance of key business processes, appropriate statistical methods were applied, specifically the Kruskal-Wallis test as a non-parametric hypothesis testing technique, and multiple regression analysis. The application of the Kruskal-Wallis test requires classifying companies into three groups ("possesses," "undecided," and "does not possess"). The group named "possesses" includes all companies that agreed or strongly agreed with the

majority of statements regarding the knowledge management process in the survey questionnaire. Companies that neither agreed nor disagreed with the majority of statements were classified into the group named "undecided." The group named "does not possess" includes all companies that disagreed or strongly disagreed with the majority of statements. Table 9 shows the companies categorized into these three groups.

Table 9

Classification of Companies by Group

Group Name	Knowledge management process					
	Knowledge Acquisition		Storage, Transfer and Sharing of Knowledge		Knowledge Application	
	f	%	f	%	f	%
Does not possess	13	8.50	11	7.19	6	3.92
Undecided	20	13.07	16	10.46	15	9.80
Possesses	120	78.43	126	82.35	132	86.27
TOTAL	153	100.00	153	100.00	153	100.00

Source: Authors

According to the data presented in the table, it can be concluded that the largest number of companies possess knowledge management processes, a significantly smaller number of companies have an undecided attitude toward knowledge management processes, while the smallest number of companies do not possess knowledge management processes. The primary objective of classifying companies into three groups is to determine whether there is a statistically significant difference in measuring business process performance among companies that possess, do not possess, or have an undecided attitude toward knowledge management processes.

Since the companies are classified into three ranks whose attitudes were measured using an ordinal measurement scale and originate from a population with an unknown distribution shape, the conditions for applying a non-parametric test are met, specifically the Kruskal-Wallis test, which serves as a non-parametric alternative to one-way analysis of variance. The results of applying the Kruskal-Wallis test, which demonstrates the existence of a statistically significant difference in measuring business process performance depending on the implementation of knowledge management processes, are presented in Table 10.

Table 10

Results of the Kruskal-Wallis Test for the Subscales of Knowledge Acquisition, Storage, Transfer, Knowledge Sharing, Knowledge Application, and Business Process Performance

No.	Knowledge Management Process		Indicators of the relationship between knowledge management process and business process performance			
			$\mu \pm \sigma$	K-W test	df	p
1	Knowledge Acquisition Process	Does not possess	86.00 $\pm$ 19.27	27.41	2	0.000
		Undecided	97.90 $\pm$ 18.72			
		Possesses	109.73 $\pm$ 15.59			
		Total	106.16 $\pm$ 17.81			
2	Knowledge Storage, Transfer, and Sharing Process	Does not possess	83.00 $\pm$ 27.07	20.20	2	0.000
		Undecided	100.13 $\pm$ 12.42			
		Possesses	108.95 $\pm$ 15.78			
		Total	106.16 $\pm$ 17.81			
3	Knowledge Application Process	Does not possess	83.17 $\pm$ 30.18	14.05	2	0.001
		Undecided	94.33 $\pm$ 19.97			
		Possesses	108.55 $\pm$ 15.64			
		Total	106.16 $\pm$ 17.81			

Source: Authors

Looking at the results presented in Table 10, it can be concluded that business process performance shows a statistically significant difference ($p=0.000$, $p=0.000$, $p=0.001$ where $p<0.05$) among companies that possess, do not possess, or are undecided regarding knowledge management processes. Accordingly, companies that possess the processes of knowledge acquisition, storage, transfer, and sharing, as well as knowledge application, achieve the highest overall rating scores (109.73, 108.95 and 108.55) related to business process performance. If companies hold an undecided attitude toward the processes of knowledge acquisition, storage, transfer, and sharing, as well as knowledge application, they have lower overall rating score values (97.90, 100.13 and 94.33). The lowest overall rating scores (86.00,

83.00 and 83.17) are found in companies that do not possess the processes of knowledge acquisition, storage, transfer, and sharing, or knowledge application.

Based on everything stated so far, it can clearly be concluded that there is a statistically significant difference in measuring business process performance among companies that possess, are undecided about, or do not possess knowledge management processes. Although the application of the non-parametric Kruskal-Wallis test showed that the processes of acquiring, storing, transferring, sharing, and applying knowledge contribute to improving business process performances, multiple regression analysis was also applied. Multiple regression analysis was conducted to determine

which of the knowledge management processes has the greatest impact on business process performance.

Thus, the regression model describes the impact of the knowledge management process on business process performance. Table 11 provides an overview of the significance of this regression model.

Table 11

Significance of the Regression Model of Knowledge Management Process and Business Process Performance

	R	R²	F	df	p
Model	0.593	0.352	20.10	(4; 148)	0.000
Independent variables (predictors): Knowledge acquisition, Storage, Transfer and Sharing; Knowledge Application					
Dependent variable: Business process performances					

Note: R - correlation coefficient; R² - coefficient of determination

Source : Authors

The regression model representing the relationship between the knowledge management process and the business process performance subscale is statistically significant, as shown by the data presented in Table 11 ($F(4, 148)=20.10$, $p=0.000$, $p<0.001$). The representativeness of the regression model is proven by the value of the coefficient of determination (R^2), which shows that 35.20% of the variance in business process performance is explained by the joint impact of knowledge management processes as a set of independent (predictor) variables. Table 12 shows the values of the regression coefficients, based on which it can be determined whether the set of knowledge management processes actually impacts business process performances.

Table 12

Values of Regression Coefficients

Predictors	B	se (B)	β	t	p
Constant	36.96	7.81		4.73	0.000
Knowledge acquisition	0.19	0.27	0.09	0.70	0.484
Knowledge storage, transfer and sharing	0.09	0.15	0.07	0.59	0.558
Knowledge application	0.81	0.27	0.35	2.96	0.004
Independent variables (predictors): Knowledge acquisition; Knowledge Storage, Transfer and Sharing; Knowledge Application					
Dependent variable: Business process performances					

Note: B – unstandardized regression coefficient, se (B) - standard error of the unstandardized regression coefficients, β – standardized regression coefficients, t - t-statistic, p - p-value

Source: Authors

Based on the values of the regression coefficients shown in Table 12, it can be concluded that one subscale of the knowledge management process makes a unique and statistically significant contribution ($p<0.05$) to explaining business process performances. Specifically, the process of knowledge application has the largest statistically significant impact on business process performances, with the highest regression coefficient value ($\beta=0.35$; $p=0.004$, $p<0.05$). The other two knowledge management processes (knowledge acquisition and knowledge storage, transfer, and sharing) do not have a unique, statistically significant impact on the variation of business process performances, as shown by their regression coefficient values (knowledge acquisition: $\beta=0.09$; $p=0.484$, $p>0.05$; and knowledge storage, transfer, and sharing: $\beta=0.07$; $p=0.558$, $p>0.05$). Based on all of the above, it can be concluded that only the process of knowledge application has a statistically significant impact on

business process performances, whereas the processes of acquiring, storing, transferring, and sharing knowledge do not demonstrate a statistically significant impact.

Conclusion

In the modern business environment characterized by daily changes related to the emergence of globalization, technological development, the rise of the knowledge economy, hyper-competition, and demands for socially responsible business practices, the only enterprises that can survive are those who improve their business processes by applying knowledge as a strategic resource. One of the organizational structures based on business processes that can respond quite well to the demands of the business environment is the process-oriented organizational structure. Since this concerns a modern business environment in which knowledge becomes a strategic resource along with the adaptability of the organizational structure to environmental conditions, the research was conducted in large and medium-sized enterprises engaged in knowledge-based activities in Bosnia and Herzegovina. The data collected in the study show that the largest number of these enterprises were founded with domestic and foreign capital who have existed for over 20 years, and operate on both domestic and foreign markets. All these enterprise characteristics indicate that these are companies operating within a modern business environment and delivering their products/services to both domestic and foreign markets. Since a large number of enterprises market their products/services domestically and internationally, it can be concluded that these companies conduct research and development, generate innovation, and apply knowledge to produce products and provide services that meet the needs and desires of

customers in domestic and foreign markets. The key characteristics of the respondents show that the majority are male, young to middle-aged, and predominantly hold a university degree, a master's degree, or a Master of Science degree. The highest number of respondents perform managerial duties at top, middle, and lower management levels. In addition, the largest number of respondents have between 5 and 20 years of work experience. All these characteristics lead to the conclusion that the respondents possess sufficient knowledge, competence, and experience to provide accurate and objective answers to the questionnaire items. The main goal of the research is to determine whether knowledge management processes affect the performance of business processes that form the basis of a process-oriented organizational structure.

In order to prove the main goal of the research, a central research hypothesis was formulated: "Knowledge management processes affect the performances of business processes."

To prove the central research hypothesis, two working hypotheses were established:

The first working hypothesis states: "There is a statistically significant difference between enterprises in measuring the performance of business processes depending on the application of knowledge management processes."

This hypothesis was tested using the non-parametric Kruskal-Wallis test, which aimed to determine a statistically significant difference in measuring the performance of business processes among enterprises that possess, are undecided about, or do not possess knowledge management processes.

Based on the research results, it can be concluded that enterprises with established knowledge management processes have the highest average overall score regarding the measurement of business process performance. A lower average overall score for measuring business process performance is found in enterprises that are undecided regarding knowledge management processes. The lowest average overall score is held by enterprises that do not possess knowledge management processes. Therefore, the first working hypothesis is confirmed, as it was shown that companies with knowledge management processes measure business process performances to a greater extent.

The second working hypothesis reads: "Knowledge management processes equally affect business process performance."

This hypothesis was tested using multiple regression analysis which aimed to determine the individual impact of knowledge management processes on business process performances. Based on the processed data, it can be concluded that among all knowledge management processes, only the knowledge application process has a unique and statistically significant impact on business process performance. The other two processes, knowledge acquisition process and knowledge storage, transfer, and sharing process, do not have a statistically significant impact on business process performances. Therefore, the second working hypothesis was rejected, as it was established that knowledge management processes do not have an equal impact on business process performance.

However, an entirely new conclusion can be reached if the overall knowledge management process is considered as a whole, wherein the knowledge

application process cannot exist without the preceding processes of knowledge acquisition, as well as knowledge storage, transfer, and sharing. Based on this, knowledge management processes affect business process performances in such a way that the knowledge application process has a direct impact on business process performance, while the acquisition processes and the storage, transfer, and sharing processes have an indirect impact through the application process.

From everything stated so far, it can be concluded that the central research hypothesis has been confirmed, and that knowledge management processes affect business process performance in large and medium-sized enterprises in Bosnia and Herzegovina whose activities are knowledge-based.

During the conduct of this research, certain limitations emerged, including:

- The research did not include medium and large Bosnian and Herzegovinian enterprises engaged in other types of activities.
- Not all enterprises in the research sample answered the survey questionnaire, but only a portion of them.
- Only one employee in each enterprise (most of ten a manager) answered the survey questionnaire.

In addition to these limitations, there are recommendations for future research, which include:

- Observing manufacturing and service enterprises separately to determine which group places greater emphasis on knowledge management processes and their impact on business process performances.

- Determining which specific types of manufacturing and service activities apply knowledge management processes the most and what is their impact on business process performance.
- Conducting research in medium and large enterprises engaged in other types of activities to determine whether these enterprises use knowledge management processes and whether these processes impact business process performance.
- In addition to knowledge as a strategic resource, observing other organizational factors and their impact on business process performance to determine whether knowledge or other factors truly contribute to creating the business processes that form the basis of a process-oriented organizational structure.

The significance of this paper is reflected in finding ways in which enterprises can shape a process-based organizational structure founded on the application of business processes that are focused on creating added value for customers. Compared to other organizational structures, the process-based organizational structure is widely applied in organizations because it can serve as a supplement to a functional or some other organizational structure.

Based on the data presented in the paper, it can be concluded that enterprises possessing knowledge management processes also have better-developed business process performance compared to enterprises that are undecided or do not possess knowledge management processes. Enterprises that wish to improve business process performance in order to survive in the modern business

environment should introduce and develop knowledge management processes.

This paper provides a significant contribution in practical terms because it helps enterprises understand how they can survive in the modern business environment. Thus, enterprises focusing on the implementation and improvement of business processes should first work on applying knowledge management processes that contribute to the improvement of business processes. Knowledge as a strategic resource can only be applied through knowledge management processes, specifically the process of knowledge acquisition, the process of knowledge storage, transfer, and sharing, as well as the process of knowledge application. If knowledge management processes are not applied, knowledge remains an abstract concept that finds its role in theory but not in practice. The practical implications of this paper are reflected in the fact that knowledge is increasingly being applied for practical purposes with the aim of improving business processes and, consequently, the enterprise's overall business. Enterprises that do not apply knowledge management processes or have an undecided attitude toward knowledge management processes do not have developed business processes either; therefore, their success in the modern business environment is unfavorable. The process of knowledge application contributes the most to improving business process performance. Enterprises seeking to advance their operations and enhance business process performance should apply knowledge. In practical terms, the application of knowledge also depends on other knowledge management processes. Thus, knowledge cannot be applied if it is not acquired, stored, transferred, and shared. Therefore, enterprises must first work on knowledge

management processes related to knowledge this knowledge can be applied to improve business acquisition, storage, transfer, and sharing so that processes.

Data Availability: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Vpliv procesov upravljanja z znanjem na poslovne procese kot temelj procesno usmerjene organizacijske strukture

Izvleček

V sodobnem poslovnem okolju vloga znanja postaja vse pomembnejša, zlasti z nastankom in razvojem gospodarstva znanja, ki je nadomestilo gospodarstvo industrije. Zato znanje postaja ključni vir, od katerega je odvisno delovanje podjetja. Z uporabo znanja kot strateškega vira podjetja oblikujejo ustrezno organizacijsko strukturo. Glavni cilj tega članka je ugotoviti vpliv procesov upravljanja znanja na uspešnost poslovnih procesov kot temelja procesno usmerjene organizacijske strukture v srednjih in velikih podjetjih v Bosni in Hercegovini, ki delujejo v na znanju temelječih panogah. Za doseg tega cilja sta bila uporabljena neparametrični Kruskal–Wallisov test in analiza multiple regresije. Rezultati raziskave so pokazali, da procesi upravljanja znanja dejansko vplivajo na uspešnost poslovnih procesov, ki tvorijo temelj procesno usmerjene organizacijske strukture. Vrednost tega članka je v dejstvu, da se znanje vse bolj uporablja v praksi z namenom izboljšanja poslovnih procesov in posledično splošne poslovne uspešnosti.

Ključne besede: poslovno okolje, upravljanje z znanjem, procesno usmerjena organizacijska struktura

The Impact of Educational Standards on Sustainable Development in Slovenian Local Communities

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Abstract

The article examines the role of municipalities in linking education, local economic development, and sustainable development. The quantitative study, involving 149 Slovenian municipalities, analyses associations between different forms of municipal engagement in education and selected socio-economic, institutional, and strategic characteristics of local communities. The findings do not confirm a statistically significant association between municipal cooperation in educational programme development and lower unemployment, nor do they support the assumption that city municipalities exert greater influence on educational programme development. By contrast, statistically significant associations are identified between selected forms of municipal co-financing of education and growth in the number of business entities, and between strategic sustainable-development documents and stronger cooperation among municipalities, educational institutions, and businesses. The findings suggest that municipalities' role in education should be understood primarily through strategic planning, stakeholder coordination, and institutional cooperation rather than as a direct causal determinant of socio-economic outcomes.

Introduction

Local communities have long been acknowledged as vital agents in shaping broader societal development. In the specific context of Slovenia, municipalities (občine) constitute the central tier of local self-government and therefore represent an important institutional framework through which economic, social, and developmental policies can be implemented. As basic units of local governance, municipalities possess administrative structures and decision-making capacities that allow them to influence the development trajectories of their communities. Their role is particularly relevant in areas such as spatial planning, local infrastructure development, public services, cooperation with economic actors, and the creation of institutional conditions conducive to local economic activity. Consequently, municipalities hold considerable potential for contributing to sustainable economic and social development within their territorial boundaries (Haček & Kukovič, 2023). From an economic perspective, their capacity to connect local development priorities with education, skills formation, and the needs of local businesses may be particularly important for strengthening human capital, supporting entrepreneurship, and enhancing the long-term developmental capacity of local communities.

Despite this institutional importance, the relationship between municipalities, educational institutions, and broader development processes has often remained insufficiently explored in both Slovenian and international scholarly literature. In many cases, education policy is treated primarily as a national policy domain, governed through centralised legislation, national curricula, and state-level institutions. Such an approach tends to overlook the potential role of local actors in

supporting educational opportunities and institutional cooperation in ways that respond to the specific developmental needs of local economies and communities. This gap is particularly relevant from the perspective of sustainable local development, where education should not be viewed solely as a public service but also as a component of local human-capital formation, institutional capacity, and economic resilience. The present study addresses this gap by examining whether and how Slovenian municipalities collaborate with educational institutions and economic actors and how such engagement is associated with selected dimensions of local socio-economic development.

In the international literature, several theoretical perspectives illuminate the nexus between local governance and education. Some scholars emphasise the importance of centralised educational systems that ensure uniform standards, quality assurance, and equality of access across regions (Spring, 2015). Others highlight the potential benefits of decentralised educational governance, arguing that greater involvement of local actors may allow education systems to become more responsive to local labour-market needs, economic structures, and demographic dynamics (Steiner-Khamisi, 2014). From this perspective, local authorities may act as mediators between the education system and local economic actors, thereby facilitating stronger alignment between educational provision and local development priorities. The present study adopts the view that these perspectives should not necessarily be treated as mutually exclusive. Nationally defined educational standards and stronger local responsiveness may perform complementary functions: the former can safeguard quality and comparability, while the latter can facilitate

adaptation to specific socio-economic conditions and development needs.

Slovenia represents a particularly interesting case in this regard. The country is characterised by a relatively small territorial scale, a high degree of municipal fragmentation, and the absence of formally established regional governments (*pokrajine*). Instead, municipalities serve as the primary level of territorial self-government. At the same time, the Slovenian education system remains largely centralised, with curricula, programme accreditation, and educational standards predominantly determined at the national level. This institutional arrangement creates a structural tension between local development needs and nationally defined educational policies. Municipalities may recognise the importance of education for local development, yet their formal competencies in shaping educational programmes remain limited (Zgaga, 2014). This makes Slovenia a useful setting for examining whether local authorities can nevertheless contribute to education-related development through coordination, financing, strategic planning, and stakeholder cooperation rather than through formal control over educational standards or curricula. Nevertheless, municipalities can play an important role in supporting education through indirect mechanisms. These include collaboration with educational institutions, co-financing of educational programmes, support for vocational training initiatives, and partnerships with local businesses. Through such activities, municipalities may contribute to creating educational opportunities that correspond more closely to local economic structures and labour-market needs. However, the existence of such mechanisms does not necessarily imply direct or uniform socio-economic effects. The relationship between

municipal engagement in education and local development is likely to depend on institutional capacity, strategic planning, local economic conditions, and the forms of cooperation established among municipalities, educational institutions, and economic actors. Accordingly, municipal engagement in education is conceptualised in this study not as an isolated policy intervention expected to produce immediate economic outcomes, but as one component of a broader local governance environment in which education, human capital, institutional cooperation, and economic development interact.

The overarching aim of this paper is to examine the relationship between municipal involvement in education and selected socio-economic and institutional characteristics of Slovenian municipalities. More specifically, the study explores how cooperation between municipalities, educational institutions, and local economic actors is associated with different dimensions of sustainable local development. The analysis focuses on several interrelated dimensions. First, the study investigates theoretical perspectives on local self-government, including institutional arrangements, governance structures, and the legislative framework shaping municipal responsibilities. Second, it explores the conceptual foundations of education and its relevance for sustainable local development. Third, it develops an empirical framework for analysing associations between municipal participation in the development and financing of educational programmes and selected local development indicators. Finally, the study examines the role of municipalities as actors in identifying local educational needs, facilitating stakeholder cooperation, and supporting local human-capital development. Particular attention is paid to whether these forms of municipal

engagement are associated with economically relevant local outcomes and conditions, including unemployment, business development, and the institutional capacity to coordinate local development processes.

In pursuing these objectives, the paper draws upon theoretical and empirical insights from previous research on sustainable development, local governance, and education policy. Studies on sustainable development emphasise the importance of integrating economic, social, and environmental dimensions of development in order to achieve long-term societal resilience (Rivera Maulucci et al., 2023; Li & Huang, 2024). Research on local governance highlights the role of local stakeholders, institutional cooperation, and community engagement in promoting balanced development (Dollery et al., 2011). Furthermore, analyses of decentralisation processes in Slovenia demonstrate that municipalities often operate under institutional constraints that limit their direct influence over national policy domains such as education (Dubajić, 2010; Vlaj, 2012). Taken together, these strands of scholarship suggest that the developmental relevance of municipalities may depend less on the extent of their formal authority over education and more on their capacity to coordinate actors, mobilise resources, identify local needs, and integrate education into wider development strategies. This constitutes the conceptual position adopted in the present study. By combining these strands of scholarship, the study seeks to contribute to the broader debate on how local governance structures can support sustainable socio-economic development through strategic engagement with education.

Against this theoretical background, the central research question guiding this study is the

following: To what extent is municipal involvement in the development and financing of educational programmes associated with selected dimensions of sustainable socio-economic development and institutional cooperation in Slovenian local communities?

Addressing this question requires the analysis of both institutional practices and selected development indicators. The study therefore examines whether different forms of municipal engagement in education are associated with unemployment, growth in the number of business entities, municipal type and institutional capacity, and the existence of strategic sustainable-development documents. Particular attention is devoted to distinguishing between statistical association and causal influence, as the cross-sectional research design does not permit causal inference. This distinction is particularly important when assessing the economic implications of municipal educational engagement, since local economic outcomes are shaped by multiple interacting structural, demographic, institutional, and regional factors.

By analysing these relationships, the study aims to fill an important gap in both Slovenian and international research. While numerous studies examine national education policies or regional economic development, relatively few focus specifically on the interaction between local self-government and education systems. Even less attention has been devoted to empirically examining whether specific forms of municipal educational engagement are associated with measurable socio-economic and institutional characteristics at the local level. Slovenia's municipal structure provides an opportunity to examine how local governance institutions can

participate in education-related processes even within a predominantly centralised educational system. Insights derived from this case may therefore be relevant not only for Slovenia but also for other small states and governance systems seeking to strengthen the role of local actors in education-related development processes (Machonin, 1997; Cingula et al., 2010). The contribution of the study is therefore both empirical and conceptual: empirically, it provides evidence from a nationwide survey covering more than 70% of Slovenian municipalities; conceptually, it examines municipal engagement in education as a form of strategic local governance rather than simply as an extension of formal educational authority.

The remainder of the paper is structured as follows. Following this introductory section, the paper presents a contextual overview of local self-government in Slovenia and reviews the relevant literature on education and sustainable local development. The subsequent section outlines the research question, develops testable hypotheses, and describes the methodological approach used in the empirical analysis. The results section then presents the empirical findings of the nationwide survey of Slovenian municipalities and reports the outcomes of hypothesis testing. A separate discussion section interprets these findings in relation to the theoretical framework and previous research, with particular attention to their economic, institutional, and practical implications. The concluding section summarises the main contributions of the study, acknowledges its limitations, and identifies directions for future research.

Literature Review

Local Self-Government in Slovenia

The roots of local self-government in the territory of present-day Slovenia date back to the mid-19th century, when municipalities were first established as administrative units within the Austro-Hungarian Empire. Over time, these structures evolved through different political systems, including the Kingdom of Yugoslavia and the Socialist Federal Republic of Yugoslavia, eventually transforming into the current system of municipalities following Slovenia's independence in 1991 (Grafenauer, 2000). In the process of democratic transition and institutional reform, Slovenia adopted a parliamentary system and began restructuring its local governance framework in accordance with European standards of local self-government (Trpin & Grafenauer, 2002).

The contemporary system of local governance in Slovenia is based on the Constitution of the Republic of Slovenia and the Act on Local Self-Government (*Zakon o lokalni samoupravi*), which grants municipalities a relatively high degree of autonomy in managing local affairs (Dubajić, 2010). Municipalities are responsible for a broad range of local public services, including spatial planning, communal infrastructure, social services, cultural activities, and certain aspects of education policy. Although these responsibilities provide municipalities with opportunities to influence local development processes, their institutional capacity varies considerably depending on factors such as population size, financial resources, administrative structures, and specialised human resources.

One of the distinctive characteristics of the Slovenian territorial governance system is the absence of formally established regions. As a result, municipalities represent the primary level of decentralised governance. This institutional arrangement has generated ongoing debates about the effectiveness and efficiency of Slovenia's single-tier local self-government system. The proliferation of relatively small municipalities—many with fewer than 5,000 inhabitants—raises questions about fiscal capacity, administrative professionalism, and the ability of local authorities to design and implement comprehensive development strategies.

Recent international research reinforces the importance of administrative capacity in explaining differences in the ability of local governments to translate sustainable-development objectives into effective strategies. Annesi et al. (2025), examining the integration of the Sustainable Development Goals (SDGs) into municipal strategic processes, identify spending capacity, specialised human capital, sustainability-oriented performance measurement, and political stability as important conditions supporting effective sustainability planning. Their findings indicate that administrative capacity should not be understood as a single organisational characteristic but as a combination of financial, human, managerial, and political resources.

This perspective is particularly relevant to Slovenia, where substantial differences in municipal size and resources coexist within a common national institutional framework. Previous research on local development planning in Slovenia shows that some municipalities have adopted sustainable-development strategies, yet their implementation is often weak. Deželan et al. (2014) argue that such strategies should be concise, based on clear and

objectively defined goals, linked to realistic municipal budgets and resources, and accompanied by precise implementation measures and clearly assigned responsibilities. They further emphasise that local authorities should coordinate planning processes, promote the sustainable use of resources, and ensure the participation of affected stakeholders in local development decision-making (pp. 551–553, 571).

More recent evidence suggests that the challenge is not merely whether local authorities adopt strategic sustainability documents, but whether they possess the institutional capacity to translate those documents into coordinated action. Ortiz-Moya and Yang (2025), drawing on 151 voluntary local reviews, demonstrate that local implementation and review of the SDGs are shaped by institutional and contextual characteristics and stress the importance of effective local follow-up mechanisms. Similarly, Suve (2026) identifies resource constraints, insufficient strategic planning, and competency gaps as significant barriers to sustainable-development implementation, particularly in smaller local governments.

From the author's perspective, this development in the literature marks an important shift in the understanding of local governance. Earlier approaches often focused primarily on the formal distribution of competencies between national and local authorities, whereas more recent research increasingly emphasises the capacity of municipalities to coordinate actors, mobilise resources, implement strategies, and transform policy objectives into local action. Formal autonomy is therefore only one dimension of effective local governance; institutional and strategic capacity may be equally important for explaining differences between municipalities.

In the context of education policy, the role of municipalities remains somewhat limited. While municipalities are responsible for the infrastructure and maintenance of primary education institutions, they typically have little formal authority over secondary, tertiary, or adult education programmes. These areas are largely governed at the national level through ministries, regulatory bodies, and accreditation procedures (Zgaga, 2014). Consequently, local authorities often have only indirect opportunities to influence the structure and content of educational programmes. Nevertheless, municipalities may still contribute to shaping local educational ecosystems through collaboration with educational institutions, partnerships with local businesses, and the co-financing of certain educational initiatives.

Understanding these institutional constraints is important for analysing the potential role of municipalities in education-related development. Although municipalities may not possess direct regulatory authority over educational systems, they can still function as facilitators of cooperation between local stakeholders and may thereby contribute to institutional environments supportive of human-capital development and local economic activity. Accordingly, the present study conceptualises municipal influence in education more broadly than formal regulatory competence. Municipalities may exercise developmental influence through financing, strategic planning, stakeholder coordination, partnership formation, and the identification of local educational and labour-market needs.

Education and Sustainable Local Development

Education has long been recognised as a central factor in long-term socio-economic development

(Ballantine, 1989). In modern knowledge-based economies, education contributes not only to the development of human capital but also to the creation of innovative capacities, technological advancement, and social cohesion. The emergence of sustainability discourse in recent decades has further emphasised the importance of education as a key component of environmentally responsible, socially inclusive, and economically resilient development models (Rivera Maulucci et al., 2023).

From the perspective of sustainable development, education plays a dual role. On the one hand, it equips individuals with the knowledge and skills necessary for participation in modern labour markets. On the other hand, it fosters values such as environmental awareness, civic responsibility, and long-term thinking, which are essential for achieving sustainable societal progress. Scholars increasingly emphasise that successful transitions towards sustainable development require education systems capable of responding to local socio-economic conditions and regional development priorities (Li & Huang, 2024).

The broader European context further reinforces this relationship between education and sustainability. European higher education institutions are increasingly responding to intertwined pressures arising from economic and technological change, digitalisation, the green transition, and post-pandemic transformation, all of which strengthen the need to embed sustainability into institutional and educational development (Popowska, 2024).

Recent research also demonstrates that education for sustainable development extends beyond formal educational institutions and increasingly involves local and community-based learning environments.

In the Slovenian context, Košmerl (2025) identifies non-formal adult education as an important component of education for sustainable development and emphasises the need for stable funding, greater regional accessibility, cooperation with educational organisations, and stronger involvement of relevant stakeholders. The study is particularly relevant to local governance because municipalities constitute an important source of local-level support for such educational activities.

In many European countries, however, education systems remain highly centralised. National governments typically regulate curricula, accreditation standards, and funding mechanisms, while local actors play a relatively limited role in shaping educational policies. This centralisation can help maintain uniform quality standards and equal access to education, but it may also limit the ability of educational systems to respond to region-specific labour-market demands and development opportunities.

For this reason, several authors advocate greater decentralisation in education governance. According to this perspective, municipalities and other local actors are often better positioned to identify emerging skill needs, economic opportunities, and social challenges within their communities (Turhan & Güneyli, 2022). Closer cooperation between municipalities, educational institutions, and local businesses may therefore facilitate a more effective alignment between labour-market demand and the supply of skills and competencies produced by educational systems (Vidic, 2012).

However, the author argues that the centralisation–decentralisation relationship should not be

interpreted as a binary choice. The relevant question is not necessarily whether educational authority should be transferred from the national to the municipal level, but how nationally defined educational standards can be complemented by locally generated knowledge and cooperation. National authorities can safeguard quality, comparability, and accessibility, while municipalities can contribute information about local skill needs, demographic change, economic structures, and development priorities. In this sense, local participation can complement rather than replace national educational governance.

In Slovenia, this issue is particularly relevant because local development disparities persist despite the country's relatively small size. Without systematic municipal engagement, vocational education and continuing education programmes may fail to address the specific needs of local economies. Consequently, educational systems may produce skills that are insufficiently aligned with local labour-market structures, potentially contributing to skill mismatches and limiting local economic dynamism (Krajnc, 2016).

Alongside formal education at different levels, adult education is also relevant to local human-capital development. Andragogy provides a conceptual basis for understanding lifelong and continuous learning and is characterised by a multidisciplinary orientation and an interdisciplinary scientific approach (Pastuović, 2022). This perspective is particularly important for municipalities seeking to respond to changing labour-market needs through continuing education and reskilling. Viewed in combination with recent research on education for sustainable development in Slovenia (Košmerl, 2025), lifelong learning further expands the

potential developmental role of municipalities beyond their statutory responsibilities for primary-school infrastructure.

The author therefore views education as a component of local development infrastructure rather than solely as a sectoral public service. Its developmental relevance derives not only from formal qualifications but also from its capacity to support human-capital formation, adaptation to technological and economic change, lifelong learning, social participation, and cooperation between institutions. This broader interpretation provides an important conceptual bridge between education policy and sustainable local development.

Municipal Contributions to Local Economic Development

A substantial body of international literature highlights the important role of local governments in promoting economic development. Municipalities may contribute to local economic development by leveraging local knowledge, fostering cooperation among stakeholders, and supporting entrepreneurial ecosystems (Sienkiewicz, 2014; Godlewska & Morawska, 2020). Through strategic planning, investment in local infrastructure, and support for education and innovation, municipalities may help create institutional conditions favourable to business development and employment.

There is no single universal model capable of capturing all determinants of local development, and appropriate development indicators may vary across municipalities. The literature nevertheless offers several models that focus on local economic development and the role of local institutions,

resources, and stakeholder cooperation (Sienkiewicz, 2014; Zadęcka, 2018; Godlewska & Morawska, 2020). Zadęcka (2018, pp. 85–87) stresses that local development models should reflect the needs, capacities, and natural conditions of municipalities and their wider territorial environment. Local economic development is therefore best understood as a multidimensional and collective process requiring coordinated participation by local authorities, businesses, non-governmental organisations, and residents, while remaining grounded in local needs, resources, and initiatives.

Recent research on sustainability governance strengthens this interpretation by showing that strategic planning alone is insufficient unless it is supported by institutional capacity and effective coordination. Annesi et al. (2025) demonstrate that different combinations of financial capacity, specialised human resources, performance-management mechanisms, and political conditions can produce different levels of sustainability integration within local government. This suggests that municipal development capacity is configurational rather than determined by a single characteristic such as size or formal status.

In the Slovenian context, cooperation between municipalities, local businesses, and educational institutions may have important developmental implications. When municipalities support educational initiatives—whether through co-financing, logistical support, or institutional collaboration—they may contribute to the development of a local workforce with skills relevant to local economic sectors. Such cooperation may help address skill mismatches in local labour markets and improve the availability of appropriately qualified labour for local employers.

On the demand side, businesses may benefit from access to a locally trained workforce familiar with regional economic structures and industry needs. On the supply side, residents may gain access to educational opportunities that correspond more closely to local employment prospects. The interaction between education and local economic structures may therefore support mutually reinforcing relationships between human-capital development, labour-market adaptation, and regional economic development. However, the existence and strength of these relationships are empirical questions and should not be assumed in advance.

From the author's perspective, this qualification is particularly important. Educational investment should not be expected to translate automatically or immediately into lower unemployment or business growth. Local economic performance reflects the interaction of numerous factors, including demographic structure, accessibility, industrial composition, investment, entrepreneurship, fiscal capacity, and broader regional and national economic conditions. Municipal support for education is therefore better understood as one element of a wider local development ecosystem rather than as an isolated causal determinant of economic performance.

The extent of municipal involvement in education varies significantly across municipalities. Larger municipalities, particularly those designated as city municipalities (*mestne občine*), often possess more developed administrative structures, greater financial resources, and specialised departments capable of coordinating cooperation with educational institutions (Brezovnik et al., 2019). In

contrast, smaller municipalities may have more limited institutional and financial capacity to support such initiatives.

Recent research nevertheless cautions against equating municipal size or formal status directly with effective institutional capacity. Suve (2026), for example, identifies substantial capacity constraints in smaller municipalities but also demonstrates that effective sustainability implementation depends on strategic planning, competencies, monitoring, and organisational capabilities. Similarly, Annesi et al. (2025) conceptualise administrative capacity as a combination of mutually interacting resources and institutional conditions.

This variation in institutional capacity suggests that differences in municipal resources and strategic orientation may be associated with the extent to which municipalities participate in local educational ecosystems. The author therefore argues that municipality type should be regarded as a possible proxy for institutional capacity rather than as a sufficient explanation of municipal developmental performance. This distinction is particularly important for the empirical analysis undertaken in the present study.

Slovenian studies also demonstrate that municipal development is commonly examined through partial, field-specific indicators. For example, research on the municipalities of the Lower Sava region has analysed demographic and social characteristics within a local sustainable-development framework (Založnik & Gorše, 2012). Such studies underline the need for development models that integrate social, demographic, economic, and institutional dimensions rather than

treating them in isolation.

Research Gaps and Contributions

Despite the growing body of literature on local governance, education policy, and sustainable development, relatively few studies systematically analyse the relationships between municipal competencies, educational initiatives, institutional cooperation, and measurable socio-economic characteristics. Existing research often focuses either on national education policies or on regional economic development, without explicitly examining how local governance structures interact with educational systems.

The more recent literature has substantially advanced understanding of local sustainability governance by highlighting administrative capacity, strategic planning, policy coordination, and local implementation of the SDGs (Annesi et al., 2025; Ortiz-Moya & Yang, 2025; Suve, 2026). At the same time, recent Slovenian research demonstrates the continuing relevance of locally supported education for sustainable development and lifelong learning (Košmerl, 2025). Yet these strands of research remain insufficiently connected. In particular, limited empirical attention has been devoted to whether municipal engagement with education is associated with socio-economic characteristics and strategic-development practices at the local level.

The need for such integration is evident in both Slovenian and international research. Effective local development requires stronger connections between local government, education, and the economy, since fragmented approaches can limit the capacity of communities to pursue balanced and sustainable development. Comparable attempts to

connect education, community needs, entrepreneurship, and sustainability can be found in studies from Croatia, Ecuador, and China (Cingula et al., 2010; Lomas Tapia & Trujillo, 2018; Zhou, 2020).

On the basis of this literature, the present study adopts an integrative conceptual perspective in which municipalities are understood primarily as coordinators and facilitators within local development ecosystems. Their potential contribution does not necessarily derive from direct control over educational programmes. Rather, it may arise from their capacity to identify local needs, connect educational and economic actors, mobilise financial and institutional resources, and incorporate education into broader sustainable-development strategies. This perspective brings together three previously rather separate strands of research: local governance and administrative capacity, education and human-capital development, and sustainable local economic development.

This study seeks to address this gap by focusing on the Slovenian municipal context and analysing several key dimensions of municipal involvement in education. In particular, the research investigates:

- the ways in which Slovenian municipalities collaborate with and support educational institutions;
- whether municipal cooperation in educational programme development is associated with local unemployment;
- whether selected forms of municipal co-financing of education are associated with growth in the number of local business entities;
- whether municipality type is associated with differences in participation in educational

programme development; and

- whether the existence of strategic sustainable-development documents is associated with stronger cooperation among municipalities, educational institutions, and businesses.

By analysing these dimensions, the study contributes to the broader debate on decentralisation, education governance, and sustainable development. Slovenia provides a particularly interesting case for such analysis due to its fragmented municipal structure, centralised education system, and absence of regional governance structures. Insights derived from this case may therefore be relevant for other small states or governance systems seeking to strengthen the role of local actors in education-related development processes (Machonin, 1997; Cingula et al., 2010).

The contribution of the study is threefold. First, it connects municipal engagement in education with measurable socio-economic and institutional characteristics rather than examining educational governance or local development in isolation. Second, it tests these relationships using nationwide empirical evidence from Slovenian municipalities. Third, it develops a context-sensitive understanding of municipal educational engagement in which national educational standards and local developmental responsiveness are treated as potentially complementary rather than competing principles. In this framework, the key analytical question is not simply how much formal educational authority municipalities possess, but how effectively they use their strategic, financial, and coordinating capacities to connect education with local development needs.

The theoretical considerations presented in this section provide the conceptual foundation for the empirical analysis that follows. They suggest that municipal engagement in education should be analysed within a broader institutional framework encompassing administrative capacity, strategic planning, stakeholder coordination, human-capital development, and local economic conditions. Based on these insights, the next section formulates the research question and develops four testable hypotheses concerning the relationships between municipal involvement in education, selected socio-economic indicators, municipality type, and strategic development planning.

Methodology

The methodological framework of this study is based on a new institutionalist perspective, which provides an analytical framework for understanding how formal institutions, governance arrangements, and organisational practices shape public policy processes and development outcomes (Lowndes, 2005). Rather than viewing municipalities solely as legally defined administrative units, the new institutionalist approach considers local governments as institutional actors whose decision-making capacity is influenced by formal competencies, organisational resources, strategic planning, and interactions with other stakeholders.

This perspective is particularly appropriate for the present study because the research does not examine municipalities primarily through their formal authority over education, but through their institutional capacity to coordinate educational institutions, businesses, and other local actors within a predominantly centralised education

system. The methodological approach is therefore consistent with the theoretical framework developed in the previous section, which conceptualises municipal engagement in education as a governance and coordination mechanism rather than as a direct regulatory function.

The empirical component of the study is based on a quantitative cross-sectional research design. The study investigates statistical associations between different forms of municipal involvement in education and selected socio-economic and institutional characteristics of Slovenian municipalities. Given the cross-sectional nature of the dataset, the analysis seeks to identify patterns of association rather than establish causal relationships.

Research Question and Hypotheses

The central research question guiding the empirical analysis is:

RQ: To what extent is municipal involvement in the development and financing of educational programmes associated with selected socio-economic outcomes and institutional characteristics of Slovenian municipalities?

This research question reflects the conceptual assumption that municipalities may contribute to sustainable local development through strategic cooperation, educational support, and stakeholder coordination, even when their formal educational competencies are limited. Based on the theoretical framework presented in the literature review, four hypotheses were formulated.

H1: Municipalities that collaborate with

educational institutions and local businesses in designing educational programmes exhibit lower unemployment rates than municipalities that do not engage in such collaboration.

H2: Municipal co-financing of educational institutions and programmes is associated with growth in the number of local business entities.

H3: City municipalities (*mestne občine*) exert greater influence on the development of educational programmes due to their larger administrative capacities and institutional resources compared with other municipalities.

H4: The existence of a strategic sustainable-development document is associated with stronger cooperation between municipalities, educational institutions, and businesses in the development of educational programmes.

These hypotheses operationalise different dimensions of municipal educational engagement identified in the theoretical literature: labour-market responsiveness (H1), education as a component of local economic development (H2), institutional capacity (H3), and strategic governance and stakeholder coordination (H4).

Data Sources

The empirical analysis is based on data collected through a nationwide survey of Slovenian municipalities. The population of interest consisted of all 212 municipalities registered in Slovenia according to official administrative records. Survey invitations were distributed electronically to all municipalities, with the request that the questionnaire be completed by the organisational

unit or individual responsible for education or related development activities within the municipal administration.

The survey was conducted using the 1KA online survey platform, which is widely used for academic and institutional research in Slovenia. The platform enabled systematic data collection, automated storage of responses, and subsequent export for statistical analysis.

A total of 149 municipalities provided valid responses, representing slightly more than 70% of all Slovenian municipalities. This high response rate provides broad territorial coverage and includes municipalities with different demographic, institutional, and economic characteristics.

The sample includes municipalities of different sizes, geographical locations, and administrative capacities, allowing the analysis to capture considerable variation in local governance practices across Slovenia. Nevertheless, although the response rate is exceptionally high for municipal survey research, the possibility of non-response bias cannot be completely excluded and statistical representativeness cannot be assumed automatically.

According to the empirical dataset, the analytical sample included 12 city municipalities and 137 other municipalities. Because of the pronounced imbalance between these two groups, comparisons involving municipality type are interpreted with particular caution.

Variables and Operationalisation

The questionnaire was designed to capture municipal engagement in education and selected

characteristics of local development. The quantitative analysis combines survey responses with official socio-economic indicators.

The principal variables included:

- cooperation between municipalities, educational institutions, and local businesses in educational programme development;
- municipal co-financing of educational institutions and programmes;
- institutional structures responsible for education within municipalities;
- existence of strategic sustainable-development documents;
- municipal unemployment indicators based on data from the Employment Service of Slovenia (ZRSZ);
- indicators describing the number and growth of registered business entities based on official statistical sources (SURS) and the empirical dataset.

The operationalisation follows the theoretical distinction developed in the literature review between formal educational competencies and indirect municipal engagement. Consequently, the independent variables primarily measure forms of cooperation, financing, and strategic planning rather than formal regulatory authority over education.

For the analysis of H1, unemployment was operationalised categorically relative to the Slovenian average, following the structure of the empirical dataset.

For H2, growth in the number of business entities was treated as a categorical development indicator describing municipal economic dynamics.

For H3, municipality type (city municipality versus other municipality) was used as a proxy indicator of institutional capacity, recognising that municipality type represents only one dimension of administrative and organisational capacity.

For H4, the existence of a strategic sustainable-development document was operationalised as an indicator of formal strategic planning within municipal governance.

This operationalisation reflects the conceptual assumption that municipal engagement in education can be expressed through multiple institutional mechanisms rather than a single policy instrument.

Supplementary Contextual Data

In addition to closed-ended questions, the questionnaire contained several open-ended questions intended to provide contextual insight into municipal educational practices, cooperation with local stakeholders, and perceived development challenges.

Respondents were invited to describe examples of cooperation with educational institutions and businesses, identify obstacles to educational cooperation, and explain their understanding of the municipal role in sustainable development.

These responses were used exclusively as contextual material supporting the interpretation of quantitative findings. They were not subjected to systematic coding, thematic analysis, or other qualitative analytical procedures. Consequently, the study remains a quantitative empirical study rather than a mixed-methods design.

Statistical Analysis

The collected data were analysed using descriptive statistics and inferential statistical methods. Descriptive statistics summarised the characteristics of participating municipalities and the prevalence of different forms of educational engagement.

The hypotheses were tested using: cross-tabulations, Pearson's chi-square test, Fisher's exact test where chi-square assumptions were not satisfied, correlation analysis for selected relationships. Pearson's chi-square test was applied to examine associations between categorical variables, while Fisher's exact test was used when expected frequencies within contingency tables were insufficient. Correlation coefficients were calculated to estimate the strength and direction of selected associations. Statistical significance was assessed primarily at the 5% significance level, while findings significant at the 1% level are additionally reported where relevant.

All statistical analyses were performed using IBM SPSS Statistics Version 12.0. The selected analytical methods correspond to the categorical nature of the principal variables and are appropriate for examining associations within a cross-sectional municipal dataset.

Analytical Strategy

Each hypothesis was analysed through variables corresponding to its theoretical proposition and empirical operationalisation.

- H1 examined whether cooperation with educational institutions and businesses is

associated with municipal unemployment categories.

- H2 examined whether selected forms of municipal co-financing are associated with growth in the number of business entities.
- H3 examined whether municipality type is associated with indicators of municipal participation in educational programme development.
- H4 examined whether municipalities possessing strategic sustainable-development documents demonstrate stronger cooperation with educational institutions and businesses.

The analytical strategy intentionally follows the conceptual progression established in the literature review: from educational cooperation and labour-market responsiveness, through education and local economic development, to institutional capacity and strategic governance.

Because the research design is cross-sectional, statistically significant findings are interpreted as associations rather than evidence of causal influence. Municipal educational engagement may coexist with favourable socio-economic characteristics without necessarily producing those outcomes directly.

Accordingly, the interpretation of the results considers the possibility that observed relationships reflect broader differences in municipal institutional capacity, development orientation, demographic structure, or local economic context. This methodological caution is particularly important when discussing the practical implications of statistically significant findings.

By combining survey responses with selected official statistical indicators, the study provides an empirical basis for examining how municipal governance practices, educational engagement, strategic planning, and selected socio-economic characteristics are interconnected within Slovenian local communities.

Results

This section presents the empirical findings of the nationwide survey of Slovenian municipalities. The analysis focuses on the relationships between municipal engagement in education and selected socio-economic and institutional characteristics, including unemployment, growth in the number of business entities, municipality type, and strategic sustainable-development planning.

Overview of the Survey Response

A total of 149 municipalities submitted valid responses, representing slightly more than 70% of all Slovenian municipalities. The analytical sample included 12 city municipalities and 137 other municipalities. The substantial difference in group size was taken into account when interpreting comparisons based on municipality type.

The participating municipalities represented diverse territorial and institutional contexts. The empirical analysis therefore captures variation in municipal engagement in education, strategic planning, and selected socio-economic characteristics across Slovenia.

To test the proposed hypotheses, cross-tabulations and statistical tests of association were applied.

Pearson's chi-square test was used for relationships between categorical variables, Fisher's exact test was applied where the assumptions of the chi-square test were not met, and correlation coefficients were used for selected relationships.

Hypothesis Testing

Table 1 summarises the results of hypothesis testing. The detailed results for each hypothesis are presented below.

Table 1

Results of Hypothesis Testing

Hypothesis	Relationship examined	Statistical result	Conclusion
H1	Cooperation in educational programme development and unemployment	$r = -0.059$ $p = 0.472$	Not supported
H2	Co-financing of higher education outside the municipality and growth in the number of business entities	Pearson $\chi^2 = 6.098$ $p = 0.014$	Supported for the examined form of co-financing
H3	Municipality type and participation in educational programme development	Relationships weak; hypothesis rejected in the source analysis	Not supported as formulated
H4	Strategic sustainable-development document and joint cooperation with educational institutions and businesses	Pearson $\chi^2 = 7.827$ $p = 0.005$	Supported

Source: Author's compilation.

The first hypothesis examined whether municipalities that cooperate with educational institutions and local businesses in the development of educational programmes exhibit lower unemployment rates than municipalities that do not engage in such cooperation. The empirical results did not support this hypothesis. The observed relationship between municipal cooperation in educational programme development and unemployment was weak and statistically non-significant. For the combined indicator of cooperation with educational institutions and businesses, the reported correlation was: $r = -0.059$, $p = 0.472$. On the basis of this result, H1 was not supported.

The second hypothesis examined whether municipal co-financing of educational institutions and programmes is associated with growth in the

number of local business entities. The analysis identified a statistically significant relationship for the examined form of co-financing. Among municipalities that co-financed higher education outside their own territory, 76.9% reported growth in the number of business entities, compared with 50.4% of municipalities that did not provide such co-financing. The relationship was statistically significant: Pearson $\chi^2 = 6.098$, $p = 0.014$. Accordingly, H2 was supported for the examined form of municipal educational co-financing.

The third hypothesis assumed that city municipalities would exert greater influence on the development of educational programmes than other municipalities. The empirical analysis did not provide sufficient support for this hypothesis. The relationships between municipality type and the examined indicators of participation in educational

programme development were weak. The analysis therefore did not confirm that city municipalities systematically demonstrate greater participation or influence in educational programme development than other municipalities. On this basis, H3 was not supported as formulated. Because the analytical sample included 12 city municipalities and 137 other municipalities, the results relating to municipality type should be interpreted with particular caution.

The fourth hypothesis examined whether the existence of a strategic sustainable-development document is associated with stronger cooperation between municipalities, educational institutions, and businesses in the development of educational programmes. The results showed a statistically significant relationship (Pearson $\chi^2 = 7.827$, $p = 0.005$). Municipalities with strategic sustainable-development documents were more likely to report joint cooperation with educational institutions and businesses in educational programme development. Additional correlation analyses also indicated weak but statistically significant relationships between strategic planning and selected forms of municipal engagement in education. Accordingly, H4 was supported.

Discussion

The findings of this study provide a differentiated picture of the relationship between municipal engagement in education and sustainable local development in Slovenia. Rather than demonstrating a uniform association between educational engagement and socio-economic outcomes, the results indicate that the relevance of municipal involvement depends on the specific form of engagement and the institutional context in which it occurs. Two hypotheses (H2 and H4) were

supported, whereas H1 and H3 were not confirmed.

Taken together, these findings support the theoretical position developed in the literature review: municipal engagement in education appears to be most appropriately understood as part of a broader local governance ecosystem rather than as an isolated determinant of socio-economic performance. Municipalities operate within a predominantly centralised educational system and have limited formal authority over many aspects of educational provision. Their developmental role may therefore arise primarily through coordination, strategic planning, financing, and cooperation with educational and economic actors.

This interpretation is consistent with the new institutionalist perspective adopted in the study. Formal competencies alone do not fully determine institutional behaviour or developmental capacity. Organisational resources, strategic orientation, stakeholder relationships, and established practices may influence how municipalities use the room for action available within the national institutional framework.

Educational Cooperation and Local Unemployment

The empirical analysis did not support correlation among educational cooperation and local unemployment as proposed in H1. This finding does not necessarily imply that cooperation between municipalities, educational institutions, and businesses is irrelevant to local labour-market development. Rather, it suggests that the relationship between educational cooperation and unemployment is more complex than a direct association between the two variables. Unemployment at the municipal level may be shaped by a wide range of factors, including

demographic structure, industrial composition, commuting patterns, regional accessibility, investment dynamics, broader macroeconomic conditions, and the availability of employment opportunities outside municipal boundaries.

The result is therefore consistent with the multidimensional understanding of local development presented in the theoretical framework. Education contributes to human-capital development and may improve the adaptability of local labour markets, but its effects need not be immediately observable in aggregate unemployment indicators. Educational initiatives may produce longer-term effects through skills development, employability, innovation, entrepreneurship, and occupational mobility rather than through short-term reductions in registered unemployment.

This interpretation is also relevant in light of recent research on education for sustainable development in Slovenia. Košmerl (2025) demonstrates the importance of non-formal adult education and lifelong learning in supporting sustainable-development objectives while also identifying the importance of institutional cooperation, regional accessibility, and stable support structures. Such findings reinforce the view that the developmental effects of education depend on the wider institutional environment in which educational opportunities are provided.

From the author's perspective, the rejection of H1 is theoretically informative rather than merely a negative statistical result. It cautions against a simplified assumption that stronger municipal engagement in education will automatically translate into lower unemployment. Municipal educational engagement may contribute to human-

capital development without producing an independently measurable effect on unemployment, particularly when labour markets extend beyond municipal boundaries.

For municipal policy, this implies that educational cooperation should not be evaluated exclusively through short-term unemployment indicators. Indicators related to skills development, participation in lifelong learning, employer cooperation, retention of qualified labour, entrepreneurship, and the responsiveness of educational provision to local economic needs may provide a more comprehensive assessment of its developmental relevance.

Educational Co-Financing and Local Business Development

The second hypothesis examined whether municipal co-financing of education was associated with growth in the number of local business entities. The findings provide partial but statistically significant support for H2. This finding represents the clearest empirical connection in the study between municipal educational engagement and an economically relevant development indicator. However, it should not be interpreted as evidence that educational co-financing causes business growth. The cross-sectional research design does not permit such a conclusion. It is equally plausible that municipalities with stronger economic performance possess greater financial capacity to support educational initiatives, or that both educational investment and business growth reflect a broader strategic orientation towards development.

Nevertheless, the result is consistent with the theoretical argument that education can form part

of the institutional infrastructure supporting local economic development. Municipal support for higher education may facilitate access to knowledge, qualifications, professional networks, and human-capital development even where the educational institution is located outside the municipality itself. From this perspective, the geographical location of the educational institution may be less important than the municipality's willingness and capacity to invest in educational opportunities accessible to its residents.

This finding also broadens the conventional understanding of local educational policy. A municipality does not necessarily need to host a higher education institution in order to incorporate higher education into its local development strategy. Support for participation in higher education outside municipal boundaries may represent a form of investment in locally available human capital.

The finding is compatible with recent research emphasising that local development capacity depends on combinations of financial resources, specialised human capital, strategic management, and institutional conditions. Annesi et al. (2025), for example, demonstrate that spending capacity and specialised human capital form part of the configurations that enable municipalities to integrate sustainability into strategic processes. Although their study examines sustainability strategy rather than educational financing specifically, it supports the broader proposition that municipal financial and human-capital capacities interact within local development processes.

From the author's perspective, H2 therefore provides suggestive evidence that municipal educational support and local economic dynamism

may form part of the same development-oriented institutional environment. The relationship should not be interpreted as a simple causal chain from educational expenditure to business growth. Rather, municipalities that actively support education may also be municipalities that pursue more proactive development policies, invest in human capital, and maintain stronger connections with their wider economic environment.

This distinction has important practical implications. Municipal decision-makers should view expenditure on education not solely as a social cost but potentially as part of a wider portfolio of local development investments. At the same time, such investment should be linked to clearly identified local skill needs, cooperation with employers, monitoring of outcomes, and broader economic-development strategies.

Municipality Type and Institutional Capacity

The empirical findings did not provide sufficient support for the third hypothesis, which stated that city municipalities would exert greater influence on educational programme development because of their larger administrative structures and institutional resources. This assumption. At first sight, this result may appear inconsistent with the expectation that larger municipalities possess greater institutional capacity. However, it becomes more understandable when municipal size and formal status are distinguished from actual administrative capacity. City-municipality status may be associated with greater resources, but it does not necessarily indicate how those resources are organised, whether specialised expertise is available, how strongly education is incorporated into development strategy, or how effectively

municipalities cooperate with external stakeholders.

Recent research supports such a multidimensional interpretation of administrative capacity. Annesi et al. (2025) identify combinations of spending capacity, specialised human capital, sustainability-oriented performance measurement, and political stability as relevant to successful integration of sustainability into municipal strategy. Administrative capacity is therefore not reducible to municipal size or legal status. Similarly, Ortiz-Moya and Yang (2025) find that local approaches to SDG implementation and review are influenced by several interacting city-level and external characteristics, including resource availability, size, growth, prior experience, and national and international influences.

The rejection of H3 consequently refines rather than undermines the theoretical framework of the study. The findings suggest that municipality type may be too crude a proxy for the institutional capacity required for meaningful engagement with education. Smaller municipalities may compensate for limited internal resources through inter-municipal cooperation, partnerships with educational institutions, collaboration with businesses, or particularly strong strategic leadership. Conversely, larger municipalities may possess greater resources without necessarily directing them towards education-related development.

This interpretation is especially important in Slovenia because of the highly fragmented municipal structure. The empirical sample itself also requires caution: only 12 city municipalities were included compared with 137 other municipalities.

The absence of a statistically convincing difference should therefore not be interpreted as evidence that municipal capacity is irrelevant.

Rather, the findings suggest that future research should measure administrative capacity directly, for example through municipal staffing levels, specialised professional expertise, development expenditure, dedicated organisational units, partnership networks, and experience in managing education-related projects.

From a practical perspective, this result is encouraging for smaller municipalities. Effective engagement with education may not require the institutional scale of a city municipality if capacity can be developed through partnerships, shared services, inter-municipal cooperation, and strategic networking.

Strategic Sustainable-Development Planning and Stakeholder Cooperation

The fourth hypothesis produced one of the strongest findings of the study. Municipalities with strategic sustainable-development documents demonstrated stronger joint cooperation with educational institutions and businesses in educational programme development (Pearson $\chi^2 = 7.827$, $p = 0.005$). This result is theoretically significant because it connects formal strategic orientation with observable patterns of stakeholder cooperation. It suggests that sustainable-development strategies may perform a function beyond merely documenting municipal objectives: they may provide an institutional framework within which cooperation among public authorities, educational institutions, and economic actors can be organised.

The finding corresponds closely with recent international research. Annesi et al. (2025) emphasise that the integration of sustainability into local government strategy depends on combinations of administrative and political capacity. Ortiz-Moya and Reggiani (2025) similarly find that embedding sustainability follow-up and review processes into municipal procedures can contribute to stronger local implementation of the SDGs. Ortiz-Moya and Yang (2025) further demonstrate that effective local sustainability review depends on the interaction between local resources, institutional experience, and wider governance conditions.

Recent evidence from Slovenia adds an important contextual dimension. Vodeb (2026), examining sustainable development through municipal spatial planning in four Slovenian municipalities, finds that sustainability principles are incorporated into statutory municipal planning, while their translation into concrete development outcomes remains uneven. This distinction between having a strategic framework and effectively implementing it is highly relevant to the findings of the present study.

From the author's perspective, H4 therefore represents more than evidence of an association between two formal municipal characteristics. It indicates that strategic planning may function as an institutional platform for stakeholder coordination. A sustainable-development document can establish common priorities, identify relevant actors, define areas of cooperation, and create continuity beyond individual projects or political initiatives.

At the same time, the finding should not be interpreted to mean that the mere existence of a strategic document automatically produces stronger cooperation. It is possible that municipalities

already characterised by a collaborative governance culture are also more likely to adopt sustainable-development strategies. The direction of the relationship cannot be established through the present cross-sectional design.

The practical implication is therefore not simply that municipalities should produce additional strategic documents. Rather, strategies should be used as active governance instruments, linked to responsible actors, financial resources, measurable objectives, stakeholder participation, monitoring mechanisms, and concrete implementation activities. This interpretation is consistent with both earlier Slovenian research on municipal development planning and the more recent literature on local sustainability governance.

Overall Interpretation

Considered together, the four hypotheses provide support for a context-sensitive model of municipal engagement in education. The pattern of findings suggests that institutional context matters at least as much as the existence of individual educational activities. Municipalities may contribute most effectively when education is embedded within broader strategic and cooperative governance arrangements.

This interpretation is consistent with the new institutionalist framework adopted in the study. Municipal behaviour is shaped not only by formal competencies but also by organisational practices,

resource configurations, strategic priorities, and relationships among actors. In a centralised education system such as Slovenia's, municipalities may have limited direct regulatory authority but can nevertheless exercise developmental agency by

coordinating stakeholders, supporting educational opportunities, mobilising resources, and connecting education with local economic priorities.

The findings therefore suggest a conceptual progression from formal authority towards developmental capacity. The relevant question is not simply whether municipalities possess formal educational competencies, but whether they possess or develop the capacity to connect education, economic actors, strategic planning, and local development.

This also supports the position developed in the literature review that national educational standards and local responsiveness should not necessarily be regarded as competing governance principles. National institutions may ensure quality, comparability, and accessibility, while municipalities contribute knowledge of local needs, stakeholder networks, strategic coordination, and context-specific development priorities.

Practical and Policy Implications

The findings have several implications for municipal practice and public policy. First, municipalities should consider education as part of their local development infrastructure, even where formal educational competencies remain primarily national. Engagement may include co-financing, facilitating partnerships, supporting lifelong learning, identifying skill needs, connecting educational institutions with employers, and incorporating education into municipal development strategies.

Second, the significant association identified under H2 suggests that educational support should be

considered alongside other instruments of local economic-development policy. Municipalities may benefit from systematically assessing how educational investments correspond to local and regional labour-market needs, entrepreneurship, sectoral development, and anticipated skill requirements.

Third, the findings under H3 suggest that capacity-building policies should not focus exclusively on municipality size. Smaller municipalities may require mechanisms that enable them to pool resources, share expertise, participate in inter-municipal projects, and develop partnerships with educational institutions and businesses outside their territorial boundaries.

Fourth, the findings under H4 emphasise the importance of strategic integration. Sustainable-development strategies should connect educational objectives with economic development, human-capital needs, demographic challenges, and stakeholder cooperation rather than treating education as an isolated sector.

Finally, both municipalities and national policymakers should recognise the potential value of multi-level governance in education-related development. The centralised nature of the Slovenian education system need not prevent meaningful local participation. A clearer division of complementary roles could allow national authorities to maintain educational standards while enabling municipalities to contribute local knowledge, coordination capacity, and development-oriented partnerships.

For practice, the central message of the study is

therefore not that municipalities require greater formal control over education, but that they require stronger mechanisms for connecting education with local development.

Conclusion

This study examined the relationship between municipal involvement in education and selected socio-economic and institutional characteristics of Slovenian municipalities. By analysing survey data from 149 municipalities, representing more than 70% of all Slovenian municipalities, the research provides broad empirical insight into how local authorities engage with educational institutions and economic actors within a predominantly centralised education system.

The findings reveal a differentiated rather than uniform relationship between municipal educational engagement and sustainable local development. Of the four hypotheses tested, two were supported and two were not. Cooperation between municipalities, educational institutions, and businesses in educational programme development was not significantly associated with lower unemployment (H1), while city-municipality status is not correlated to stronger participation in educational programme development (H3). By contrast, selected municipal co-financing of higher education was significantly associated with growth in the number of local business entities (H2), and the existence of a strategic sustainable-development document was significantly associated with stronger cooperation among municipalities, educational institutions, and businesses (H4).

These findings challenge a simple linear interpretation of the relationship between education and local development. Municipal

engagement in education should not be understood as an isolated policy intervention expected to produce immediate socio-economic outcomes. Rather, its developmental relevance appears to depend on the broader institutional environment in which educational support, strategic planning, administrative capacity, stakeholder cooperation, and local economic conditions interact.

From a theoretical perspective, the study contributes to the literature on local governance, education, and sustainable development by shifting attention from formal municipal authority towards developmental capacity. In a centralised education system, municipalities may possess limited regulatory influence over curricula, accreditation, and educational standards while still exercising meaningful developmental agency through financing, coordination, strategic planning, and partnership-building. This finding supports the new institutionalist perspective adopted in the study, according to which institutional outcomes are shaped not only by formal rules and competencies but also by organisational capacities, established practices, strategic orientations, and relationships among actors.

The study further suggests that national educational standards and local responsiveness need not be viewed as competing principles. They may instead perform complementary functions within a multi-level governance framework. National institutions can safeguard educational quality, comparability, and accessibility, while municipalities can contribute knowledge of local labour-market conditions, demographic trends, economic structures, and development needs. The potential added value of local involvement therefore lies primarily in connecting nationally regulated

educational systems with context-specific local development priorities.

The empirical findings also have important economic implications. The statistically significant association between selected municipal co-financing of higher education and growth in the number of business entities indicates that educational support and local economic dynamism may form part of the same development-oriented institutional environment. This relationship should not be interpreted causally. Nevertheless, it highlights the relevance of considering education alongside more conventional instruments of local economic-development policy. Investment in educational opportunities may contribute to the wider conditions supporting human-capital formation, entrepreneurship, labour-market adaptability, and business development.

The findings concerning strategic sustainable-development planning are similarly important. Municipalities with strategic sustainable-development documents demonstrated stronger cooperation with educational institutions and businesses. This suggests that strategic planning may serve not merely as a formal administrative exercise but as an institutional platform through which local actors, priorities, and resources can be connected. However, the existence of a strategy alone cannot guarantee effective implementation. Its developmental value ultimately depends on whether strategic objectives are translated into concrete measures, responsibilities, resources, stakeholder partnerships, and monitoring mechanisms.

From a practical perspective, the results suggest that municipalities do not necessarily require broader formal authority over education in order to

strengthen their contribution to education-related local development. Instead, they may benefit from strengthening mechanisms that connect education with local economic and social needs. Such mechanisms may include systematic identification of current and future skill requirements, cooperation with educational institutions and employers, support for lifelong learning and reskilling, targeted co-financing of educational opportunities, inter-municipal cooperation, and the integration of education into wider sustainable-development strategies.

The findings are also relevant for smaller municipalities. The absence of a confirmed relationship between city-municipality status and educational engagement suggests that formal municipal type alone does not adequately capture institutional capacity. Smaller municipalities may compensate for limited internal resources through partnerships, shared expertise, inter-municipal cooperation, and collaboration with educational institutions located outside their territorial boundaries. For policymakers, this indicates that strengthening municipal developmental capacity may be more important than simply expanding formal competencies.

Several limitations of the study should be acknowledged. First, the cross-sectional research design permits the identification of statistical associations but does not allow causal inference. The direction of the observed relationships therefore cannot be established. Second, although the response rate was high and the sample covered more than 70% of Slovenian municipalities, the possibility of non-response bias cannot be entirely excluded. Third, some concepts—particularly institutional capacity—were operationalised through indirect indicators such as municipality

type rather than through comprehensive measures of administrative resources, professional expertise, organisational structures, and partnership networks. Finally, the relatively small number of city municipalities in the sample requires particular caution when interpreting comparisons based on municipality type.

These limitations also provide directions for future research. Longitudinal studies could examine whether changes in municipal educational engagement are followed by changes in socio-economic indicators over time and would provide a stronger basis for assessing possible causal mechanisms.

Future research could also develop more comprehensive measures of municipal institutional capacity, including staffing, professional expertise, development expenditure, organisational structures, project-management experience, and stakeholder networks. Comparative studies involving other small or highly centralised European states could further assess whether the patterns identified in Slovenia are specific to its institutional setting or reflect broader characteristics of local educational governance.

Future research should also examine more directly the mechanisms through which municipal educational engagement may contribute to local economic development. Rather than relying solely on aggregate indicators such as unemployment or

the number of business entities, studies could investigate graduate retention, employer demand for specific competencies, participation in lifelong learning, entrepreneurship, innovation, skill matching, and the development of local knowledge networks. Such research would provide a more detailed understanding of the pathways connecting education, municipal governance, and sustainable local development.

Overall, the study demonstrates that the role of municipalities in education-related development extends beyond their formally defined educational responsibilities. The central issue is not simply whether municipalities have authority over education, but whether they possess the strategic and institutional capacity to connect education with the needs and resources of their communities. In this sense, municipalities can act as facilitators within local development ecosystems, linking educational institutions, businesses, residents, and development strategies.

For Slovenia, strengthening these connections may provide a realistic pathway towards more responsive and sustainable local development without requiring the decentralisation of national educational standards themselves. More broadly, the findings suggest that effective local development depends not only on the distribution of formal competencies, but also on the capacity of institutions to cooperate, coordinate, and transform education into a shared developmental resource.

Data Availability: The data that support the findings of this study are available from the author upon reasonable request.

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Vpliv izobraževalnih standardov na trajnostni razvoj v slovenskih lokalnih skupnostih

Izvleček

Članek proučuje vlogo občin pri povezovanju izobraževanja, lokalnega gospodarskega in trajnostnega razvoja. Kvantitativna raziskava, v kateri je sodelovalo 149 slovenskih občin, analizira povezanost med različnimi oblikami vključevanja občin v izobraževanje ter izbranimi družbeno-ekonomskimi, institucionalnimi in strateškimi značilnostmi lokalnih skupnosti. Rezultati ne potrjujejo statistično značilne povezanosti med sodelovanjem občin pri oblikovanju izobraževalnih programov in nižjo brezposelnostjo niti predpostavke o večjem vplivu mestnih občin na razvoj izobraževalnih programov. Nasprotno pa kažejo statistično značilno povezanost med izbranimi oblikami občinskega sofinanciranja izobraževanja in rastjo števila gospodarskih subjektov ter med obstojem strateških dokumentov trajnostnega razvoja in intenzivnejšim sodelovanjem občin z izobraževalnimi institucijami in gospodarstvom. Ugotovitve kažejo, da je vlogo občin v izobraževanju smiselno razumeti predvsem z vidika strateškega načrtovanja, povezovanja deležnikov in institucionalne koordinacije, ne pa kot neposreden vzročni dejavnik družbeno-ekonomskih rezultatov.

Ključne besede: lokalna samouprava, izobraževalna politika, trajnostni razvoj, decentralizacija, človeški kapital, regionalni razvoj

Developing the Cloud ERP Cybersecurity Assessment Framework (CECAF) for Evidence-Based Cybersecurity Capability Assessment in Cloud ERP Platforms

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Abstract

The purpose of this study is to develop the Cloud ERP Cybersecurity Assessment Framework (CECAF) to systematically evaluate cybersecurity capabilities in cloud ERP platforms. The framework was developed through the synthesis of academic literature, internationally recognised cybersecurity standards, cybersecurity capability maturity assessment principles, and cloud ERP-specific cybersecurity requirements, and demonstrated through an evidence-based assessment of Infor CloudSuite using publicly available official technical documentation. The findings demonstrate that CECAF enables a structured, transparent, and reproducible evaluation of cybersecurity capabilities across multiple assessment domains. The study contributes by introducing an analytical assessment framework tailored to cloud ERP platforms and by highlighting the methodological importance of documented technical evidence for objective cybersecurity capability assessment. The framework provides practical guidance for cybersecurity evaluation and comparative assessment of cloud ERP platforms.

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Introduction

Digital transformation has fundamentally reshaped how organisations design, integrate, and manage business processes, making cloud Enterprise Resource Planning (ERP) platforms key enablers of organisational agility, scalability, and innovation (Ivanović & Marić, 2021; Lee et al., 2024). Organisations are replacing traditional on-premises ERP systems (Klaus et al., 2000) with cloud ERP platforms to improve operational efficiency, cross-functional integration, and data-driven decision-making (Lee et al., 2024; Llivisaca-Villazhañay et al., 2025). Their strategic value depends not only on their functional and technical capabilities but also on their successful organisational adoption and effective use within business processes (Sternad Zabukovšek & Bobek, 2025).

The widespread adoption of cloud ERP platforms has increased cybersecurity challenges. Unlike traditional ERP systems, cloud ERP platforms operate within highly interconnected digital ecosystems characterised by shared responsibility models, third-party integrations, cloud-native architectures, and continuous data exchange. Consequently, cybersecurity has evolved from a technical concern into a strategic organisational capability supporting business continuity, regulatory compliance, operational resilience, and organisational trust (Anica-Popa et al., 2024; Lee et al., 2024; NIST, 2024).

Despite the growing importance of cybersecurity in cloud ERP platforms, assessing cybersecurity capabilities remains a significant challenge. Existing cybersecurity standards and frameworks, including ISO/IEC 27001, the NIST Cybersecurity Framework (CSF 2.0), Zero Trust Architecture, and the Cloud Security Alliance Cloud Controls Matrix,

guide organisational cybersecurity management. However, these frameworks were developed primarily for cybersecurity governance and risk management rather than for evidence-based assessment of cybersecurity capabilities in cloud ERP platforms (Rose et al., 2020; Bertino, 2021; ISO/IEC, 2022; NIST, 2024; Cloud Security Alliance, 2024).

Furthermore, existing research has predominantly focused on cybersecurity risks, security controls, cloud ERP adoption, or individual technological solutions, while comparatively limited attention has been devoted to developing analytical approaches to cybersecurity capability assessment in cloud ERP platforms (Anica-Popa et al., 2024; Khokrale, 2025; Qazi et al., 2026). Although recent studies recognize the importance of assessing cybersecurity capability maturity, they offer limited methodological guidance on systematically, transparently, and reproducibly assessing cybersecurity capabilities using documented technical evidence (Brezavšček & Baggia, 2025; Liyanage et al., 2024). Consequently, a research gap exists regarding the availability of an analytical assessment framework specifically designed for evidence-based cybersecurity capability assessment in cloud ERP platforms.

To address this gap, this study develops the Cloud ERP Cybersecurity Assessment Framework (CECAF) to provide an evidence-based assessment of cybersecurity capabilities in cloud ERP platforms. It demonstrates its application by assessing Infor CloudSuite using publicly available technical documentation. The study contributes by (1) developing an analytical assessment framework synthesising established cybersecurity standards, capability maturity principles, and cloud ERP requirements; (2) demonstrating its application to a

contemporary cloud ERP platform; and (3) highlighting the value of transparent technical documentation for objective and reproducible cybersecurity assessment. The remainder of the paper presents the theoretical background, methodology, assessment results, discussion, and conclusions.

Theoretical Background

Evolution of ERP Systems

ERP systems were originally developed to overcome organisational information silos by integrating fragmented business functions into a unified information system. Their primary objective was to standardise business processes, establish a single source of organisational data, and support information sharing across functional areas, enabling greater operational efficiency, reduced data redundancy, and coordinated decision-making (Klaus et al., 2000).

As organisations accelerated their digital transformation initiatives, ERP systems evolved from transactional systems into enterprise-wide digital platforms that support organisational agility, process innovation, data-driven decision-making, and integration with advanced digital technologies. Contemporary ERP solutions increasingly incorporate business intelligence, advanced analytics, artificial intelligence, robotic process automation, and the Internet of Things (IoT), extending their role beyond process integration to become key enablers of digital transformation and long-term business competitiveness (Ivanović & Marić, 2021; Khan et al., 2025; Sternad Zabukovšek & Bobek, 2025).

The transition to cloud computing represents the latest stage in this evolution. Cloud-native ERP platforms provide scalability, flexibility, accessibility, and continuous software innovation while reducing infrastructure management requirements. As components of broader digital ecosystems integrating cloud services, external partners, mobile technologies, artificial intelligence, and data-driven business processes, they fundamentally transform the architecture and operational context of ERP systems. However, their extensive connectivity also expands the cybersecurity attack surface, making cybersecurity a strategic prerequisite for organisational resilience and the successful operation of cloud ERP platforms (Lee et al., 2024).

Unlike traditional on-premises ERP systems, cloud ERP platforms operate within highly interconnected digital infrastructures characterised by distributed services, external integrations, mobile access, and shared cloud resources. These characteristics substantially increase cybersecurity complexity, making security an essential organisational capability rather than merely a technical requirement. Understanding these characteristics, therefore, provides the foundation for examining the cybersecurity challenges associated with cloud-based ERP platforms.

Cloud-Based ERP Systems

The evolution of cloud computing has transformed the architecture, deployment, and management of ERP systems. Unlike traditional on-premises solutions that require dedicated hardware and software infrastructure, cloud ERP platforms are primarily delivered via Software-as-a-Service (SaaS)

models, enabling organisations to access enterprise applications via cloud infrastructure maintained by external service providers. This deployment model offers scalability, flexibility, lower infrastructure costs, automatic software updates, rapid implementation, and improved accessibility, making cloud ERP an attractive option for organisations of all sizes (Demi & Haddara, 2018; Lee et al., 2024). Beyond a different deployment model, cloud ERP represents a fundamental shift in the role of enterprise systems within digital organisations. Cloud ERP platforms operate as cloud-native digital platforms that support continuous innovation and interoperability while integrating enterprise processes with customer relationship management, supply chain management, IoT, artificial intelligence, business analytics, and external digital services through standardised application programming interfaces (APIs) and cloud integration services. This connectivity enhances organisational agility, accelerates digital innovation, and supports data-driven decision-making (Lee et al., 2024; Llivisaca-Villazhañay et al., 2025).

However, the same characteristics that create business value also increase cybersecurity complexity. Compared with traditional ERP environments, cloud ERP platforms operate within distributed infrastructures characterised by shared cloud resources, external integrations, remote access, mobile connectivity, and continuous data exchange. Consequently, security responsibilities are shared between cloud service providers and customer organisations, introducing challenges related to identity and access management (IAM), multi-tenancy, third-party dependencies, cloud misconfigurations, APIs, and increasingly sophisticated cyberattacks. Cybersecurity, therefore, becomes a strategic organisational capability rather

than merely a technical requirement (Demi & Haddara, 2018; Lee et al., 2024).

These characteristics distinguish cloud ERP platforms from traditional enterprise applications and explain why conventional cybersecurity approaches are insufficient for cloud-native ERP environments. Understanding these characteristics provides the foundation for identifying appropriate cybersecurity mechanisms and assessment frameworks.

Cybersecurity Challenges in Cloud-Based ERP Platforms

The migration of ERP systems to cloud environments has transformed organisational cybersecurity requirements. Unlike traditional on-premises ERP systems operating within relatively isolated corporate infrastructures, cloud ERP platforms are embedded in highly interconnected digital ecosystems characterised by cloud services, mobile access, external APIs, third-party integrations, and distributed data processing. While these characteristics enhance organisational flexibility and digital innovation, they also expand the cybersecurity attack surface and increase exposure to sophisticated cyber threats (Anica-Popa et al., 2024; Lee et al., 2024).

One of the principal cybersecurity challenges is the rapid expansion of potential attack vectors. Cloud ERP platforms continuously exchange data across organisational boundaries while supporting remote work, mobile devices, supplier integration, customer portals, and cloud-based applications. As a result, cyber attackers increasingly exploit vulnerabilities across cloud infrastructure, APIs, connected applications, and third-party services rather than targeting only the ERP application itself. Recent

studies identify ransomware, phishing attacks, cloud misconfigurations, supply chain attacks, and API vulnerabilities among the most critical threats affecting cloud ERP platforms (Anica-Popa et al., 2024; Khokrale, 2025).

Identity and access management (IAM) has therefore become one of the most critical security domains in cloud ERP platforms. Because these platforms support geographically distributed users, external partners, contractors, and mobile access, organisations require robust authentication, authorisation, and continuous identity verification. Traditional perimeter-based security models are increasingly insufficient, while identity-centric approaches based on multi-factor authentication, least-privilege access, privileged access management, and continuous verification have become essential for protecting enterprise resources against unauthorised access and insider threats (Rose et al., 2020; Bertino, 2021).

Cloud ERP has also changed organisational responsibility for cybersecurity. Under the shared responsibility model, cloud providers typically secure infrastructure and platform services. At the same time, customer organisations remain responsible for user management, access control, data governance, application configuration, regulatory compliance, and organisational security policies. Effective cloud ERP cybersecurity, therefore, requires coordinated governance rather than isolated technical controls (Singh & Sharma, 2021; NIST, 2024).

Beyond technical protection, contemporary literature increasingly recognises cybersecurity resilience as a strategic organisational capability. Organisations must continuously monitor security events, detect anomalies, respond rapidly to incidents, and recover critical business operations.

As cloud ERP platforms support mission-critical business processes, cybersecurity has evolved from an operational IT function into an essential component of organisational resilience and enterprise governance (Anica-Popa et al., 2024; NIST, 2024).

These challenges demonstrate that securing cloud ERP platforms requires more than isolated technical controls. Organisations need integrated cybersecurity frameworks combining governance, identity management, data protection, monitoring, incident response, and organisational resilience. The following section, therefore, reviews the principal cybersecurity frameworks that provide the theoretical foundation for assessing cybersecurity capabilities in cloud ERP platforms.

Cybersecurity Frameworks for Cloud-Based ERP Platforms

The increasing complexity of cloud ERP environments has stimulated the development of cybersecurity frameworks that provide organisations with structured guidance for managing cyber risks. Rather than relying on isolated technical controls, contemporary frameworks integrate governance, risk management, identity protection, continuous monitoring, incident response, and organisational resilience. Although they were not specifically developed for cloud ERP platforms, they provide a valuable theoretical foundation for assessing cybersecurity capabilities.

From a governance perspective, cybersecurity is regarded as an organisational capability requiring strategic management rather than merely a technical function. The NIST Cybersecurity Framework (CSF) 2.0 organises cybersecurity

activities into six interconnected functions—Govern, Identify, Protect, Detect, Respond, and Recover—supporting organisational cyber resilience throughout the cybersecurity lifecycle (NIST, 2024). Similarly, ISO/IEC 27001 defines requirements for implementing an Information Security Management System (ISMS) based on continuous risk assessment, governance, and improvement. Together, these frameworks emphasise that cybersecurity should be embedded within organisational governance structures and business processes rather than treated as an isolated technical responsibility (ISO/IEC, 2022).

The migration of enterprise systems to cloud environments has challenged traditional perimeter-based security models. As cloud ERP platforms support geographically distributed users, mobile devices, external partners, cloud services, and APIs, the assumption of trusted internal networks has become increasingly obsolete. Zero Trust Architecture (ZTA) addresses these challenges by continuously verifying the "never trust, always verify" principle (Rose et al., 2020). It emphasises identity and access management (IAM), multi-factor authentication (MFA), least-privilege access, privileged access management, and continuous authentication as key mechanisms for protecting enterprise resources against unauthorised access and insider threats (Bertino, 2021). Recent studies further highlight the growing importance of identity-centric security in cloud ERP environments (Mushtaq et al., 2025).

Contemporary cybersecurity extends beyond preventing cyberattacks to ensuring the continuous operation of organisational processes. This perspective emphasises continuous monitoring, threat detection, incident response, business continuity, and recovery capabilities. Modern cloud

ERP platforms, therefore, require security approaches capable of maintaining operational continuity during cybersecurity incidents. Security monitoring, security information and event management (SIEM), automated threat detection, vulnerability management, backup strategies, disaster recovery, and organisational learning are recognised as essential components of resilient cloud ERP platforms (NIST, 2024; Anica-Popa et al., 2024). Cybersecurity should therefore be evaluated not only by the technical controls implemented, but also by an organisation's ability to detect, respond to, and recover from cyber incidents.

Although these frameworks provide complementary perspectives for managing organisational cybersecurity, none were specifically designed to evaluate cybersecurity capabilities in cloud ERP platforms. Cloud ERP environments introduce domain-specific characteristics, including enterprise process integration, cloud-native architectures, shared responsibility models, and extensive third-party connectivity. Consequently, assessing cybersecurity capabilities requires an analytical framework that integrates governance, identity-centric protection, and operational resilience into a unified assessment. Building on these complementary perspectives, this study develops the Cloud ERP Cybersecurity Assessment Framework (CECAF).

Key Cybersecurity Mechanisms for Cloud-Based ERP Platforms

The increasing complexity of cloud ERP environments has shifted organisational cybersecurity from isolated technical safeguards to integrated security mechanisms that collectively protect enterprise applications, business processes, and organisational data. Rather than relying on

individual security controls, cloud ERP cybersecurity combines complementary mechanisms to address identity protection, data security, continuous monitoring, governance, and organisational resilience, thereby establishing a multilayered security architecture for cloud-native enterprise environments.

Identity has become the primary security perimeter in cloud ERP environments. Unlike traditional on-premises systems protected by network boundaries, cloud ERP platforms support geographically distributed users, external partners, suppliers, mobile devices, and cloud services. Consequently, identity and access management (IAM) has become one of the most critical cybersecurity mechanisms for controlling access to enterprise resources. Multi-factor authentication (MFA), single sign-on (SSO), privileged access management (PAM), role-based access control (RBAC), and least-privilege principles provide continuous identity verification and reduce unauthorised access, identity theft, credential misuse, and insider threats (Rose et al., 2020; Bertino, 2021).

Protecting enterprise data remains a core objective of cloud ERP cybersecurity. As sensitive organisational information is exchanged across cloud services, applications, and external stakeholders, organisations must ensure data confidentiality, integrity, and availability throughout their lifecycle. Encryption of data at rest and in transit, cryptographic key management, secure backup strategies, data integrity verification, and secure cloud storage are widely recognised as fundamental mechanisms for protecting enterprise information. These controls are particularly important under shared responsibility models, where organisations remain responsible for

protecting business data despite outsourcing infrastructure management to cloud providers (NIST, 2024; ISO/IEC, 2022).

Cloud ERP cybersecurity also depends on continuous monitoring rather than periodic security assessments. Modern security architectures integrate logging, Security Information and Event Management (SIEM), vulnerability management, automated alerting, behavioural analytics, and AI-supported threat detection to identify suspicious activities, correlate security events, and accelerate incident detection (Anica-Popa et al., 2024; Dwivedi et al., 2021).

Effective cybersecurity also requires governance mechanisms integrating organisational policies, regulatory compliance, security auditing, risk management, and continuous security assessment. These mechanisms establish organisational responsibilities, support compliance, and provide the foundation for implementing technical security controls (NIST, 2024; ISO/IEC, 2022).

Finally, organisational resilience has become an essential component of cloud ERP cybersecurity. Preparedness, incident response, business continuity, disaster recovery, recovery testing, and organisational learning enable organisations to minimise operational disruption and restore critical ERP services following cybersecurity incidents, thereby strengthening organisational resilience (NIST, 2024; Anica-Popa et al., 2024).

Collectively, these complementary cybersecurity mechanisms provide the theoretical foundation for developing the Cloud ERP Cybersecurity Assessment Framework (CECAF), which synthesises governance, identity protection, data security,

monitoring, and resilience into a structured analytical approach for assessing cybersecurity capabilities in cloud ERP platforms.

Research Methodology

Research Design

This study employs a qualitative case research design to assess cybersecurity capabilities in a Cloud ERP environment systematically. A qualitative case research is appropriate because cybersecurity represents a complex, context-dependent phenomenon shaped by technological architecture, governance mechanisms, security controls, and organisational practices. Rather than examining individual security features or testing causal relationships, the study evaluates cybersecurity capabilities within a real-world Cloud ERP platform by applying the proposed CECAF to the Infor CloudSuite case research.

Building on the identified research gap, the CECAF was developed by synthesising academic literature, internationally recognised cybersecurity standards, and industry best practices. The framework provides a structured approach for evaluating cybersecurity capabilities across predefined assessment domains using documented technical evidence and a capability maturity model. This enables a consistent evaluation from organisational, technical, and operational perspectives (Becker et al., 2009; ISO/IEC, 2022; NIST, 2024).

A case research design is particularly appropriate because cybersecurity capabilities cannot be adequately evaluated outside their technological context. Cloud ERP platforms integrate interconnected security mechanisms, including

application security, security monitoring, incident response, and governance (Yin, 2018).

The research followed a four-phase process. First, the literature was reviewed to identify cybersecurity requirements and assessment domains relevant to Cloud ERP platforms. Second, these findings were synthesised into the CECAF. Third, the framework was applied to the selected case through systematic evidence collection and capability assessment. Finally, the results were analysed to identify cybersecurity strengths, potential vulnerabilities, and opportunities for improvement. This process establishes a connection between the theoretical foundations, the analytical framework, and the empirical evaluation, enhancing the methodological rigour and reproducibility of the study.

Research Context: Infor CloudSuite Industrial

The selected case is Infor CloudSuite Industrial (Infor CSI), a cloud-native ERP platform primarily designed for manufacturing organisations. It integrates core business processes, including production planning, procurement, inventory management, supply chain management, finance, customer relationship management, and quality management, within a unified cloud environment. As a SaaS solution, Infor CSI incorporates embedded cybersecurity mechanisms supporting secure data management, user authentication, access control, regulatory compliance, and continuous service availability.

Infor CSI was selected for three reasons. First, it represents a contemporary Cloud ERP platform with cybersecurity capabilities aligned with internationally recognised security standards and current cloud security practices. Second, its

architecture integrates multiple layers of cybersecurity controls, including IAM, encryption, application security, infrastructure protection, security monitoring, and governance, providing an appropriate environment for cybersecurity assessment. Third, the platform is widely adopted in manufacturing organisations, making the findings relevant to comparable Cloud ERP implementations.

The assessment focuses on cybersecurity capabilities embedded within the platform rather than organisation-specific security policies or implementation practices. Accordingly, the CECAF was applied to evaluate documented cybersecurity mechanisms while minimising the influence of organisation-specific factors that may differ across individual implementations.

The unit of analysis is the cybersecurity capability of the selected Cloud ERP platform. Rather than evaluating individual security features in isolation, the assessment examines how governance mechanisms, technical safeguards, operational controls, and compliance measures collectively contribute to overall cybersecurity capability. This holistic perspective enables a consistent assessment across the six CECAF domains.

Cloud ERP Cybersecurity Assessment Framework (CECAF)

The cybersecurity assessment was conducted using the CECAF. Developed through the synthesis of academic literature, internationally recognised cybersecurity standards, and industry best practices, the CECAF provides a structured instrument for evaluating cybersecurity capabilities

in Cloud ERP platforms. Rather than proposing a new cybersecurity framework, it operationalises established cybersecurity principles into a consistent analytical assessment methodology. Its development was informed by ISO/IEC 27001:2022, the NIST Cybersecurity Framework (CSF 2.0), the Cloud Security Alliance Cloud Controls Matrix (CCM), and recent research on cybersecurity challenges and maturity assessment in Cloud ERP platforms (ISO/IEC, 2022; NIST, 2024; Cloud Security Alliance, 2024; Anica-Popa et al., 2024; Qazi et al., 2026).

The CECAF translates cybersecurity requirements identified in the literature into six complementary assessment domains representing the principal organisational, technical, and operational dimensions of Cloud ERP cybersecurity. By organising predefined domains and representative assessment criteria, it supports a systematic, transparent, and repeatable evaluation while enabling cybersecurity capabilities to be assessed holistically rather than as isolated security controls. This multidimensional perspective is consistent with previous research advocating structured cybersecurity assessments in cloud environments (Almorsy et al., 2016; Sunyaev, 2020).

Unlike recent approaches that focus primarily on benchmarking or ranking ERP platforms, the CECAF emphasises an evidence-based assessment of cybersecurity capabilities within a selected Cloud ERP environment. It supports the evaluation of governance mechanisms, technical safeguards, operational controls, and compliance practices through a consistent analytical methodology (Qazi et al., 2026). The structure of the CECAF is presented in Table 1.

Table 1
CECAF: Assessment Domains, Representative Assessment Criteria, Evidence Sources, and Capability Assessment

Assessment Domain	Representative Assessment Criteria	Typical Evidence	Capability Assessment
Identity and Access Management (IAM)	User authentication, Multi-Factor Authentication (MFA), Role-Based Access Control (RBAC), Single Sign-On (SSO), privileged access management, password policies	System configuration, security settings, vendor documentation, and administration guides	Level 1–5
Data Protection and Privacy	Encryption at rest, encryption in transit, key management, backup and recovery, data retention, privacy controls	Encryption documentation, backup policies, compliance reports, and technical documentation	Level 1–5
Infrastructure and Network Security	Network segmentation, firewalls, secure cloud infrastructure, vulnerability management, endpoint protection, and infrastructure hardening	Infrastructure documentation, security architecture, vulnerability reports, cloud configuration	Level 1–5
Application Security	Secure software development, patch management, API security, application configuration, security testing, and secure integrations	Release notes, patch documentation, API documentation, security configuration	Level 1–5
Security Monitoring and Incident Response	Logging, audit trails, security monitoring, alerting, incident response procedures, threat detection	Audit logs, monitoring dashboards, incident response documentation, and security reports	Level 1–5
Governance, Risk, and Compliance	Security governance, risk management, compliance certifications, security policies, third-party assurance, and audit support	Security policies, compliance certificates, audit documentation, governance reports	Level 1–5

Source: Developed by the authors based on ISO/IEC (2022), NIST (2024), Cloud Security Alliance (2024), Anica-Popa et al. (2024), and Qazi et al. (2026).

Each representative assessment criterion was evaluated using a five-level Capability Maturity Model (CMM). The CMM assesses the extent to which cybersecurity capabilities are implemented, formalised, monitored, measured, and continuously improved. Applying a common maturity scale ensures consistency across assessment domains and facilitates comparison of cybersecurity capabilities. The use of maturity-based assessment is consistent with established maturity model research (Paulk et al., 1993; Becker et al., 2009) and recent cybersecurity assessment approaches for Cloud ERP systems (Qazi et al., 2026). The capability maturity levels are presented in Table 2.

Table 2

Capability Maturity Levels Used in the CECAF Assessment

Capability Level	Description
Level 1 – Initial	Cybersecurity practices are informal, limited, and primarily reactive. Security controls are implemented inconsistently or only after security incidents occur.
Level 2 – Managed	Basic cybersecurity controls have been implemented and are managed, although processes remain only partially standardised and are applied inconsistently across the platform.
Level 3 – Defined	Cybersecurity policies, procedures, and technical controls are formally documented, standardised, and consistently implemented throughout the platform.
Level 4 – Managed and measured	Cybersecurity capabilities are continuously monitored, measured, and periodically reviewed using defined security metrics and performance indicators to support proactive management.
Level 5 – Optimized	Cybersecurity capabilities are continuously improved through automation, advanced monitoring, proactive risk management, and the systematic adoption of security best practices.

Source: Adapted from Paulk et al. (1993), Becker et al. (2009), and Qazi et al. (2026).

Each capability rating was supported by documented evidence, including observable security features, system configuration settings, vendor technical documentation, compliance documentation, administrative guides, audit reports, and other verifiable sources. This evidence-based approach reduces evaluator subjectivity, strengthens consistency, and improves assessment repeatability (Yin, 2018; ISO/IEC, 2022).

The CECAF integrates governance mechanisms, technical safeguards, operational controls, and compliance practices into a single analytical framework for evaluating cybersecurity capabilities. The resulting capability profile provides a structured basis for identifying cybersecurity strengths, potential vulnerabilities, and opportunities for improvement.

Data Collection, Assessment Procedure, and Research Quality

The cybersecurity assessment was based on multiple sources of evidence to ensure a comprehensive evaluation of the selected cloud ERP platform. Consistent with evidence-based case research, information was collected from publicly available vendor documentation, technical implementation guides, security configuration documentation, compliance reports, official knowledge base articles, product release documentation, and other official information describing the cybersecurity capabilities of Infor CSI (Yin, 2018).

Using multiple evidence sources enabled methodological triangulation by verifying cybersecurity capabilities through different types of documentation rather than relying on a single source. Whenever possible, individual assessment criteria were supported by multiple sources of evidence. The collected evidence was organised according to the six assessment domains of the CECAF before the capability assessment.

The assessment followed a four-stage procedure. First, the collected evidence was reviewed and classified according to the six CECAF assessment

domains. Relevant security mechanisms, governance practices, technical safeguards, and compliance features were identified for each assessment criterion. Second, the documented evidence was evaluated against the representative assessment criteria presented in Table 1. Third, each assessment criterion was assigned a capability maturity level using the five-level CMM presented in Table 2. Capability ratings were based exclusively on documented evidence. Finally, the individual assessments were synthesised into an overall cybersecurity capability profile identifying cybersecurity strengths, potential weaknesses, and opportunities for improvement.

The collected evidence was analysed qualitatively using the CECAF. Cybersecurity capabilities were evaluated against predefined assessment criteria and maturity levels, with a focus on their presence, completeness, and maturity across the six assessment domains. Particular attention was given to aligning governance mechanisms, technical controls, operational security practices, and compliance measures to provide an integrated assessment of cybersecurity capability. The findings were synthesised into domain-level assessments and an overall cybersecurity capability profile.

Several measures enhanced the quality and credibility of the assessment. First, the CECAF provided predefined assessment domains, representative criteria, evidence requirements, and the CMM, ensuring consistency throughout the evaluation. Second, each capability rating was supported by documented, verifiable evidence from multiple official sources, thereby strengthening methodological triangulation and reducing subjective interpretation (Yin, 2018). Third, the

predefined capability maturity levels enabled consistent evaluation across all assessment domains and facilitated comparison of cybersecurity capabilities (Becker et al., 2009; Paulk et al., 1993). Finally, the explicit documentation of the assessment procedure, evaluation criteria, and evidence sources supports replication of the methodology and application of the CECAF to other Cloud ERP platforms. Although based on a single case research, the framework provides a structured and transferable approach for future cybersecurity assessments.

Results

To achieve the research objective, the CECAF was applied to assess Infor CSI's cybersecurity capabilities across six assessment domains. The assessment was based exclusively on documented technical evidence obtained from official vendor documentation, security administration guides, API documentation, compliance documentation, and the Infor Trust Center. Capability maturity levels were assigned solely on documented evidence rather than vendor claims.

The assessment indicates that Infor CSI demonstrates a high level of cybersecurity capability. Four of the six assessment domains achieved Capability Maturity Level 4 (Managed), while two achieved Level 3 (Defined). These findings indicate that cybersecurity is systematically supported through technical controls, centralised administration, and governance mechanisms. The lower maturity levels reflect limitations in publicly available technical evidence rather than deficiencies in cybersecurity capabilities. Consequently, Level 3 assessments should be interpreted as evidence limitations within the

CECAF rather than lower security maturity.

Table 3 summarises the cybersecurity capability profile produced by the CECAF. The strongest capabilities were identified in IAM, Application and Platform Security, Integration and API Security, and Compliance, Governance and Resilience, where extensive technical documentation supports mature

security controls. Lower maturity levels were assigned to Data Protection and Privacy and Monitoring, Logging, and Auditability because several advanced capabilities could not be fully verified using publicly available documentation. Consequently, the assessment reflects both implemented cybersecurity controls and the availability of documented technical evidence.

Table 3

Cybersecurity Capability Profile of Infor CSI Based on the CECAF Assessment

CECAF Assessment Domain	Assessment Dimensions	Key Technical Evidence	CMM Level
Identity and Access Management (IAM)	Authentication; Authorisation; Identity Federation; Access Governance	MFA, RBAC, SAML federation, centralized identity administration	Level 4 – Managed
Application and Platform Security	Infrastructure Security; Secure Configuration; Vulnerability Management; Platform Protection	Secure cloud infrastructure, centralized security configuration, vulnerability management, and platform protection	Level 4 – Managed
Data Protection and Privacy	Data Encryption; Data Lifecycle Protection; Backup and Recovery; Privacy Protection	Data protection controls, backup and recovery processes, privacy framework, and GDPR compliance	Level 3 – Defined
Integration and API Security	API Authentication; Secure Communication; API Management; Integration Security	OAuth 2.0 authentication, API Gateway, HTTPS communication, secure system integration	Level 4 – Managed
Monitoring, Logging and Auditability	Audit Logging; Security Monitoring; Event Traceability; Incident Support	Audit logging, event traceability, operational monitoring, vulnerability reporting	Level 3 – Defined
Compliance, Governance and Resilience	Regulatory Compliance; Security Governance; Business Continuity; Risk Management	ISO certifications, SOC assurance reports, business continuity planning, security governance	Level 4 – Managed

Source: Authors' assessment based on Infor (2020, 2023, 2024, n.d.).

Identity and Access Management

The IAM domain achieved Level 4 (Managed), indicating a mature approach to authentication, authorisation, and identity administration. The assessment identified comprehensive support for enterprise authentication mechanisms, including

multi-factor authentication (MFA), role-based access control (RBAC), centralised identity administration, and federated identity management based on Security Assertion Markup Language (SAML). Together, these capabilities provide a robust foundation for controlling user access to cloud ERP resources while reducing the risk of

unauthorised access (Infor OS Security Administration Guide, n.d.; Infor Federated Security, n.d.).

The assessment also confirmed support for configurable authentication policies, delegated administration, service account management, and integration with external identity providers. These capabilities support centralised identity management consistent with the principle of least privilege and strengthen identity protection by enabling federated authentication through enterprise identity providers (Infor OS User Administration Guide, n.d.).

Although authentication, authorisation, and identity federation demonstrated mature, well-documented capabilities, the available documentation provides limited evidence of advanced identity governance mechanisms, including automated access recertification, segregation-of-duties (SoD) analysis, privileged access management (PAM), and continuous identity risk assessment. While these capabilities may exist within broader enterprise security ecosystems, they cannot be verified from publicly available technical documentation.

The findings indicate that Infor CSI provides mature identity protection capabilities supported by documented technical controls. However, the available evidence was insufficient to justify the highest maturity level.

Application and Platform Security

The Application and Platform Security domain achieved Level 4 (Managed), reflecting a mature implementation of technical and organisational security controls. The assessment covered four

dimensions: infrastructure security, secure configuration, vulnerability management, and platform protection, demonstrating that security is embedded throughout the design, deployment, and operation of the cloud ERP platform (Infor Trust Center, n.d.).

The assessment identified substantial evidence of secure cloud infrastructure management, including documented security controls, centralised security administration, and internationally recognised compliance certifications. Secure configuration is supported by documented administrative procedures enabling organisations to configure authentication policies, security domains, session management, and other platform security settings in a controlled and consistent manner (Infor OS Security Administration Guide, n.d.; Infor Information Security Plan, 2023).

The vulnerability management dimension also demonstrated a high level of maturity. Official documentation outlines coordinated vulnerability disclosure procedures, structured security assessments, and regular maintenance processes to identify and mitigate security weaknesses throughout the platform lifecycle. Secure cloud architecture, encrypted communications, tenant isolation, and layered infrastructure protection further support platform protection.

Although all four assessment dimensions demonstrated mature capabilities, the publicly available documentation provides limited evidence of advanced infrastructure hardening techniques, autonomous threat-prevention mechanisms, and internal security engineering practices. Consequently, the available evidence supports a managed cybersecurity environment but is

insufficient to justify the highest maturity level.

The findings indicate that Application and Platform Security is one of the strongest cybersecurity domains of the evaluated platform. Comprehensive documentation of security controls, centralised administration, and vulnerability management demonstrates a mature and well-managed security environment.

Data Protection and Privacy

The Data Protection and Privacy domain achieved Level 3 (Defined). The assessment covered four dimensions: data encryption, data lifecycle protection, backup and recovery, and privacy protection. While it identified a comprehensive organisational framework supporting data protection and privacy, the publicly available documentation provided less detailed evidence for several advanced technical controls than in other assessment domains (Infor Data Privacy, 2024).

The privacy protection dimension demonstrated the highest level of maturity. Official documentation describes established privacy governance practices, compliance with the General Data Protection Regulation (GDPR), and policies governing the processing, protection, and management of customer data. These measures indicate that privacy management is formally integrated into the platform's governance framework (Infor Information Security Plan, 2023; Infor Trust Center, n.d.).

The documentation also describes administrative, technical, and physical safeguards for protecting customer information throughout its lifecycle. In addition, backup and recovery mechanisms are incorporated into the SaaS operating model to

support service availability and organisational resilience.

However, publicly available documentation provides limited evidence for several important aspects of data protection, including encryption key management, secure data deletion procedures, product-specific data retention mechanisms, and recovery objectives for individual ERP services. Because the CECAF assigns capability levels solely on verifiable, documented evidence, these limitations influenced the assessment.

The findings indicate mature organisational privacy governance and well-established data protection practices. However, the available evidence was insufficient to verify several advanced technical capabilities. Consequently, the assessment reflects the availability of documented technical evidence rather than deficiencies in the platform's overall approach to data protection and privacy.

Integration and API Security

The Integration and API Security domain achieved Level 4 (Managed), demonstrating a mature approach to securing the platform's integration architecture. The assessment covered four dimensions: API authentication, secure communication, API management, and integration security. Together, these dimensions indicate that Infor CSI provides a robust framework for secure communication between the ERP platform and external applications, services, and enterprise systems (Infor ION API Administration Guide, n.d.; Infor OS API Gateway Administration Guide, n.d.).

The strongest evidence was identified in the API authentication and API management dimensions.

Official documentation describes the implementation of OAuth 2.0 authentication, bearer token authorisation, centralised management of authorised applications, and secure client registration through the API Gateway. These mechanisms provide standardised authentication and authorisation procedures widely recognised as best practices for protecting APIs (Infor ION API Administration Guide, n.d.).

The secure communication dimension further demonstrates platform maturity by enabling encrypted communication via HTTPS and Transport Layer Security (TLS). Together with centralised API administration and secure integration mechanisms, these controls help ensure the confidentiality, integrity, and authenticity of information exchanged between interconnected systems.

The integration security dimension supports secure system-to-system communication through standardised authentication flows, controlled API access, and secure integration services. These capabilities enable organisations to integrate Infor CSI with heterogeneous enterprise environments while maintaining consistent security controls across multiple integration points.

Overall, the available evidence demonstrates a mature integration security architecture supported by well-documented technical controls. However, publicly available documentation provides limited evidence of advanced API threat detection, adaptive protection mechanisms, behavioural analytics, and automated protection against API abuse. Consequently, the findings support a mature integration security capability, although the available evidence was insufficient to justify the highest maturity level.

Monitoring, Logging and Auditability

The Monitoring, Logging, and Auditability domain achieved Level 3 (Defined). The assessment covered four dimensions: audit logging, security monitoring, event traceability, and incident support. Although comprehensive capabilities supporting auditability and operational transparency were identified, the available documentation provides limited evidence regarding advanced security monitoring and automated incident response capabilities (Infor Audit Logging Documentation, n.d.).

Among the four assessment dimensions, audit logging and event traceability demonstrated the highest level of maturity. Official documentation describes configurable audit logs for user activities, administrative actions, authentication events, and system operations. These capabilities establish comprehensive traceability of critical activities within the cloud ERP environment and provide a strong foundation for internal controls, compliance verification, and digital forensic investigations (Infor ION API Administration Guide, n.d.; Infor Trust Center, n.d.).

The documentation also describes monitoring capabilities for operational processes, API transactions, and administrative activities. In addition, Infor maintains a structured vulnerability reporting programme enabling security researchers and customers to report suspected vulnerabilities through established disclosure procedures. These processes contribute to continuous platform security improvement and strengthen accountability throughout the security lifecycle.

However, the available evidence provides limited insight into capabilities typically associated with

highly mature security operations, including integrated SIEM, automated threat detection, security orchestration, behavioural anomaly detection, and automated incident response. As these capabilities could not be verified through publicly available documentation, they were not considered in the maturity assessment.

The findings indicate strong support for auditability, accountability, and operational monitoring. However, the available evidence was insufficient to verify advanced operational cybersecurity capabilities typically associated with the highest maturity level.

Compliance, Governance, and Resilience

The Compliance, Governance and Resilience domain achieved Level 4 (Managed), indicating a mature governance framework supported by internationally recognised compliance practices and documented resilience measures. The assessment covered four dimensions: regulatory compliance, security governance, business continuity, and risk management (Infor Trust Center, n.d.).

The strongest evidence was identified in the regulatory compliance and security governance dimensions. Official documentation demonstrates that Infor maintains internationally recognised certifications and assurance programmes, including ISO certifications and SOC assurance reports, complemented by documented information security policies and privacy management practices. Together, these mechanisms establish a formal governance structure supporting regulatory compliance and the consistent implementation of cybersecurity controls across the cloud ERP environment (Infor Information Security Plan, 2023; Infor Business Continuity Plan Overview, 2020).

The business continuity dimension also demonstrated a high level of maturity. Publicly available documentation describes business continuity and disaster recovery planning, including organisational procedures for maintaining service availability and recovering from operational disruptions. These measures strengthen platform resilience and support the continuity of critical business services.

In contrast, the risk management dimension was supported primarily by documented vulnerability disclosure procedures and organisational security management practices. While these mechanisms demonstrate a structured approach to identifying and addressing security risks, the available documentation provides limited evidence of enterprise-wide cybersecurity risk metrics, continuous resilience testing, quantitative risk assessment, and governance performance indicators. Consequently, the available evidence was insufficient to verify the most advanced risk management capabilities.

The findings indicate that Infor CSI is supported by a mature governance framework integrating compliance, security management, and operational resilience. However, the available evidence was insufficient to justify the highest maturity level (Infor Trust Center, n.d.; Infor Information Security Plan, 2023; Infor Business Continuity Plan Overview, 2020).

Overall Assessment of the CECAF Capability Profile

The overall CECAF capability profile indicates that Infor CSI demonstrates a consistently high level of cybersecurity capability across the evaluated domains. Four domains achieved Level 4 (Managed), reflecting mature implementation of technical

security controls, centralised administration, secure integration mechanisms, and governance practices. The remaining two domains—Data Protection and Privacy and Monitoring, Logging and Auditability—achieved Level 3 (Defined).

These lower maturity levels should not be interpreted as evidence of weaker cybersecurity controls. Instead, they reflect the evidence-based assessment principles of the CECAF, under which capability levels were assigned exclusively based on publicly verifiable technical evidence. Where sufficient evidence was unavailable to verify advanced cybersecurity capabilities, higher maturity levels were not assigned.

This assessment approach enhances methodological transparency and reproducibility by emphasising documented technical capabilities rather than vendor claims or marketing materials. Consequently, the resulting capability profile represents an evidence-based evaluation of publicly documented cybersecurity capabilities rather than a comprehensive audit of all security mechanisms implemented within the platform.

Overall, the findings demonstrate that Infor CSI provides a mature cybersecurity environment characterised by robust identity management, secure cloud platform architecture, standardised API security, and comprehensive governance practices. They also highlight the importance of transparent technical documentation when assessing cybersecurity capabilities in cloud ERP platforms. This observation provides the basis for discussing the findings, their relationship to existing cybersecurity frameworks and prior research, and the methodological contribution of the CECAF.

Discussion

The primary objective of this study was to evaluate the cybersecurity capabilities of a cloud ERP platform using the proposed CECAF and to examine whether an evidence-based analytical framework can provide a transparent, systematic, and reproducible approach to cybersecurity assessment based on publicly available technical documentation. The assessment demonstrated that Infor CSI exhibits a consistently high level of cybersecurity capability, with four assessment domains achieving Level 4 (Managed) and two achieving Level 3 (Defined). Overall, the findings indicate that cybersecurity within the evaluated cloud ERP platform is supported by an integrated combination of technical controls, administrative mechanisms, and governance practices rather than isolated security measures.

Although the Data Protection and Privacy and Monitoring, Logging and Auditability domains achieved Level 3 (Defined), these results should not be interpreted as evidence of weaker cybersecurity capabilities. Instead, they reflect the limited availability of publicly verifiable technical evidence for advanced capabilities, including encryption key management, behavioural monitoring, security operations, and automated incident response. Consequently, while such capabilities may be implemented within the platform, they could not be independently verified using the evidence available at the time of the assessment.

This observation highlights an important methodological contribution of the CECAF. The findings demonstrate that cybersecurity capability assessment depends not only on the

implementation of security controls but also on the availability of verifiable technical evidence to support them. By assigning capability levels exclusively on documented evidence, the CECAF promotes a transparent, reproducible, and evidence-based assessment while reducing reliance on vendor claims or marketing materials.

Taken together, these findings demonstrate that the CECAF addresses the identified research gap by providing a structured methodology for assessing cybersecurity capabilities in cloud ERP platforms, supported by documented technical evidence.

The findings are broadly consistent with previous research identifying identity and access management, secure cloud infrastructure, governance, and secure integration as fundamental components of cloud ERP cybersecurity (Lee et al., 2024; Anica-Popa et al., 2024; NIST, 2024). Consistent with these studies, the assessment confirms that effective cloud ERP cybersecurity depends on the coordinated implementation of technical, organisational, and governance controls rather than isolated security mechanisms.

The high maturity observed in the IAM and Integration and API Security domains reinforces previous research highlighting secure authentication, identity federation, API protection, and secure interoperability as essential requirements for cloud-based enterprise systems (Rose et al., 2020; Bertino, 2021; NIST, 2024). As cloud ERP platforms become increasingly interconnected with external applications and cloud services, these capabilities become critical for maintaining secure enterprise environments.

The findings for Data Protection and Privacy and Monitoring, Logging and Auditability also support

previous research emphasising privacy governance, regulatory compliance, continuous monitoring, auditability, and incident response as key cybersecurity capabilities in cloud environments (ISO/IEC, 2022; NIST, 2024; Anica-Popa et al., 2024). However, this study extends existing research by demonstrating that cybersecurity assessment should distinguish between implemented security capabilities and those that can be independently verified through official technical documentation. By incorporating documented technical evidence as an explicit assessment criterion, the CECAF strengthens the objectivity and reproducibility of cybersecurity capability assessment.

Compared with previous cloud ERP research, the principal contribution of this study lies not in identifying additional cybersecurity controls but in providing a structured methodology for evaluating documented cybersecurity capabilities. While existing studies have primarily focused on cybersecurity risks, adoption challenges, governance issues, and conceptual security requirements, the CECAF integrates assessment domains, predefined evaluation criteria, documented technical evidence, and capability maturity levels into a single analytical framework. In doing so, it complements existing cybersecurity maturity research by enabling transparent, systematic, and comparable assessments across cloud ERP platforms (Liyanage et al., 2024; Rose et al., 2020).

The findings have several theoretical implications for cloud ERP cybersecurity research. First, the primary contribution of this study is the development of the CECAF, which addresses the identified research gap by providing a structured analytical framework integrating cybersecurity assessment domains, predefined assessment

criteria, documented technical evidence, and capability maturity levels into a unified evaluation methodology. While previous studies have primarily focused on cybersecurity risks, security controls, or challenges in cloud ERP adoption, the CECAF provides a systematic approach for evaluating cybersecurity capabilities using consistent, transparent assessment criteria. In this respect, it contributes to the growing body of research on cybersecurity capability maturity assessment by operationalising cybersecurity evaluation within the context of cloud ERP platforms (Brezavšek & Baggia, 2025).

Second, this study demonstrates the application of the CECAF through a real-world case research of Infor CSI. Rather than presenting the framework as a conceptual model, it shows how publicly available official technical documentation can be systematically analysed to produce an evidence-based cybersecurity capability profile. This demonstrates the practical feasibility and reproducibility of the proposed methodology and provides a foundation for future comparative studies across cloud ERP platforms.

Third, the study contributes methodologically by demonstrating that the transparency and completeness of official technical documentation directly influence the objectivity and reproducibility of cybersecurity capability assessment. Accordingly, cybersecurity maturity should be evaluated not only by implemented security mechanisms but also by the availability of verifiable technical evidence supporting those mechanisms. This complements recent research on cybersecurity capability maturity models by emphasising the importance of evidence-based assessment principles (Brezavšek & Baggia, 2025; Liyanage et al., 2024).

From a practical perspective, the CECAF provides organisations with a structured methodology for evaluating cybersecurity capabilities during cloud ERP selection, implementation, governance, and periodic security reviews. By applying consistent assessment domains and predefined capability maturity criteria, it enables transparent and comparable evaluations based on publicly available technical documentation, reducing reliance on marketing materials or subjective assessments and supporting more informed decision-making.

Although this study focused on Infor CSI, the CECAF was designed to be vendor-independent and can be applied to other cloud ERP platforms with sufficient official technical documentation. As a result, the framework provides a practical basis for benchmarking cybersecurity capabilities across cloud ERP solutions using a consistent, transparent, and reproducible assessment methodology.

Conclusion

This study achieved its objective by developing and demonstrating the CECAF for systematically evaluating cybersecurity capabilities in cloud ERP platforms. Using Infor CSI as a case research, the framework was applied to assess six cybersecurity domains based exclusively on publicly available official technical documentation. The results indicate a consistently high level of cybersecurity capability, with four domains achieving Level 4 (Managed) and two achieving Level 3 (Defined). More importantly, the findings demonstrate that an evidence-based assessment approach enables transparent and reproducible evaluation of cloud ERP cybersecurity capabilities.

By addressing the identified research gap, this study

makes three principal contributions. First, it develops the CECAF, a structured analytical framework for systematically evaluating cybersecurity capabilities in cloud ERP platforms. Second, it demonstrates the practical application of the framework through an evidence-based assessment of Infor CSI using publicly available technical documentation. Third, it highlights the methodological importance of transparent and comprehensive technical documentation for objective, reproducible, and consistent cybersecurity capability assessment.

From a practical perspective, the CECAF provides organisations with a structured methodology to support cloud ERP selection, implementation, governance, and periodic cybersecurity assessments. By applying consistent assessment domains and predefined capability maturity criteria, it enables transparent and comparable evaluations across cloud ERP platforms.

Several limitations should be acknowledged. First,

the study is based on a single cloud ERP case, limiting the generalisability of the findings. Second, the assessment relied exclusively on publicly available official technical documentation; as a result, proprietary cybersecurity mechanisms could not be evaluated. Finally, because cloud ERP platforms and their technical documentation continuously evolve, the findings represent documented cybersecurity capabilities at the time of the assessment.

Future research should apply the CECAF to additional cloud ERP platforms, including SAP S/4HANA Cloud, Microsoft Dynamics 365, Oracle Fusion Cloud ERP, and Odoo, to enable comparative cybersecurity assessments across vendors. Further validation through multiple case studies, expert evaluations, and longitudinal assessments would strengthen the framework and support the continued development of evidence-based methodologies for cloud ERP cybersecurity assessment.

Data Availability: Findings in this paper are based on publicly available technical documentation of Infor CSI (Infor, n.d.).

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Razvoj ocenjevalnega okvira kibernetске varnosti za ERP-rešitve v oblaku (CECAF): ocenjevanje zmogljivosti kibernetске varnosti oblačnih ERP-platform

Izveček

Namen raziskave je razviti okvir za ocenjevanje kibernetске varnosti ERP-rešitev v oblaku (CECAF), ki omogoča sistematično vrednotenje zmogljivosti kibernetске varnosti oblačnih ERP-platform. Okvir je bil razvit s sintezo znanstvene literature, mednarodno priznanih standardov kibernetске varnosti, načel ocenjevanja zrelosti zmogljivosti kibernetске varnosti in specifičnih zahtev kibernetске varnosti ERP-rešitev v oblaku. Njegova uporabnost je prikazana na primeru ocenjevanja rešitve Infor CloudSuite na podlagi javno dostopne uradne tehnične dokumentacije. Ugotovitve kažejo, da CECAF omogoča strukturirano, pregledno in ponovljivo vrednotenje zmogljivosti kibernetске varnosti na več ocenjevalnih področjih. Raziskava prispeva k razvoju področja z uvedbo analitičnega ocenjevalnega okvira, prilagojenega ERP-platformam v oblaku, ter poudarja metodološki pomen dokumentiranih tehničnih dokazov za objektivno ocenjevanje zmogljivosti kibernetске varnosti. Okvir zagotavlja praktične smernice za ocenjevanje kibernetске varnosti in primerjalno vrednotenje ERP-platform v oblaku.

Ključne besede: ERP-rešitve v oblaku; kibernetска varnost; okvir za ocenjevanje kibernetске varnosti; ocenjevanje zmogljivosti kibernetске varnosti; ocenjevanje na podlagi dokazov; zrelost kibernetских zmogljivosti.

Digital Transformation of Anti-Money Laundering Business Processes: A Capability-Oriented Perspective on Analytics-Driven AML

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Abstract

Anti-money laundering (AML) is becoming an increasingly information-intensive business process requiring advanced analytical support for effective organisational decision-making. Although previous research has extensively investigated machine learning, graph analytics, and other analytical methods, existing studies largely examine these approaches as isolated technological solutions. This conceptual study adopts a business process perspective. It develops a capability-oriented framework for analytics-driven AML by synthesizing digital transformation, business process management, business analytics, and AML literature. This perspective conceptualises the digital transformation of AML as the coordinated development of interconnected organisational analytical capabilities embedded within business processes. The study contributes by integrating previously fragmented research streams into a coherent, management-oriented perspective. It provides a conceptual foundation for future empirical research and practical guidance for financial institutions pursuing analytics-driven AML transformation.

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Introduction

Digital transformation has fundamentally reshaped how organisations create value, organise business processes, and support managerial decision-making. Rather than representing the simple adoption of new digital technologies, digital transformation involves comprehensive organisational change in which digital capabilities become embedded within business processes, organisational structures, and strategic decision-making (Bharadwaj et al., 2013; Vial, 2019; Warner & Wäger, 2019). Accordingly, organisations redesign information-intensive business processes to improve agility, responsiveness, and decision quality in rapidly changing business environments.

Among the business processes most profoundly affected by digital transformation is anti-money laundering (AML). Financial institutions operate in an environment characterised by continuously evolving financial crime typologies, increasing regulatory expectations, growing transaction volumes, and expanding data complexity. As a result, AML has evolved from a predominantly compliance-oriented function into a knowledge-intensive business process that requires the continuous collection, integration, analysis, and interpretation of large volumes of heterogeneous information to support timely and effective organisational decision-making. The effectiveness of AML, therefore, depends not only on regulatory compliance but increasingly on the organisation's ability to process information, assess risk, and respond adaptively to emerging threats (Cornelli et al., 2021; Papathomas & Konteos, 2024).

Traditional AML systems have historically relied on predefined rules, threshold-based transaction monitoring, and manual investigation procedures.

Although these approaches remain essential components of regulatory compliance, they have become increasingly challenged by the growing complexity of financial crime. Criminal networks continuously modify their behaviour, exploit interconnected financial relationships, and operate across multiple institutions and jurisdictions, making suspicious activities more difficult to detect through static monitoring rules alone. As a result, financial institutions face persistent challenges, including high volumes of false-positive alerts, fragmented information, limited analytical integration, and increasing investigative workloads (Oliveira et al., 2025; Korherr et al., 2022; Oztas et al., 2024).

These challenges have spurred rapid advances in analytical approaches to support AML decision-making. Recent research has demonstrated the potential of machine learning, behavioural analytics, graph analytics, heterogeneous graph neural networks, and integrated analytical platforms to improve transaction monitoring, customer risk assessment, anomaly detection, and network analysis (Colladon & Remondi, 2017; Chai et al., 2023; Johannessen & Jullum, 2025; Deprez et al., 2025). Collectively, these developments illustrate a broader shift towards analytics-driven AML, in which analytical methods increasingly support multiple stages of the AML business process rather than isolated operational tasks.

Despite these significant advances, the existing literature remains fragmented. Research on digital transformation primarily focuses on organisational change and business process redesign, and business process management research emphasises process improvement and coordination. At the same time, AML studies predominantly evaluate individual analytical methods or technological solutions. As a

result, current research provides a limited understanding of how these complementary perspectives collectively explain the digital transformation of AML as a business process. Existing studies offer valuable insights into specific analytical techniques. However, they pay considerably less attention to how these approaches interact to develop the organisational analytical capabilities required for analytics-driven AML.

This study addresses this conceptual gap by adopting a business process perspective on the digital transformation of AML. Instead of viewing digital transformation as the implementation of individual analytical technologies, the study argues that it should be understood as the development of interconnected organisational analytical capabilities that collectively support analytics-driven business processes. Building on the synthesis of literature from digital transformation, business process management, business analytics, and AML research, the study develops a capability-oriented conceptual framework that explains how complementary analytical capabilities enable the transformation of AML from a predominantly compliance-oriented function into an analytics-driven business process. Accordingly, the study addresses the following research question: How can the digital transformation of AML be conceptualised from a business process perspective through organisational analytical capabilities?

The study makes three principal contributions. First, it integrates four research streams—digital transformation, business process management, business analytics, and AML—into a unified conceptual perspective. Second, it introduces a capability-oriented explanation of analytics-driven AML that shifts attention from isolated analytical

methods towards complementary organisational analytical capabilities embedded within business processes. Third, it provides a management-oriented perspective that expands current understanding of AML beyond regulatory compliance and technological implementation by conceptualising AML as a digitally transforming organisational business process.

The remainder of the paper is organised as follows. Section 2 reviews the literature on digital transformation, business process management, business analytics, and AML and identifies the existing research gap. Section 3 develops the proposed capability-oriented conceptual framework for analytics-driven AML. Section 4 discusses the theoretical and managerial implications of the proposed perspective, outlines its limitations, and suggests directions for future research.

Literature Review

Digital Transformation of Business Processes in Financial Institutions

Digital transformation has become one of the principal drivers of organisational change across industries, fundamentally reshaping how organisations create value, organise business processes, and support managerial decision-making. Contemporary research consistently emphasises that digital transformation should not be understood merely as the implementation of advanced digital technologies, but rather as a organisation-wide transformation encompassing business strategies, operational processes, organisational structures, and capabilities (Bharadwaj et al., 2013; Vial, 2019). From this perspective, digital technologies are important enablers of organisational change; however,

sustainable value creation occurs only when these technologies are embedded in redesigned business processes and integrated into organisational decision-making.

Accordingly, business process transformation has become a central element of digital transformation initiatives. Rather than simply automating existing activities, organisations increasingly redesign business processes to exploit digital technologies, improve organisational agility, strengthen operational performance, and support data-driven decision-making. The business process management literature suggests that successful digital transformation requires not only process redesign but also the continuous development of organisational capabilities that enable organisations to adapt their business processes to changing technological, organisational, and environmental conditions (Ahmad & Van Looy, 2020; Dumas et al., 2023; Warner & Wäger, 2019). Therefore, digital transformation is increasingly recognised as a continuous organisational capability rather than a discrete technology implementation project.

This organisational perspective is particularly relevant for financial institutions, where digital transformation extends far beyond customer-facing digital services and increasingly influences internally oriented business processes. The rapid growth of digital financial services, expanding data availability, increasing regulatory expectations, and rising operational complexity require financial institutions to redesign how critical business processes are organised, coordinated, and managed. Recent studies argue that competitive advantage in the financial sector depends not only on investments in digital technologies but also on the

organisational ability to transform data into actionable knowledge and integrate analytical insights into operational and strategic decision-making (Cornelli et al., 2021; Papathomas & Konteos, 2024).

An important implication of this transformation is the growing strategic importance of organisational capabilities. Digital transformation research increasingly argues that technologies themselves do not generate organisational value; instead, value is created through organisational capabilities that enable institutions to effectively utilise digital resources within business processes (Warner & Wäger, 2019; Ellström et al., 2022). These capabilities encompass not only technological competencies but also new approaches to information management, organisational learning, analytical decision-making, and cross-functional coordination. As organisations become increasingly data-intensive, the ability to transform data into reliable managerial insights becomes a critical prerequisite for effective business process performance.

Business processes characterised by intensive information processing, complex decision-making, and stringent regulatory requirements are particularly affected by digital transformation. Among these processes, AML is one of the most information-intensive and analytically demanding within financial institutions. Its effective execution increasingly depends on the ability to integrate large volumes of heterogeneous information, support complex organisational decision-making, and continuously respond to evolving financial crime risks. Understanding AML as a business process, therefore, provides the conceptual foundation for explaining why its ongoing digital

transformation extends beyond regulatory compliance towards analytics-driven organisational decision-making.

Anti-Money Laundering as a Business Process

AML has traditionally been examined primarily from a regulatory and compliance perspective. International regulatory frameworks define the objectives, principles, and obligations that financial institutions must fulfil to prevent the misuse of the financial system for money laundering and related financial crimes. Consequently, AML has frequently been perceived as a compliance function responsible for implementing customer due diligence, transaction monitoring, suspicious activity reporting, and ongoing regulatory oversight (Financial Action Task Force (FATF, 2023); Alnasser et al., 2020).

From a management perspective, however, regulatory requirements define what financial institutions are expected to achieve rather than how these objectives should be operationalised. Their implementation depends on the design and coordination of interconnected organisational activities involving information collection, customer risk assessment, transaction monitoring, alert investigation, reporting, and continuous decision-making. Accordingly, AML extends beyond regulatory compliance and can be understood as a complex organisational business process that integrates people, information, technologies, and managerial decisions to achieve both regulatory and organisational objectives (Dumas et al., 2023; Ahmad & Van Looy, 2020).

The business process management literature characterises business processes as coordinated sets of interrelated activities that transform

organisational resources and information into outcomes while enabling continuous improvement and organisational performance (Dumas et al., 2023; Ahmad & Van Looy, 2020). From this perspective, AML exhibits all the essential characteristics of a business process. Individual activities—including customer due diligence, customer risk assessment, transaction monitoring, alert investigation, suspicious activity reporting, and ongoing customer monitoring—are not independent compliance tasks but mutually dependent activities forming an integrated process of organisational decision-making. The output generated in one stage directly influences subsequent activities, requiring continuous coordination throughout the AML process.

Compared with many other organisational processes, AML is distinguished by exceptionally high levels of information intensity, uncertainty, and regulatory complexity. Financial institutions must continuously evaluate heterogeneous customer information, transactional data, beneficial ownership structures, sanctions lists, and external intelligence while simultaneously responding to evolving money laundering typologies and changing regulatory expectations. As a result, effective AML performance depends not only on regulatory compliance but also on the organisation's ability to process information, assess risk, coordinate knowledge across organisational functions, and support timely managerial decision-making (Papathomas & Konteos, 2024; Oztas et al., 2024).

This perspective also highlights the inherently cross-functional nature of AML business processes. Effective AML implementation requires close coordination among compliance departments, risk management, information technology, internal

audit, business units, and senior management. Rather than functioning as an isolated compliance activity, AML operates across organisational boundaries and depends upon continuous information sharing, integrated decision-making, and organisational collaboration. The effectiveness of AML therefore reflects not only compliance expertise but also the organisational capability to align business processes, information resources, and managerial decision-making across multiple functional areas (Warner & Wäger, 2019; Ellström et al., 2022).

Understanding AML as a business process has important implications for analysing its ongoing digital transformation. If AML is viewed exclusively as a regulatory obligation, technological innovation primarily appears as a means of improving compliance efficiency. However, when AML is understood as a business process, digital transformation is a broader organisational phenomenon that reshapes how information is collected, analysed, interpreted, and used to inform operational decisions. This perspective shifts attention from regulatory compliance alone towards improving organisational decision-making and business process performance. As transaction volumes continue to increase and financial crime becomes more complex, the effectiveness of traditional rule-based approaches becomes increasingly constrained, creating the need for new analytics-driven approaches to organisational decision-making.

From Rule-Based AML to Analytics-Driven Decision-Making

The traditional implementation of AML has largely relied on predefined rules, regulatory thresholds, and transaction-monitoring systems to identify

potentially suspicious financial activities. For many years, this rule-based approach provided financial institutions with a practical mechanism for fulfilling regulatory obligations by automatically identifying transactions that deviated from established risk criteria. Such systems remain an essential component of AML programmes, providing consistency, transparency, and regulatory accountability in routine monitoring activities (FATF, 2023; Oztas et al., 2024).

However, the operating environment of financial institutions has changed fundamentally. Rapid digitalisation of financial services, increasing transaction volumes, global payment infrastructures, fintech innovations, virtual assets, and increasingly sophisticated money laundering techniques have substantially increased both the complexity and the scale of AML activities. Financial crime has evolved from relatively isolated suspicious transactions towards highly coordinated, adaptive, and interconnected schemes involving multiple entities, jurisdictions, and financial channels. Consequently, managerial decision-making within AML business processes has become considerably more demanding than when conventional rule-based monitoring systems were originally designed (Vial, 2019; Cornelli et al., 2021; Papathomas & Konteos, 2024).

The literature consistently suggests that the principal limitations of traditional rule-based AML do not arise from the regulatory logic itself, but rather from the increasing complexity, volume, and interconnectedness of financial activities, which exceed the analytical capacity of static monitoring approaches. Static rules are inherently dependent on predefined scenarios and therefore perform effectively only when suspicious behaviour corresponds to previously known money laundering

typologies. As financial crime continues to evolve, rule-based systems often struggle to identify previously unseen behavioural patterns or complex relationships among customers, transactions, and financial networks. At the same time, they frequently generate large numbers of false-positive alerts, requiring extensive manual investigation by compliance analysts. This growing imbalance between increasing alert volumes and limited investigative resources creates significant operational challenges for financial institutions, reducing both the efficiency and the effectiveness of AML business processes (Korherr et al., 2022; Oliveira et al., 2025; Oztas et al., 2024).

From a management perspective, these limitations extend beyond the technical performance of monitoring systems. The principal challenge is not simply the inability of rule-based approaches to detect every suspicious transaction, but also their limited capacity to support effective decision-making in increasingly complex, data-intensive environments. Compliance analysts must continuously assess risk, prioritise investigative activities, interpret heterogeneous information, and make timely decisions under conditions of uncertainty. As the volume and complexity of available information continue to increase, decision-making based primarily on static rules and manual judgment becomes increasingly less sustainable (Davenport & Harris, 2017; Sharda et al., 2023; Warner & Wäger, 2019).

In response to these challenges, the literature advocates integrating business analytics into AML processes. Rather than replacing regulatory compliance, analytical approaches seek to augment organisational decision-making by transforming large volumes of heterogeneous data into actionable knowledge. Recent research explores a

broad spectrum of analytical methods, including machine learning, predictive risk scoring, behavioural analytics, adaptive monitoring, graph-based analysis, and network-oriented approaches. Although these approaches differ in their analytical techniques, they share a common objective: improving the quality, consistency, and timeliness of organisational decision-making throughout the AML process (Halford et al., 2025; Oliveira et al., 2025; Deprez et al., 2025; Johannessen & Jullum, 2025).

The reviewed literature, therefore, suggests that the ongoing evolution of AML should not be interpreted simply as a technological transition from rule-based systems to artificial intelligence. Instead, it reflects a broader transformation in the logic of organisational decision-making. While traditional AML primarily relied on predefined rules to support compliance activities, contemporary AML increasingly depends on analytical approaches that enable financial institutions to assess risks dynamically, prioritise investigative efforts, integrate diverse sources of information, and respond proactively to evolving financial crime. Understanding this evolution provides the conceptual foundation for examining how analytics has progressively transformed AML business processes (Davenport & Harris, 2017; Oztas et al., 2024; Deprez et al., 2025).

Evolution of Analytics in Anti-Money Laundering

The increasing limitations of traditional rule-based AML systems have spurred extensive research into analytical approaches that improve the effectiveness of organisational decision-making. Rather than replacing regulatory requirements, these approaches seek to enhance financial institutions' ability to identify suspicious activities,

assess financial crime risks, and support investigators in increasingly complex, data-intensive environments. Accordingly, the evolution of analytics in AML reflects a gradual transition from isolated monitoring techniques towards more sophisticated approaches that support multiple stages of the AML business process (Oztas et al., 2024; Deprez et al., 2025).

Early developments in AML analytics primarily focused on improving transaction monitoring through enhanced risk scoring, anomaly detection, and statistical analysis. These approaches addressed some of the operational limitations of traditional rule-based systems by enabling more effective identification of suspicious transactions and reducing unnecessary investigations. Although these analytical methods improved monitoring performance, they generally remained focused on individual transactions and predefined risk indicators rather than supporting broader organisational understanding of financial crime patterns (Oliveira et al., 2025; Korherr et al., 2022; Oztas et al., 2024).

Subsequent research increasingly incorporated machine learning and behavioural analytics to improve the adaptability of AML decision-making. Instead of relying exclusively on predefined rules, these approaches enabled analytical models to learn from historical transaction data, identify complex behavioural patterns, and estimate financial crime risks with greater flexibility. As a result, the analytical focus gradually shifted from detecting isolated suspicious transactions towards understanding customer behaviour, risk dynamics, and evolving money laundering typologies. This development significantly expanded the analytical support available to investigators while improving

the responsiveness of AML business processes to evolving criminal strategies (Oliveira et al., 2025; Halford et al., 2025).

A further stage in the evolution of AML analytics emerged as graph-based and network-oriented approaches gained wider application. Unlike transaction-centred analytical methods, graph analytics recognises that money laundering typically involves interconnected entities, accounts, organisations, and financial transactions rather than isolated events. Research on social network analysis, graph neural networks, heterogeneous graph learning, and sub-network discovery consistently demonstrates that analysing relationships among entities provides substantially richer insights into complex money laundering schemes than analysing transactions individually (Colladon & Remondi, 2017; Weber et al., 2019; Chai et al., 2023; Johannessen & Jullum, 2025; Deprez et al., 2025). These developments represent an important conceptual shift by redefining AML as the analysis of financial networks rather than merely the monitoring of financial transactions.

More recently, the literature has recognised that the effectiveness of AML analytics depends not only on individual analytical methods but also on the integration of heterogeneous data, complementary analytical models, and organisational decision-making processes. Graph databases, integrated analytical platforms, and network-based information structures illustrate this broader perspective by enabling financial institutions to combine customer information, transactional data, ownership structures, and relationship networks within unified analytical environments (Tiwari et al., 2023; Deprez et al., 2025). These developments suggest that the value of analytics increasingly

arises from combining multiple analytical approaches rather than relying on individual algorithms or isolated technological solutions.

The reviewed literature demonstrates a clear evolution in AML analytics, from improving individual analytical techniques to supporting increasingly integrated, information-rich organisational decision-making. While existing research provides substantial evidence regarding the effectiveness of specific analytical methods—including machine learning, behavioural analytics, graph analytics, and integrated data environments—it predominantly evaluates these developments as separate technological innovations. Considerably less attention has been devoted to understanding how these analytical approaches collectively contribute to the organisational transformation of AML business processes. This observation provides the conceptual foundation for identifying the research gap addressed in the following section. Consequently, although analytical sophistication has increased substantially, the literature provides only limited guidance on how financial institutions can systematically organise these analytical developments into coherent organisational capabilities that support analytics-driven AML business processes.

Research Gap and Research Synthesis

The reviewed literature demonstrates substantial progress in understanding the digital transformation of financial institutions, the process-oriented nature of AML, the limitations of traditional rule-based monitoring, and the growing role of advanced analytical methods in supporting AML decision-making. Collectively, these research streams indicate that AML is undergoing a profound transformation from a predominantly compliance-

oriented function towards a more data-intensive, analytically supported organisational business process. At the same time, they illustrate that this transformation extends beyond the adoption of individual analytical technologies and increasingly involves broader organisational changes affecting business processes, information management, and managerial decision-making.

Despite these advances, the existing literature remains fragmented. Studies on digital transformation primarily emphasise organisational change and business process redesign. At the same time, AML research predominantly evaluates individual analytical methods, including machine learning, behavioural analytics, graph analytics, and network-based approaches. Although these contributions have significantly advanced the analytical sophistication of AML, they generally investigate technological solutions in isolation and provide limited explanation of how different analytical approaches collectively support the transformation of AML business processes. Consequently, current knowledge offers only a partial understanding of how financial institutions can systematically develop the analytical capabilities required to support analytics-driven AML.

This fragmentation also reveals an important conceptual gap. Existing studies frequently propose or evaluate analytical models designed to improve specific tasks within the AML process, such as transaction monitoring, risk scoring, alert investigation, or network analysis. However, considerably less attention has been devoted to explaining how these complementary analytical approaches contribute to the development of integrated organisational capabilities that support decision-making across the entire AML business

process. As a result, the literature provides limited guidance for financial institutions seeking to move beyond isolated analytical applications towards a coherent, analytics-driven approach to AML management.

To address this gap, this study adopts a business process perspective. It proposes that the digital transformation of AML should be understood as the development of interconnected organisational analytical capabilities rather than the implementation of individual analytical techniques. Building on the synthesis of the reviewed literature, the study develops a conceptual perspective to understand how complementary analytical capabilities collectively support the digital transformation of AML business processes.

Accordingly, the following section develops the proposed conceptual framework by identifying and explaining the key analytical capabilities that collectively enable the transformation of AML from a traditional compliance-oriented function into an analytics-driven business process.

Organisational Analytics Capabilities Enabling Analytics-Driven AML Business Processes

Enabling the Transformation Towards an Analytics-Driven AML Business Process

The literature reviewed in the preceding sections consistently indicates that the digital transformation of business processes extends beyond the adoption of new technologies. Rather than representing isolated technological upgrades, digital transformation requires organisations to redesign business processes, develop new organisational capabilities, and fundamentally change how decisions are made and executed.

Digital technologies create opportunities for transformation, but sustainable improvements emerge only when organisations develop the capabilities required to effectively integrate data, analytics, and decision-making into their operational processes. Therefore, the successful digital transformation of business processes depends not only on technological innovation but also on the organisational ability to utilise these technologies coherently and systematically.

The proposed capabilities should not be interpreted as a maturity model or sequential implementation stages. Instead, they represent complementary and mutually reinforcing organisational capabilities whose relative importance may differ across organisational contexts.

This perspective is equally applicable to AML. Traditionally, AML has relied on predefined rules, transaction monitoring, and manual investigation to support regulatory compliance. However, increasing transaction volumes, more sophisticated money laundering schemes, and the growing complexity of financial networks have exposed important limitations of rule-based monitoring. Consequently, financial institutions increasingly adopt advanced analytical approaches—including machine learning, adaptive monitoring, graph analytics, and network-based analysis—to improve detection accuracy, reduce false positives, and identify increasingly complex patterns of suspicious behaviour.

However, the literature synthesis presented in this study also reveals an important limitation of current research. Most studies evaluate individual analytical techniques independently, with relatively little attention devoted to explaining how these analytical innovations collectively

transform AML as a business process. Consequently, the transition towards analytics-driven AML cannot be sufficiently explained by the implementation of individual analytical methods alone. The transformation requires a broader organisational perspective that considers how analytical capabilities are embedded within business processes and organisational decision-making.

From this perspective, digital transformation of AML should be understood as a progressive shift from rule-based compliance towards analytics-driven decision-making. In such an environment, analytical methods no longer operate as isolated technological solutions but become integrated components of organisational processes that support continuous risk assessment, prioritisation of investigative resources, adaptive monitoring, comprehensive data integration, and network-oriented analysis of financial crime. The organisational value of analytics lies not in adopting individual algorithms but in developing complementary capabilities that enable financial institutions to transform analytical outputs into more effective operational decisions.

Based on the synthesis of the reviewed literature, this study argues that the transformation towards analytics-driven AML business processes is enabled by the development of mutually reinforcing organisational analytics capabilities. These capabilities address different organisational challenges throughout the AML process while collectively supporting more effective risk assessment, data utilisation, and decision-making. Rather than representing independent technological solutions, they constitute complementary organisational mechanisms that together facilitate the transition from traditional

rule-based AML to analytics-driven business processes.

The following sections examine each of these organisational analytics capabilities in greater detail. By analysing their individual roles and collective contribution to organisational decision-making, the study provides a management-oriented explanation of how financial institutions can successfully transform AML into an analytics-driven business process.

Enhancing Risk Assessment through Accurate Risk Classification

Accurate risk assessment represents one of the most critical challenges within contemporary AML business processes. Financial institutions must continuously evaluate large volumes of customer activities and financial transactions to distinguish normal business behaviour from potentially suspicious activities. As transaction volumes continue to increase and money laundering schemes become more sophisticated, traditional rule-based approaches frequently generate excessive numbers of false-positive alerts while simultaneously struggling to identify previously unknown or evolving laundering patterns. Accordingly, improving the accuracy of risk classification has become a prerequisite for more effective AML decision-making rather than merely a technical improvement in transaction monitoring.

Previous studies demonstrate that recent advances in business analytics and artificial intelligence have substantially improved financial institutions' ability to classify AML-related risks. Machine learning models are increasingly capable of recognising complex relationships within transactional data,

identifying subtle behavioural patterns, and reducing false-positive alerts compared with conventional rule-based monitoring. Rather than relying exclusively on predefined rules and manually determined thresholds, these approaches utilise historical data and continuously refine their predictive performance as new information becomes available. As a result, analytical classification increasingly supports more reliable identification of suspicious activities while enabling investigators to focus their attention on transactions with a higher probability of representing genuine financial crime.

However, the literature synthesis indicates that the organisational value of accurate risk classification extends beyond predictive accuracy. Existing studies primarily evaluate classification models using technical performance measures, while providing limited insight into how improved classification supports organisational decision-making. From a management perspective, its primary contribution lies in enabling more consistent, transparent, and evidence-based risk assessment throughout the AML process.

Viewed from this perspective, accurate risk classification should be understood as an organisational analytics capability rather than solely as an analytical technique. It enables financial institutions to transform large volumes of heterogeneous transactional and customer data into meaningful assessments of financial crime risk that support operational decision processes. By improving the reliability of risk assessment, this capability establishes the analytical foundation for subsequent AML activities—including alert prioritisation, investigation planning, adaptive monitoring, and strategic resource allocation—to be performed more effectively. The capability,

therefore, contributes not only to regulatory compliance but also to improving the efficiency and overall performance of AML business processes.

Although accurate risk classification substantially improves the quality of organisational risk assessment, financial institutions must still determine which alerts require immediate investigation and which represent lower operational priorities. Consequently, once reliable risk classification has been established, organisations require an additional capability to prioritise investigative activities and analytical resources effectively. This capability is discussed in the following section.

Improving Resource Allocation through Risk-Based Alert Prioritisation

Following accurate risk classification, financial institutions face a second organisational challenge: determining how to allocate limited investigative resources across an increasing number of generated alerts. Even when analytical models substantially improve risk classification, AML systems continue to produce large volumes of alerts that require further assessment by compliance analysts. Given finite human resources, not every alert can be investigated with the same level of urgency or intensity. As a result, effective alert prioritisation has become a critical organisational requirement for ensuring that investigative efforts are directed towards activities posing the greatest potential risk.

Existing research indicates that recent advances in analytics increasingly support risk-based prioritisation of AML alerts. Machine learning-based scoring models, predictive analytics, and risk-ranking approaches enable financial institutions to estimate the relative significance of

generated alerts by considering multiple risk indicators simultaneously. Rather than treating alerts as independent events requiring equal attention, these analytical approaches facilitate the identification of cases most likely to represent genuine money laundering. Such prioritisation reduces unnecessary investigative effort while improving the timeliness and effectiveness of AML operations.

The literature indicates that the organisational value of alert prioritisation extends beyond analytical efficiency. Existing studies primarily evaluate prioritisation using operational performance indicators, while providing a limited explanation of its broader organisational role. From a management perspective, prioritisation enables the effective allocation of scarce investigative resources, directly influencing both financial crime detection and the efficiency of AML operations.

From this perspective, risk-based alert prioritisation should be understood as an organisational analytics capability that enables financial institutions to transform analytical risk assessments into informed operational decisions regarding resource allocation. By systematically ranking alerts by estimated risk, organisations can focus investigative capacity on cases with the highest potential impact while reducing unnecessary effort on low-risk activities. The capability strengthens business decision-making by improving responsiveness, increasing operational efficiency, and supporting the more effective utilisation of analytical and human resources throughout the AML process.

Although effective prioritisation enables organisations to allocate investigative resources more efficiently, money laundering techniques

continue to evolve in response to regulatory measures and analytical controls. As a result, AML business processes cannot rely solely on static classification and prioritisation mechanisms. Financial institutions must also develop the capability to continuously adapt monitoring activities to emerging risks, behavioural changes, and newly identified money laundering typologies. This adaptive organisational capability is discussed in the following section.

Achieving Adaptive AML through Continuous Monitoring

While accurate risk classification and risk-based alert prioritisation substantially improve the effectiveness of AML decision-making, neither capability alone is sufficient to address the dynamic nature of financial crime. Money laundering schemes continuously evolve in response to regulatory changes, technological innovation, and the implementation of increasingly sophisticated detection mechanisms. Criminal networks rapidly modify transaction patterns, exploit new financial products, and adapt their behaviour to circumvent existing monitoring systems. Therefore, AML business processes cannot rely solely on static analytical models or predefined decision rules; they must continuously adapt to emerging risks and changing behavioural patterns.

The reviewed literature suggests a growing shift from static transaction monitoring to adaptive, continuously evolving monitoring approaches. Recent advances in machine learning, continuous model updating, behavioural analytics, and hybrid analytical techniques enable financial institutions to identify previously unseen risk patterns and respond more effectively to changing money laundering typologies. Rather than depending

solely on fixed rules established during system implementation, adaptive monitoring incorporates new transactional evidence, evolving customer behaviour, and newly identified risk indicators into ongoing analytical processes. This continuous learning capability enhances the responsiveness of AML systems while reducing the likelihood that emerging money laundering strategies remain undetected.

The literature indicates that adaptive monitoring should be understood as more than a technological feature of analytical models. Existing research primarily evaluates improvements in model performance, while paying less attention to its organisational role. From this perspective, adaptive monitoring represents an organisational capability that enables financial institutions to continuously update analytical assumptions, monitoring practices, and operational decision-making in response to emerging risks.

Viewed from this perspective, adaptive monitoring extends the role of analytics beyond the detection of suspicious activities towards continuous organisational learning. It enables financial institutions to systematically integrate newly emerging risks, regulatory developments, and operational experience into AML business processes, thereby maintaining the relevance and effectiveness of analytical decision-making over time. This capability transforms AML from a predominantly reactive compliance activity into a continuously evolving business process that can respond to increasingly dynamic financial crime environments.

Nevertheless, effective adaptation depends on the availability of comprehensive and interconnected information. Even the most sophisticated adaptive

monitoring approaches remain constrained when customer information, transactional data, ownership structures, and external risk indicators are fragmented across multiple information systems. Consequently, continuous organisational learning must be supported by the capability to integrate heterogeneous sources of information into a coherent analytical environment. This organisational capability is examined in the following section.

Enabling Holistic Risk Visibility through Data Integration

The effectiveness of analytics-driven AML business processes depends not only on the quality of analytical models but also on the availability of comprehensive and interconnected information. While adaptive monitoring enables financial institutions to respond to evolving money laundering typologies, meaningful adaptation is only possible when relevant information can be accessed, combined, and interpreted across organisational and technological boundaries. In practice, however, AML-related information is frequently distributed across multiple information systems, organisational units, and external data sources. Customer profiles, transaction records, ownership information, sanctions lists, and regulatory databases are often maintained separately, limiting financial institutions' ability to obtain a complete understanding of financial crime risks.

The literature recognises that fragmented information represents a significant obstacle to effective AML decision-making. Recent research demonstrates that advanced analytical approaches—including graph databases, network-oriented data structures, and integrated analytical

platforms—enable organisations to consolidate heterogeneous information into coherent analytical environments. Rather than analysing individual transactions or isolated customer records independently, integrated data environments provide a more comprehensive representation of relationships among customers, accounts, transactions, beneficial ownership structures, and other relevant entities. Such integration substantially improves the completeness and contextual richness of information available for analytical decision-making.

More importantly, the literature synthesis indicates that data integration should be understood as more than a technological infrastructure issue. Existing research primarily focuses on technical solutions for integrating heterogeneous information, while providing a limited explanation of how integrated information supports organisational decision-making. From a broader organisational perspective, its primary value lies in enabling a unified analytical view of financial crime risk.

From this perspective, data integration represents an organisational analytics capability that enables financial institutions to transform fragmented data into holistic risk visibility. Rather than supporting isolated analytical tasks, this capability provides the informational foundation for accurate risk assessment, effective alert prioritisation, and adaptive monitoring to operate consistently across the entire AML business process. By connecting previously separated sources of information, organisations improve the quality, consistency, and transparency of analytical decision-making while strengthening collaboration between compliance professionals, investigators, and other organisational stakeholders.

Although integrated information substantially enhances organisational understanding of financial crime risks, effective AML decision-making increasingly requires more than holistic visibility. Money laundering activities are rarely confined to isolated customers or individual transactions; instead, they typically involve complex networks of interconnected entities, financial relationships, and transactional pathways. Consequently, organisations require an additional analytical capability to discover and interpret these hidden structures within integrated data environments. This capability is examined in the following section.

Detecting Complex Financial Crime through Network Discovery

Although integrated information provides financial institutions with a comprehensive view of customers, transactions, and related entities, effective AML decision-making increasingly depends on understanding how these elements are interconnected. Money laundering rarely consists of isolated suspicious transactions. Instead, illicit financial activities are typically organised through networks of individuals, legal entities, accounts, intermediaries, and transactional relationships that collectively conceal the origin and movement of illicit funds. Consequently, understanding the structure of these interconnected relationships has become essential for effective AML business processes.

The reviewed studies consistently show a shift from transaction-centered analysis towards network-oriented approaches to financial crime detection. Recent advances in graph analytics, social network analysis, graph neural networks, and sub-network discovery enable financial institutions to identify

hidden relationships, complex transaction paths, and coordinated laundering structures that remain largely invisible when transactions are analysed individually. Rather than evaluating isolated financial events, network-oriented analytics reveal broader organisational patterns, thereby improving the detection of sophisticated money laundering schemes involving multiple actors and interconnected financial activities.

The literature synthesis indicates that the organisational value of network discovery extends beyond graph-based analytical techniques. Existing research primarily evaluates technical performance, while providing a limited explanation of how network-oriented analysis supports organisational decision-making. From a management perspective, its primary contribution lies in transforming complex relational information into actionable knowledge for investigative and strategic decisions.

Viewed from this perspective, network discovery represents an organisational analytics capability that enables financial institutions to move beyond transaction-level analysis towards a relationship-oriented understanding of financial crime. By revealing hidden connections among customers, accounts, beneficial owners, intermediaries, and financial transactions, organisations gain a more holistic understanding of how money laundering schemes operate within broader financial ecosystems. This capability supports more accurate investigations, strengthens strategic risk assessment, and enhances strategic decision-making by providing contextual insights that cannot be obtained through isolated transaction analysis alone.

Importantly, network discovery does not operate independently of the previously discussed organisational analytics capabilities. Its effectiveness depends on accurate risk classification, meaningful prioritisation of investigative resources, continuous adaptation to emerging money laundering typologies, and comprehensive integration of heterogeneous information. Only when these complementary capabilities operate together can financial institutions fully exploit the analytical potential of network-oriented approaches to financial crime detection.

The synthesis of the reviewed literature, therefore, suggests that network discovery represents the highest level of analytical maturity within analytics-driven AML business processes. Rather than replacing previous organisational capabilities, it builds upon them by transforming integrated information into a deeper understanding of complex financial relationships, supporting more proactive, intelligence-driven, and strategically informed AML decision-making.

From Individual Capabilities to an Analytics-Driven AML Business Process

The preceding sections examined five organisational analytics capabilities that support different stages of AML business processes. Although each capability addresses a distinct organisational challenge, the literature synthesis suggests that their primary value lies in their combined contribution to decision-making across the AML business process rather than in their individual applications. Consequently, the transformation towards analytics-driven AML

should not be interpreted as the adoption of isolated analytical techniques but as the progressive development of complementary organisational capabilities that collectively reshape how AML business processes are performed.

The first capability, accurate risk classification, establishes the analytical foundation for reliable risk assessment by improving the identification of potentially suspicious activities. Building on this foundation, risk-based alert prioritisation enables financial institutions to allocate investigative resources based on the relative significance of identified risks, thereby improving operational efficiency and decision quality. Adaptive monitoring subsequently extends this decision-making process by enabling organisations to continuously respond to evolving money laundering typologies, emerging behavioural patterns, and changing regulatory environments.

The final two capabilities broaden the organisational perspective beyond individual transactions and operational decision-making. Data integration enables financial institutions to consolidate fragmented information into an integrated analytical environment that supports consistent and transparent risk assessment across organisational functions. Network discovery further extends this capability by revealing complex relationships among customers, transactions, accounts, beneficial owners, and other interconnected entities, thereby enabling financial institutions to understand money laundering as a networked phenomenon rather than as a sequence of isolated financial events.

Taken together, these capabilities illustrate that analytics-driven AML represents substantially more

than the implementation of advanced analytical technologies. The literature synthesis indicates that digital transformation creates organisational value only when analytical methods become embedded within business processes and decision-making practices. Consequently, organisational capabilities—not individual algorithms—constitute the primary mechanism through which financial institutions transform analytical potential into improved operational performance and more effective AML decision-making.

From a management perspective, this interpretation shifts attention away from the technological characteristics of individual analytical solutions towards the organisational conditions required for their successful utilisation. Instead of asking which analytical model performs best under specific technical conditions, organisations must consider how different analytical capabilities complement one another throughout the AML business process. The effectiveness of analytics-driven AML depends upon the coordinated development of organisational capabilities that jointly support risk assessment, resource allocation, continuous adaptation, information integration, and network-oriented understanding of financial crime.

The synthesis presented in this study supports a broader conceptual interpretation of digital transformation within AML. Rather than representing a technological transition from rule-based monitoring to artificial intelligence, analytics-driven AML should be understood as an organisational transformation in which complementary analytics capabilities progressively reshape business processes, managerial decision-making, and organisational responses to financial

crime. This perspective provides the conceptual foundation for the theoretical and managerial implications discussed in the following section.

Discussion

The synthesis of the reviewed literature suggests that the digital transformation of AML cannot be adequately explained solely through the adoption of increasingly sophisticated analytical technologies. While existing research demonstrates substantial advances in machine learning, behavioural analytics, graph analytics, and integrated data platforms, these developments have predominantly been investigated as technological solutions addressing specific analytical tasks within the AML process (Deprez et al., 2025; Johannessen & Jullum, 2025). From the broader perspective of digital transformation, however, organisational value is created not by technology itself but by embedding digital capabilities within redesigned business processes and organisational decision-making (Vial, 2019; Warner & Wäger, 2019). This observation provides the foundation for reconsidering how digital transformation in AML should be conceptualised.

The proposed capability-oriented perspective argues that the fundamental transformation of AML extends beyond technological innovation and reflects a broader transformation of business processes. Consistent with the business process management literature, business processes evolve when organisations redesign how information is collected, analysed, shared, and transformed into decisions, rather than merely automating existing activities (Ahmad & Van Looy, 2020; Dumas et al., 2023). Within AML, this transformation is evident in the growing reliance on analytical support for customer risk assessment, transaction monitoring,

investigation prioritisation, relationship analysis, and continuous adaptation to emerging financial crime typologies. Consequently, analytics should be viewed not simply as a collection of technological tools but as an organisational capability that fundamentally reshapes how AML business processes operate.

This interpretation also broadens the role of business analytics within financial institutions. Previous studies have primarily evaluated analytical methods based on their ability to improve detection accuracy, reduce false positives, or identify increasingly complex money laundering patterns (Oztas et al., 2024; Deprez et al., 2025). While these contributions remain essential, the proposed framework suggests that their strategic value lies in enabling organisations to integrate heterogeneous information, coordinate analytical insights across organisational functions, and support evidence-based managerial and operational decision-making. From this viewpoint, business analytics becomes an organisational resource that enhances the overall effectiveness of AML business processes rather than an isolated technological solution.

The proposed framework further complements existing digital transformation research by reinforcing the central role of organisational capabilities in creating sustainable value. Consistent with research on digital transformation and organisational capability, competitive advantage increasingly depends on the organisation's ability to orchestrate complementary resources, continuously adapt business processes, and support organisational learning in dynamic environments (Warner & Wäger, 2019; Ellström et al., 2022). Applied to AML, this implies that sustainable improvements are unlikely to result from implementing individual analytical techniques

in isolation. Instead, they emerge through the coordinated development of complementary analytical capabilities that collectively support decision-making throughout the entire AML business process.

Accordingly, the principal contribution of this study is conceptual rather than technological. Instead of proposing another analytical model or evaluating the performance of a specific artificial intelligence technique, this study provides a management-oriented perspective for understanding how interconnected analytical capabilities collectively enable the transformation of AML from a predominantly compliance-oriented function into an analytics-driven business process. By integrating insights from digital transformation, business process management, business analytics, and AML research, the proposed perspective offers a more holistic explanation of how financial institutions can organise, coordinate, and continuously develop analytical capabilities to support increasingly effective AML decision-making (Deprez et al., 2025; Tiwari et al., 2023).

The proposed capability-oriented perspective addresses the conceptual fragmentation identified in the literature review. Although research on digital transformation, business process management, business analytics, and AML has advanced considerably, these streams have largely evolved independently. By integrating these complementary perspectives, this study provides a more comprehensive conceptual explanation of analytics-driven AML as a digitally transforming business process (Vial, 2019; Deprez et al., 2025).

First, this study bridges the fields of digital transformation and AML research. While digital transformation studies explain how organisations

redesign business processes and develop organisational capabilities (Bharadwaj et al., 2013; Vial, 2019; Warner & Wäger, 2019), AML research has largely focused on regulatory compliance and technological innovations. By integrating these perspectives, the study conceptualises digital transformation in AML as the coordinated development of organisational analytical capabilities rather than the implementation of isolated analytical technologies.

Second, this study integrates business process management and business analytics within AML research. While business process management emphasises process redesign and continuous improvement (Ahmad & Van Looy, 2020; Dumas et al., 2023), AML analytics research has mainly examined analytical techniques for specific operational tasks. The proposed framework demonstrates that analytical capabilities create organisational value when embedded within business processes and organisational decision-making.

Third, this study addresses the fragmented nature of AML analytics research. Previous studies have demonstrated the value of machine learning, behavioural analytics, graph analytics, and integrated data environments (Oztas et al., 2024; Johannessen & Jullum, 2025; Tiwari et al., 2023; Deprez et al., 2025), but have largely examined these approaches independently. This perspective explains how they collectively form organisational analytical capabilities that enable analytics-driven AML business processes.

Finally, this study contributes to AML research by introducing a management-oriented perspective that complements dominant compliance- and technology-oriented viewpoints. Rather than

focusing solely on regulatory requirements or analytical models, it conceptualises AML as a business process whose digital transformation depends on the coordinated development of complementary analytical capabilities. In doing so, it links digital transformation, business process management, and business analytics into a unified conceptual explanation of analytics-driven AML.

Collectively, these contributions suggest that the digital transformation of AML is an organisational phenomenon in which business process management, digital transformation, and business analytics converge. By positioning organisational analytical capabilities as the conceptual link between these research streams, the study establishes a theoretical foundation for future research on analytics-driven transformation in other knowledge-intensive and highly regulated business processes.

The proposed capability-oriented perspective has important implications for managers responsible for digital transformation, compliance, risk management, and organisational development within financial institutions. Rather than viewing AML primarily as a regulatory obligation supported by isolated analytical technologies, the findings suggest that organisations should approach AML as a strategically important business process whose performance depends on the coordinated development of organisational analytical capabilities.

The conceptual perspective highlights the importance of aligning digital transformation initiatives with business process redesign. Investments in artificial intelligence, machine learning, graph analytics, or advanced monitoring technologies are unlikely to achieve their full

potential if implemented as standalone technological solutions. Consistent with digital transformation research, organisations create sustainable value when digital technologies are embedded within redesigned business processes and supported by appropriate organisational capabilities (Vial, 2019; Warner & Wäger, 2019). Managers should therefore evaluate analytical investments not only on their technical performance but also on their contribution to the overall effectiveness of AML business processes.

The study also emphasises that effective AML increasingly depends on cross-functional coordination. Analytics-driven AML requires close collaboration among compliance specialists, risk managers, information technology professionals, business units, and senior management. Consequently, managers should focus on strengthening organisational mechanisms that facilitate information sharing, coordinated decision-making, and continuous organisational learning rather than treating AML as an isolated compliance activity. This observation is consistent with the business process management perspective, which recognises that business process performance depends on effective coordination across organisational functions (Ahmad & Van Looy, 2020; Dumas et al., 2023).

Furthermore, the proposed framework suggests that analytical capabilities should be developed as complementary organisational resources rather than independent technological initiatives. Financial institutions frequently implement individual analytical solutions to address specific operational challenges, such as transaction monitoring or risk scoring. However, the findings indicate that greater organisational value is likely to emerge when these analytical approaches are

systematically integrated to support the entire AML business process. Such an integrated perspective enables organisations to improve decision quality, respond more effectively to evolving financial crime typologies, and continuously adapt analytical practices to changing regulatory and operational environments (Deprez et al., 2025; Tiwari et al., 2023).

Finally, the proposed perspective has implications for organisational governance of digital transformation. The successful transformation of AML requires not only technological investment but also strategic leadership, organisational commitment, and long-term capability development. Managers should therefore view analytical capabilities as strategic organisational assets that contribute to resilience, regulatory effectiveness, and continuous business process improvement. By adopting this broader management perspective, financial institutions may achieve more sustainable outcomes than through the isolated implementation of advanced analytical technologies alone.

Overall, the managerial implications extend beyond AML itself. The proposed capability-oriented perspective may also support the digital transformation of other knowledge-intensive, data-driven, and highly regulated organisational processes where effective decision-making depends on the coordinated integration of analytical methods, organisational knowledge, and business process management.

This study has several limitations that also provide opportunities for future research. As a conceptual study, the proposed framework has not yet been empirically validated. Future research should therefore examine its applicability and explanatory

power across different types of financial institutions and organisational contexts. Although the framework integrates insights from digital transformation, business process management, business analytics, and AML research, it does not evaluate the relative importance or maturity of individual analytical capabilities. Future studies should therefore investigate how these capabilities evolve, interact under different organisational conditions, and contribute to analytics-driven AML performance. This study intentionally adopts a management-oriented perspective and does not evaluate the technical performance of individual analytical methods. Future research could extend the proposed framework by examining how analytical methods contribute to the development of organisational analytical capabilities and how technological innovation translates into improvements in organisational decision-making (Deprez et al., 2025; Johannessen & Jullum, 2025; Tiwari et al., 2023). Although developed within the context of AML, the proposed capability-oriented perspective may also support the digital transformation of other knowledge-intensive and highly regulated business processes, including fraud detection, cybersecurity management, financial risk management, healthcare compliance, and public sector governance. Overall, the proposed framework should be viewed as a conceptual foundation for future empirical and conceptual research rather than as a definitive representation of analytics-driven AML. It provides a basis for examining how organisational analytical capabilities support the digital transformation of AML and other knowledge-intensive business processes.

Conclusion

The digital transformation of AML presents financial

institutions with challenges that extend well beyond the adoption of advanced analytical technologies. Increasing transaction volumes, evolving financial crime typologies, fragmented information environments, and growing regulatory expectations require organisations to rethink how AML business processes are designed, managed, and continuously improved. Although recent research has demonstrated significant progress in developing analytical methods for transaction monitoring, risk assessment, behavioural analysis, graph analytics, and network discovery, existing studies have predominantly examined these developments as individual technological solutions rather than as components of a broader organisational transformation.

This study addressed this conceptual gap by proposing a capability-oriented perspective on the digital transformation of AML. Building upon insights from digital transformation, business process management, business analytics, and AML research, the study argued that analytics-driven AML should be understood as the coordinated development of complementary organisational analytical capabilities embedded within business processes. Instead of conceptualising digital transformation as the implementation of isolated analytical technologies, this perspective emphasises that sustainable improvements in AML performance emerge from integrating analytical capabilities that collectively support organisational decision-making across the entire AML business process.

The proposed framework contributes to existing knowledge in several ways. First, it integrates previously fragmented research streams into a coherent conceptual perspective that links digital

transformation, business process management, business analytics, and AML. Second, it shifts the analytical focus from individual methods towards organisational analytical capabilities as the primary mechanism through which digital transformation creates value within AML. Third, it introduces a management-oriented interpretation of AML that complements the dominant compliance- and technology-oriented perspectives by positioning AML as a digitally transforming organisational business process.

From a practical perspective, the study suggests that financial institutions should approach AML not merely as a regulatory function but as a strategically important business process requiring continuous organisational learning, cross-functional collaboration, and the systematic development of analytical capabilities. Investments in artificial intelligence, machine learning, graph analytics, or integrated analytical platforms are therefore most likely to create sustainable value when they are embedded within redesigned business processes and supported by appropriate organisational structures and managerial practices.

As a conceptual study, the proposed framework provides a foundation for future empirical research rather than a definitive model of analytics-driven AML. Future studies should validate the proposed capability-oriented perspective in different organisational and regulatory contexts, examine the relationships among individual analytical capabilities, and investigate their influence on organisational performance and decision quality. Such research would further enhance understanding of how financial institutions can successfully transform AML into an analytics-driven business process capable of responding to increasingly

complex financial crime environments.

Ultimately, this study demonstrates that the future of anti-money laundering is not defined solely by the adoption of increasingly sophisticated analytical technologies. Rather, it depends on the organisational ability to integrate these

technologies into coherent analytical capabilities that transform AML from a predominantly compliance-oriented function into an analytics-driven business process supporting more effective, adaptive, and informed organisational decision-making.

Data Availability: Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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Digitalna preobrazba poslovnih procesov preprečevanja pranja denarja: perspektiva analitično podprtega preprečevanja pranja denarja

Izvleček

Preprečevanje pranja denarja (AML) postaja vse bolj informacijsko intenziven poslovni proces, ki za učinkovito organizacijsko odločanje zahteva napredno analitično podporo. Čeprav so predhodne raziskave obsežno preučevale strojno učenje, analitiko grafov in druge analitične metode, jih večinoma obravnavajo kot ločene tehnološke rešitve. Ta konceptualna raziskava zavzema perspektivo poslovnih procesov. Z uporabo sinteze literature s področij digitalne preobrazbe, upravljanja poslovnih procesov, poslovne analitike in preprečevanja pranja denarja razvijemo okvir analitično podprtega preprečevanja pranja denarja, usmerjenega v organizacijske zmogljivosti. Ta perspektiva digitalno preobrazbo preprečevanja pranja denarja opredeljuje kot usklajen razvoj medsebojno povezanih organizacijskih analitičnih zmogljivosti, vpetih v poslovne procese. Prispevek raziskave je v povezovanju doslej razdrobljenih raziskovalnih tokov v enotno, upravljavsko usmerjeno perspektivo. Raziskava podaja konceptualne temelje za prihodnje empirične raziskave ter praktične usmeritve za finančne institucije pri uresničevanju analitično podprte digitalne preobrazbe preprečevanja pranja denarja.

Ključne besede: preprečevanje pranja denarja (AML), digitalna preobrazba, upravljanje poslovnih procesov (BPM), poslovna analitika, organizacijske analitične zmogljivosti, analitično podprto preprečevanje pranja denarja.

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Navajanje v seznamu literature in virov:

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In-text quotation:

Example 1a: Another graphic way of determining the stationarity of time series is correlogram of autocorrelation function (Gujarati, 1995).

Example 1b: Another graphic way of determining the stationarity of time series is correlogram of autocorrelation function (Gujarati, 1995, p. 36).

Example 2a: Engle and Granger (1987) present critical values also for other cointegration tests.

Example 2b: Engle and Granger (1987, p. 89) present critical values also for other cointegration tests.

Quotation in the list of references:

Example 1: A book: Gujarati, D. N. (1995). *Basic Econometrics*. New York: McGraw-Hill.

Example 2: A paper in a journal: Engle, R. F., & Granger, C. W. J. (1987). Co-integration and Error Correction: Representation, Estimation and Testing. *Econometrica*, 55(2), 251-276.

Example 3: Chapter in a book, paper in a Proceedings: MacKinnon, J. (1991). Critical Values for Cointegration Tests. In R. F. Engle & C.W. J. Granger, (Eds.), *Long-Run Economic Relationships: Readings in Cointegration* (pp. 191-215). Oxford: University Press.

Example 4: Electronic source: Esteves, J., Pastor, J. A., & Casanovas, J. (2002). *Using the Partial Least Square (PLS): Method to Establish Critical Success Factors Interdependence in ERP Implementation Projects*. Retrieved from <http://erp.ittoolbox.com/doc.asp?i=2321>

Next to the references in the list, authors should also provide DOI numbers if they exist.

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