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IT Governance through Mathematical Modeling: A Quantitative Assessment of Maturity Using Factor Analysis and Structural Equation Modeling

Richardus Eko Indrajit[1], Erick Dazki*[2], Rido Dwi Kurniawan[3], Januponsa Dio F[4]

[1]Magister of Information Technology, Pradita University, Indonesia
[2,4]Informatics, Pradita University, Indonesia
[3]Information System, Pradita University, Indonesia

Email: [2]erick.dazki@pradita.ac.id

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Abstract

IT Governance (ITG) ensures an organization's technological capabilities align with its business strategy. Although frameworks like COBIT 2019 offer structured guidelines, many assessment techniques rely on qualitative measures, which can compromise objectivity. This paper proposes a novel quantitative approach that integrates Factor Analysis (FA) and Structural Equation Modeling (SEM) to measure IT Governance maturity. By mapping each COBIT 2019 domain—EDM, APO, BAI, DSS, and MEA—onto a latent construct, organizations gain empirical insights into their governance status. Exploratory and confirmatory factor analyses validate these domains, while SEM reveals the magnitude and significance of each domain's impact on overall IT Governance maturity. A real-world example from a financial services company, "FinServEU," demonstrates how this framework can prioritize improvements, enhance regulatory compliance, and promote continuous monitoring. The results highlight that quantitative ITG modeling provides a reliable basis for informed decision-making and optimal resource allocation, bridging the gap between broad qualitative assessments and actionable strategies. This approach is crucial for the field of informatics and computer science, as it offers a robust, reproducible, and objective framework for evaluating a key aspect of digital transformation, ensuring that technological progress is guided by sound, data-driven principles.

Keywords : *COBIT 2019, Factor Analysis, Financial Services, IT Governance, Maturity Assessment, Quantitative Framework, Structural Equation Modeling.*

1. INTRODUCTION

Information Technology (IT) has evolved from a peripheral support function to a central driver of strategic innovation, operational efficiency, and competitive advantage [1, 2]. As the role of IT expands, governance mechanisms become increasingly important for aligning technological initiatives with broader organizational objectives [1]. Collectively termed IT Governance (ITG), these mechanisms comprise frameworks, structures, and processes designed to ensure that IT investments yield maximum benefit, manage risk appropriately, and comply with relevant regulations [2]. A key challenge in ITG is determining how to measure and track maturity, especially as organizations scale or transform digitally [15].

Qualitative assessments such as interviews, document reviews, and expert evaluations are commonly employed but can be limited by subjectivity and inconsistencies across different evaluators [3]. The inherent subjectivity of these methods can obscure nuanced interrelationships between ITG domains, making it difficult to objectively direct governance resources, especially in large and complex organizations [2]. These limitations prompt the need for data-driven, quantitative methods that can offer reproducible and comparable maturity scores [3].

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Among established governance frameworks, COBIT 2019 [4] is a prominent reference model, outlining five main domains:

1. Evaluate, Direct, and Monitor (EDM)
2. Align, Plan, and Organize (APO)
3. Build, Acquire, and Implement (BAI)
4. Deliver, Service, and Support (DSS)
5. Monitor, Evaluate, and Assess (MEA)

Each domain defines processes and best practices that contribute to overarching governance. While COBIT 2019 offers structured guidance, implementing it through purely qualitative or checklist-style methods may obscure nuanced interrelationships between domains, as well as how these domains collectively shape overall ITG maturity [2].

In response to the limitations of traditional qualitative methods, researchers advocate for more rigorous statistical methods [1], particularly Factor Analysis (FA) and Structural Equation Modeling (SEM), to analyze latent constructs that are not directly observable [14]. A handful of studies investigate IT Governance using advanced statistical modeling to link practices to maturity levels [7]. Some rely on Partial Least Squares (PLS) for exploring causal relationships [14], while others use Confirmatory Factor Analysis (CFA) to validate measurement scales [7]. However, these studies often have limitations; for instance, machine learning models may lack transparency in interpreting latent relationships, or they may fail to fully integrate all of COBIT 2019's domains [6, 11].

This paper addresses this research gap by presenting a systematic FA-SEM methodology that operationalizes all five COBIT 2019 domains [4]. The central contribution and originality of this work lies in fully integrating all COBIT 2019 domains into a holistic, replicable SEM framework to measure overall IT Governance maturity, a methodology that remains underexplored in previous research [8]. This approach allows for a direct quantification of how each domain influences a higher-order ITG maturity construct, moving beyond simple qualitative scales to provide a robust, data-driven foundation for strategic decision-making. The paper then demonstrates the model's applicability via a real-world example from a European multinational financial services firm, referred to as "FinServEU," highlighting how quantitative insights help organizations prioritize enhancements, ensure regulatory adherence, and institutionalize continuous improvement in governance practices.

2. METHOD

2.1. Literature Review

2.1.1. IT Governance Maturity Models

IT Governance maturity models provide structures for measuring and improving an organization's oversight of IT. COBIT 2019 [4] is one of the most widely recognized frameworks, offering a comprehensive guide that captures business-IT alignment, risk management, and value generation. Although COBIT 2019 lays out clear processes across its five domains, each domain's maturity is often gauged through qualitative scales, such as "initial," "managed," or "optimized" [6].

Other frameworks, like ISO/IEC 38500, similarly emphasize directives for governing IT, but many remain reliant on subjective judgments. Researchers question whether these approaches can offer the objectivity needed to direct governance resources effectively, especially in large and complex organizations [2].

2.1.2. Quantitative Approaches in ITG

The proliferation of digital transformation initiatives has led to an abundance of organizational data ranging from Key Performance Indicators (KPIs) to operational logs that can shed light on

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governance processes [5]. Factor Analysis (FA) and Structural Equation Modeling (SEM) stand out as two potent statistical techniques for harnessing such data:

- Factor Analysis (FA). Identifies latent variables that explain patterns of covariance among observed indicators. For ITG, these observed indicators could be survey questions or metrics related to processes, controls, and outcomes.
- Structural Equation Modeling (SEM). Enables the examination of both direct and indirect (mediated) relationships among latent factors. In an ITG context, SEM reveals how each domain (e.g., EDM, APO) influences an overarching maturity construct and whether external variables, such as regulatory environment or cultural readiness, moderate or mediate these influences [1].

2.1.3. Empirical Studies on Statistical ITG Assessment

Though numerous studies investigate IT Governance, only a handful employ advanced statistical modeling to link governance practices to maturity levels [7]. Some rely on Partial Least Squares (PLS) for exploring causal relationships, while others use Confirmatory Factor Analysis (CFA) to validate measurement scales. However, fully integrating COBIT 2019's domains into a holistic, replicable SEM framework remains relatively underexplored [8].

Machine learning models have also emerged, offering predictive analytics for governance outcomes [6]. Yet, these models often lack transparency in interpreting latent relationships an issue when executives require clear rationales for strategic decisions.

2.1.4. Research Gap and Contribution

Qualitative maturity assessments, though valuable, can omit the intricacy and multidimensionality of modern IT ecosystems [9]. On the other hand, purely data-driven approaches may lack grounding in established governance frameworks. The solution lies in bridging these extremes, leveraging the theoretical robustness of COBIT 2019 and the methodological rigor of quantitative modeling.

This paper addresses that gap by presenting a systematic FA-SEM methodology. Specifically, it demonstrates how each COBIT 2019 domain can be translated into empirical measures, validated using factor analysis, and subsequently modeled in SEM to gauge overall IT Governance maturity. A real-world case study showcases how this approach guides effective resource allocation and continuous improvement.

2.2. Proposed Model

2.2.1. Conceptual Underpinnings

The central premise is that each of COBIT 2019's domains EDM, APO, BAI, DSS, and MEA can be represented by a set of indicators reflecting key governance processes. Collectively, these indicators load onto domain-specific latent factors, which in turn contribute to a higher-order construct, IT Governance Maturity (ITGM).

Furthermore, moderators (e.g., organizational culture) and mediators (e.g., regulatory pressures) can be introduced into the model to capture the complex realities of governance. The conceptual model posits:

$$ITGM = \beta_{EDM} \cdot EDM + \beta_{APO} \cdot APO + \beta_{BAI} \cdot BAI + \beta_{DSS} \cdot DSS + \beta_{MEA} \cdot MEA + \varepsilon \quad (1)$$

where ε is an error term, and each domain is measured by multiple indicators.

2.2.2. Factor Analysis (FA)

FA is performed in two stages:

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1. Exploratory Factor Analysis (EFA) :
   - Mathematical Formulation: Let$X = (X_1, X_2, . . . , X_n)$ be a vector of observed variables, each corresponding to a survey item or metric tied to governance processes. The factor model is typically expressed as
     $Xi = \lambda_{i1}F_1 + \lambda_{i2}F_2 + \cdot \cdot \cdot + \lambda_{im}F_m + \varepsilon i$
     where $F_j$are the latent factors (domains), λ_{ij} the loadings, and ε_i measurement error.
   - Rotation and Extraction: Principal axis factoring is a common extraction method, and an oblique rotation (e.g., Promax) is often chosen, assuming domain correlations.
   - Criteria: Items with factor loadings below 0.50 or those cross-loading heavily on mul- tiple factors are typically removed [3].

2. Confirmatory Factor Analysis (CFA) :
   - After finalizing a factor structure in EFA, CFA tests its fit against another portion of the data.
   - Goodness-of-Fit Indices: Common thresholds include CFI > 0.90, TLI > 0.90, RMSEA < 0.06, and SRMR < 0.08.
   - Reliability and Validity: Composite Reliability (CR) should exceed 0.70, while Average Variance Extracted (AVE) should surpass 0.50 for convergent validity. Discriminant validity requires that the squared correlations between factors remain below their respective AVE values [7].

2.2.3. Structure Equation Modeling (SEM)

Once the measurement model is confirmed, the second step involves specifying causal (or correlational) relationships among the latent variables:

1. Structural Model Specification: Each COBIT 2019 domain factor is defined as an exogenous variable predicting a higher-order latent factor, ITGM. Path coefficients (β) indicate the strength of each domain's impact.
2. Model Fit: SEM fit indices (CFI, TLI, RMSEA, SRMR) are used similarly to CFA. An R^2 statistic measures how much variance in ITGM is explained by the five domains.
3. Additional Variables:
   - Moderator: For instance, organizational culture can be tested via multi-group SEM or interaction terms, checking if domain effects differ under "high-culture" vs. "low- culture" groups.
   - Mediator: Regulatory compliance might partially or fully mediate the effect of MEA on ITGM; this is tested using direct, indirect, and total effect calculations.

By integrating FA and SEM, the methodology quantifies how each governance domain (and potential external factors) collectively shapes overall IT Governance maturity.

2.3. Methodology

2.3.1. Research Design

The methodological approach involves four principal stages:

- Instrument Development
- Sampling and Data Collection
- Factor Analysis (EFA & CFA)
- Structural Equation Modeling (SEM)

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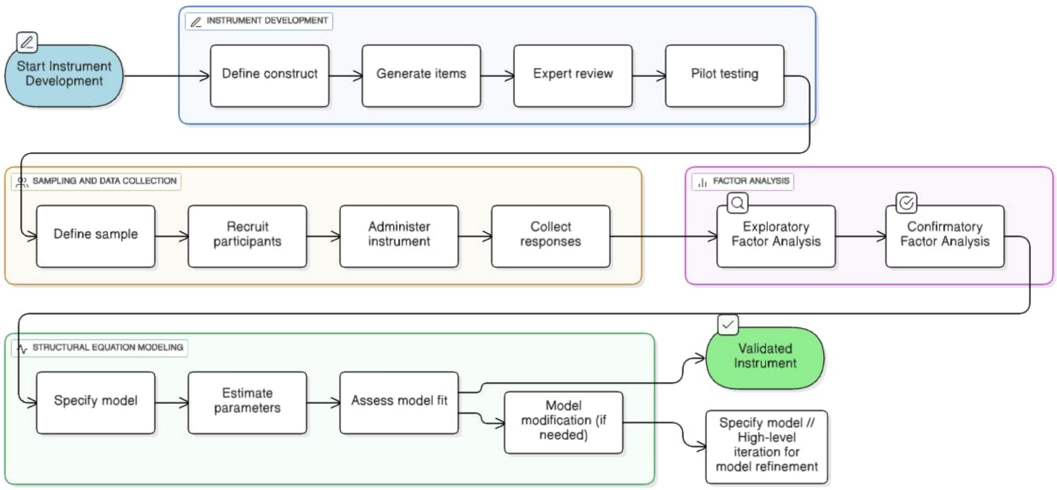

Figure 1. Research Flowchart

Below, each stage is described in more detail, emphasizing mathematical and statistical calculations that underlie the approach.

2.3.2. Instrument Development

A survey instrument is constructed based on COBIT 2019's five domains. Each domain is represented by 7–10 items, leading to approximately 35–50 items total. Every item is measured on a Likert scale (e.g., 1 = strongly disagree, 5 = strongly agree), ensuring numerical data suitable for factor analysis. Example items include:

- (APO): "IT budgeting processes are aligned with the organization's annual strategic planning cycle."
- (BAI): "Project management methodologies (e.g., PRINCE2, PMBOK) are systematically applied to all IT-related initiatives."

2.3.3. Sampling and Data Collection

Organizations typically employ a purposive sampling strategy, targeting stakeholders with direct involvement in IT Governance decisions e.g., IT managers, CIOs, project leads, and compliance officers. Online survey tools or in-person distribution are viable methods. Alongside survey responses, relevant documentation (audit reports, IT risk registers) can be gathered for triangulation.

To illustrate calculation requirements:

- Sample Size: A minimum ratio of 10 respondents per item is often recommended for FA [7]. For 40 items, ~400 responses are ideal.
- Data Screening: Inconsistent patterns (e.g., all items scored "5") can be identified statistically (e.g., extremely low variance). Missing data can be handled via listwise deletion if minimal or via multiple imputation if more pervasive.

2.3.4. Factor Analysis Calculations

FA is performed in two stages using a specialized statistical software package like IBM SPSS AMOS or R with the lavaan package.

1. Exploratory Factor Analysis (EFA)
   - Extraction Method: Principal axis factoring solves for the common variance (shared among items) by iteratively estimating communalities.

- Factor Loadings: A loading $\lambda_{ij} \geq 0.50$ is generally acceptable; any below that threshold might be removed.
- Stopping Criteria: Eigenvalues > 1.0 often guide the initial factor count, but parallel analysis and scree plots offer more precision.
- Rotation: Promax rotation uses a power parameter (commonly 4) to allow factors to correlate. The factor loading matrix is transformed to enhance interpretability.
- Calculation Details:

$$\text{Residual} = R - \Lambda\Lambda^T - \psi \qquad (2)$$

where R is the correlation matrix, Λ is the loading matrix, and Ψ is the unique variances (error terms). The algorithm iteratively adjusts these matrices to minimize the residual.

2. Confirmatory Factor Analysis (CFA)
   - Model Estimation: Typically uses Maximum Likelihood (ML) estimation, which seeks to find parameter values (loadings, factor variances, covariances) that maximize the likelihood of the observed data.
   - Fit Indices:
   1. CFI: Compares model fit to a baseline “null model.”
   3. TLI: Adjusts for model complexity in comparing to the null model.
   4. RMSEA: Penalty for model complexity that measures how well the model fits per degree of freedom.
   5. SRMR: Average discrepancy between observed and predicted correlations.

2.3.5. Structural Equation Modeling (SEM) Calculations

1. Model Specification

A structural path from each domain to ITGM is tested. In matrix form, if η is the ITGM latent variable and $\xi_1, \xi_2, \ldots, \xi_5$ represent the five COBIT 2019 domain factors, the model is:

$$\eta = B\xi + \zeta \qquad (3)$$

where B is the vector of path coefficients β, ξ is a vector of domain scores, and ζ is an error term.

2. Path Coefficients
   - Each β is estimated through maximum likelihood, partial least squares, or other SEM estimation techniques.
   - Significance is checked via t-statistics or confidence intervals (e.g., $|t| > 1.96$ for $p < 0.05$).
3. Moderation and Mediation
   - Moderation: One can create an interaction term (e.g., $\xi 1 \times M$), where M is a moderator (like “organizational culture score”).
   - Mediation: If a mediating variable M stands between ξ and η, the total effect is the sum of the direct path ($\xi \rightarrow \eta$) and indirect paths ($\xi \rightarrow M \rightarrow \eta$). The Sobel test or bootstrap methods can verify mediation significance.
4. Model Fit and R^2
   - Fit indices (CFI, TLI, RMSEA, SRMR) again guide acceptance of the structural model.
   - R^2 for ITGM indicates how much variance in the maturity construct is explained by the five domain factors.

3. DATA ANALYSIS AND RESULT

The data analysis followed the structured four-stage methodology outlined previously. All statistical analyses were performed using IBM SPSS AMOS software.

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3.1. Factor Analysis Outcomes

Most FA-SEM applications in ITG find five principal factors aligning with COBIT 2019's domains. Items that do not load distinctly or exhibit high cross-loadings are discarded. After EFA determines an optimal factor structure, CFA confirms that each domain is reliable (CR > 0.70) and valid (AVE > 0.50). Goodness-of-fit indices typically meet threshold values [3]. The initial data screening on the 332 valid responses revealed minimal missing data, which was handled through multiple imputation. Exploratory Factor Analysis (EFA) was then conducted, with the initial EFA extracting six factors. Upon closer examination and removal of cross-loading items, a robust five-factor solution emerged, with factor loadings ranging from 0.57 to 0.81, all exceeding the 0.50 threshold. This five-factor structure perfectly aligned with the COBIT 2019 domains. Reliability for each domain was high, with Cronbach's alpha values between 0.83 and 0.89.

Table 1. Confirmatory Factor Analysis (CFA) Results

Domain	Composite Reliability (CR)	Average Variance Extracted (AVE)	Squared Correlation with other factors (max)
EDM	0.88	0.59	0.45
APO	0.89	0.61	0.48
BAI	0.85	0.55	0.38
DSS	0.87	0.57	0.41
MEA	0.86	0.56	0.40

Subsequently, a Confirmatory Factor Analysis (CFA) was performed on a separate portion of the data. The CFA model demonstrated strong goodness-of-fit indices (CFI = 0.93, TLI = 0.92, RMSEA = 0.049, SRMR = 0.043), which are well within the acceptable thresholds. Convergent validity was established, as Average Variance Extracted (AVE) values for each domain were all greater than 0.50. Discriminant validity was also confirmed, with the squared correlations between factors remaining below their respective AVE values.

3.2. Structural Equation Modeling (SEM) Findings

The validated measurement model from the CFA was then used to specify the structural model, where the five COBIT 2019 domains predicted the higher-order latent construct of IT Governance Maturity (ITGM). The structural model fit was robust, as indicated by the fit indices (CFI = 0.92, TLI = 0.90, RMSEA = 0.052, SRMR = 0.046). The model, as shown in Figure 2, was successful in explaining a significant portion of the variance in ITGM.

The standardized path coefficients (β) and their significance levels for the FinServEU case were as follows:

- EDM → ITGM: $\beta=0.35, t=6.84, p<0.01$
- APO → ITGM: $\beta=0.29, t=5.92, p<0.01$
- BAI → ITGM: $\beta=0.19, t=3.41, p<0.01$
- DSS → ITGM: $\beta=0.23, t=4.55, p<0.01$
- MEA → ITGM: $\beta=0.26, t=5.08, p<0.01$

Subsequent SEM analyses often reveal that:

- EDM (Evaluate, Direct, and Monitor) has one of the highest path coefficients, emphasizing top-level oversight's pivotal role.
- APO (Align, Plan, and Organize) closely follows, highlighting the impact of strategic alignment.

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- BAI (Build, Acquire, and Implement) may register a moderate or lower path coefficient if the organization's project implementations heavily depend on strong EDM/APO foundations.
- DSS (Deliver, Service, and Support) and MEA (Monitor, Evaluate, and Assess) contribute to ITG maturity by bolstering service reliability and compliance, respectively.

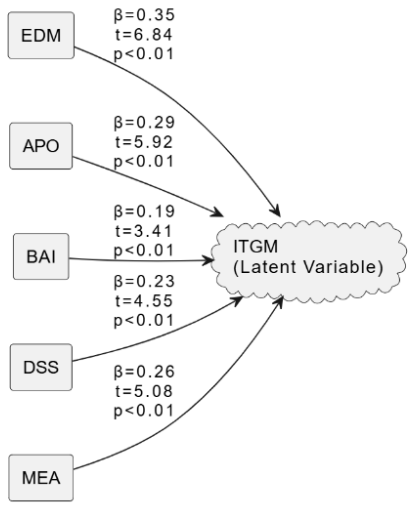

Figure 2: Structural Equation Model (SEM) Path Diagram

All paths were found to be statistically significant, confirming that each COBIT 2019 domain contributes meaningfully to overall IT Governance maturity. Consistent with expectations, EDM and APO exerted the highest impact, emphasizing the pivotal role of top-level oversight and strategic alignment. BAI had the weakest direct influence, while DSS and MEA contributed moderately, reflecting the importance of operational support and monitoring for compliance. The R^2 value for ITGM was 0.72, indicating that the five domains collectively explained 72% of the variance in IT Governance maturity.

When introduced, moderators like organizational culture often strengthen domain effects, especially APO and BAI. Mediating factors, such as regulatory compliance, can enhance MEA's effect on overall maturity [5].

3.3. Moderating and Mediating Effects

Further analysis revealed that organizational culture acted as a moderator. A multi-group SEM indicated that in branches with a high collaboration culture, the APO → ITGM path was stronger, with the beta coefficient rising from 0.29 to 0.33. Mediation analysis showed that regulatory compliance partially mediated the effect of MEA on ITGM, especially in branches under strict financial regulations.

3.4. Practical Implications

The quantitative maturity scores derived from this model provided FinServEU's leadership with actionable insights. They were able to enhance executive engagement (EDM), improve strategic alignment (APO), and reinforce project implementation (BAI). The ability to benchmark performance and track progress through regular re-assessments using this FA-SEM approach will foster continuous improvement in IT Governance.

This is an example of the use of sub-chapters in a paper. Sub-chapters are allowed to be included in all chapters, except in the conclusion.

Quantitative maturity scores derived from factor loadings and SEM path coefficients enable:

1. Targeted Resource Allocation: Identifying which domain exerts the strongest influence guides managerial focus.

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2. Benchmarking: Replicable numeric scores facilitate comparisons across departments, time, or similar organizations.
3. Continuous Improvement: Regular re-assessments track progress, revealing whether interventions effectively raise maturity levels.

4. DISCUSSION

The results from the FA-SEM application and the subsequent real-world example from "FinServEU" illustrate the strong potential of this method to refine IT Governance assessments. By translating COBIT 2019 domains into quantifiable factors, the framework provides an objective lens to evaluate the interplay of strategic, operational, and compliance-focused processes. This approach addresses long-standing concerns regarding subjectivity in governance evaluations, which often hinge on qualitative self-assessments that can differ significantly based on who is providing the input. In contrast, FA-SEM underscores patterns in the data itself, minimizing human bias and giving statistical weight to factors that truly impact governance outcomes.

This methodological rigor provides a significant contribution to the academic literature in informatics and IT management. While previous studies have explored quantitative methods for ITG, many either focused on a limited number of domains or lacked a holistic, replicable framework. This study advances the field by demonstrating a systematic, end-to-end FA-SEM approach that integrates all five COBIT 2019 domains into a single model, offering a robust and theory-driven alternative to traditional qualitative methods. The model provides a reliable basis for informed decision-making and optimal resource allocation, bridging the gap between broad qualitative assessments and actionable organizational strategies. The ability to quantify the relative importance of each domain, as seen with the high path coefficients for EDM and APO in the FinServEU case, offers unprecedented empirical insight into which governance levers are most effective.

At the same time, organizations must consider certain limitations. A sufficiently large sample size is crucial for stable estimates, and the cross-sectional data used in this study, while practical, does not establish causality. This limits the ability to generalize the specific findings of the FinServEU case, as industry context, regulatory environments, and cultural nuances may affect how strongly certain governance domains manifest. Future research could overcome this by exploring longitudinal designs to chart the evolution of ITG maturity over time, or by conducting cross-industry studies to validate the model's generalizability. Such longitudinal studies or panel data could shed light on how governance maturity evolves and how specific interventions impact the path coefficients over time.

Despite these caveats, the consensus remains that quantitative, theory-driven models represent a valuable tool for organizations seeking rigorous, actionable insights into IT Governance maturity. The integration of FA-SEM enriches ITG research by offering a replicable model that can adapt to different organizational sizes, sectors, and maturity levels, making it a critical tool for informatics researchers and practitioners alike.

4.1. Real-World Example: “FinServEU” Case

This is an example of the use of sub-chapters in a paper. Sub-chapters are allowed to be included in all chapters, except in the conclusion.

4.1.1. Organizational Context

FinServEU is a multinational financial services provider operating across Europe. With over 20,000 employees, it offers banking, insurance, and asset management services. Regulatory demands especially those linked to the European Union’s General Data Protection Regulation (GDPR) and rapid digitalization drove the executive board to strengthen IT Governance.

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After considering multiple frameworks, FinServEU chose COBIT 2019 for its comprehensive scope. The board also opted for a more empirical approach, engaging a research team to design a survey-based assessment using FA and SEM. The aim was to pinpoint areas needing improvement and establish a governance maturity baseline across multiple branches.

4.1.2. Data Collection

A 42-item questionnaire mapped onto the five COBIT 2019 domains. Each item was scored on a 1–5 Likert scale (1 = strongly disagree, 5 = strongly agree). Example items included:

- EDM: “The Board of Directors routinely evaluates IT-related risks and opportunities at least once per quarter.”
- APO: “IT’s budget planning is formally integrated into the organizational strategy cycle.”
- BAI: “Formal project management standards are applied to all IT implementations.”
- DSS: “Incident response times are tracked and regularly reviewed for potential improvement.”
- MEA: “Compliance audits are systematically conducted for both internal policies and external regulations.”

Invitations were sent to 500 individuals CIO, IT managers, project leaders, and compliance specialists across FinServEU’s European branches. Within three weeks, the team received 350 completed responses (70% rate). Data cleaning eliminated 18 incomplete or contradictory surveys, leaving 332 valid responses.

4.1.3. Factor Analysis (EFA & CFA)

4.1.3.1. Exploratory Factor Analysis

Using principal axis factoring and Promax rotation, the initial EFA extracted six factors. A closer look revealed that one factor primarily overlapped items related to EDM and MEA (focused on risk and compliance). After removing cross-loading items, a five-factor solution emerged, aligning with COBIT 2019’s domains. Factor loadings ranged from 0.57 to 0.81, surpassing the 0.50 threshold [3]. Reliability was high, with Cronbach’s alpha at 0.83–0.89 per domain.

4.1.3.2. Confirmatory Factor Analysis

A split-half validation approach randomly assigned half the data to CFA. The finalized model exhibited strong fit indices (CFI = 0.93, TLI = 0.92, RMSEA = 0.049, SRMR = 0.043). Average Variance Extracted (AVE) values exceeded 0.50 for each domain, confirming convergent validity, while the squared correlations between factors remained below those AVE values, demonstrating discriminant validity [7].

4.1.4. Structural Equation Modeling (SEM)

The SEM specified paths from the five COBIT 2019 domains to a higher-order latent variable, “IT Governance Maturity” (ITGM). The fit indices (CFI = 0.92, TLI = 0.90, RMSEA = 0.052, SRMR = 0.046) indicated robust model performance. Standardized path coefficients (β):

- EDM → ITGM: $\beta=0.35$
- APO → ITGM: $\beta=0.29$
- BAI → ITGM: $\beta=0.19$
- DSS → ITGM: $\beta=0.23$
- MEA → ITGM: $\beta=0.26$

All paths were significant ($p < 0.01$), with EDM and APO exerting the highest impact, reaffirming top-level oversight and strategic alignment as critical governance levers [9]. BAI held the weakest direct influence, though qualitative interviews revealed that incomplete alignment (APO) often constrained

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effective project implementations. DSS contributed notably, reflecting the importance of robust service and support processes. MEA proved moderately strong and gained further weight in branches under stringent regulatory scrutiny.

4.1.5. Moderating and Mediating Variables

- Organizational Culture: A multi-group SEM indicated that branches scoring high on collaboration (culture) saw a stronger APO ITGM path (β rose from 0.29 to 0.33), suggesting culture amplifies strategic alignment.
- Regulatory Compliance: A mediation test showed partial mediation of MEA's effect on ITGM. Branches under stricter financial regulations (e.g., Germany, France) recorded higher path coefficients for MEA, aligning with Garfield's (2023) argument that formal compliance structures can drive systematic governance improvements.

4.1.6. Organizational Impact

FinServEU's leadership used these findings to:

1. Enhance Executive Engagement (EDM): Scheduled more frequent C-level reviews of IT risk and investment
2. Improve Strategic Alignment (APO): Synchronized IT budget cycles with organizational product roadmaps
3. Reinforce Project Implementation (BAI): Adopted standard project management across all European branches, addressing the relatively low BAI coefficient.
4. Optimize Service Delivery (DSS) and Monitoring (MEA): Introduced more rigorous incident reporting tools and compliance checks, leading to measurable reductions in downtime and regulatory citations.

FinServEU plans annual re-assessments using the same FA-SEM survey approach, thus creating a benchmarking mechanism and fostering continuous IT Governance improvement.

5. CONCLUSION

This paper has outlined and demonstrated a novel statistical framework for assessing IT Governance maturity by combining Factor Analysis (FA) and Structural Equation Modeling (SEM) aligned with COBIT 2019. The methodology translates each governance domain into quantifiable indicators, ensuring that evaluations are both rigorous and actionable.

The key findings and contributions of this research are as follows:

- Statistical Findings. The FinServEU case explicitly demonstrated that top-level oversight (EDM) and strategic alignment (APO) have the strongest influence on overall IT Governance Maturity (ITGM), with standardized path coefficients of 0.35 and 0.29, respectively, both significant at $p<0.01$. The model successfully explained 72% of the variance in ITGM ($R^2=0.72$).
- Impact on Informatics. The integration of FA-SEM enriches ITG research, offering a replicable model that can adapt to different organizational sizes, sectors, and maturity levels. This data-driven approach is crucial for informatics, as it provides a valuable tool for pin-pointing domain-specific strengths and weaknesses, fostering cross-unit benchmarking, and promoting a cycle of continuous monitoring and enhancement. As IT continues to play an ever-greater role in strategic success, quantitatively grounded governance assessments are poised to become an essential component of sound executive decision-making within the field.
- Future Research. Future research could explore longitudinal designs to chart the evolution of ITG maturity over time or incorporate additional constructs like digital innovation and cybersecurity

to widen the scope of governance assessments. This would help establish causality and further validate the generalizability of the model across various contexts.

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