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Evaluating TxDOT's Pavement Asset Management Maturity using ISO 55000, GFMAM, and FHWA Criteria

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This study evaluates TxDOT's pavement asset management maturity by conducting a document-based assessment in accordance with international and federal standards. The analytical approach was rooted in ISO 55000/55001 standards, the GFM maturity model, and FHWA TAM requirements. TxDOT's performance reports, asset management plans, and strategic plans were evaluated subjectively and assigned a grade based on a five-level maturity scale. A directed content analysis of TxDOT documents was conducted, encompassing coding best practices and assessing maturity levels ranging from Initial to Leading. Findings recommended Policy alignment, data management, decision-making, and performance management have been assigned as “Proficient” Level 4, whereas lifecycle management, risk management and resilience, and organization-wide integration fall into the category as “Structured” Level 3. All federal TAM criteria are satisfied by TxDOT, and excellence is demonstrated in inventory and condition monitoring; however, comprehensive risk mitigation and continuous improvement are lacking. The document-based maturity evaluation indicates TxDOT's progress and identifies areas for improvement. Findings also suggest that adherence to international standards, implementation of risk and resilience planning, and conducting maturity self-assessments may enhance asset management. The study outlines an approach for state DOTs to assess their asset management maturity relative to industry guidelines and promote strategic enhancements.

Keywords: Pavement Asset Management, Maturity, TxDOT, ISO 55000, GFMAM

Introduction

Asset management maturity has become a crucial concern for state Departments of Transportation (DOTs) because it directly influences infrastructure performance and sustainability. Recent assessments by ASCE in Texas highlight this issue: the 2025 Texas Infrastructure Report Card assigned an overall grade of “C” to the state's infrastructure (consistent with 2021) and a grade of C- to its road network (Civil Engineers, 2025). The report explicitly recommends that agencies “prioritize asset management and planning” to optimize investments, allocate resources effectively, and mitigate risks (ASCE Texas infrastructure report card, 2025). This context highlights that despite increased funding and some progress in pavement conditions, there remains considerable room for improvement in how Texas's transportation assets are managed over their life cycles. Rapid

population growth, heavy highway usage, and extreme weather further amplify the urgency for resilient, modern infrastructure, for which effective asset management is essential.

The Texas Department of Transportation (TxDOT) has initiated structured asset management through the development of federally mandated (National Academies, 2022) Transportation Asset Management Plans (TAMPs) for pavements and bridges, with a first publication in 2019 and an update in 2022. Although these developments, alongside improved data systems and funding, have maintained pavement conditions above national averages, TxDOT's efforts fall short of demonstrating full asset management maturity as suggested by ASCE infrastructure report. True maturity requires deeper integration of asset management into the agency's culture, data-driven processes, and a commitment to continuous improvement beyond compliance, raising questions about how TxDOT's current practices compare to industry benchmarks (ISO, 2014).

This study highlights a research issue concerning the lack of a structured assessment of TxDOT's pavement asset management maturity in relation to established frameworks like ISO 55000 and guidance from Global Forum on Maintenance and Asset Management (GFMAM). These international standards promote advanced practices including strategic alignment and asset lifecycle planning, in contrast to federal requirements. Organizations like FHWA and AASHTO have tools for state DOTs to enhance their asset management (AASHTO, 2011). However, TxDOT has not been benchmarked against these standards, leaving its maturity level unclear and hindering strategic improvement and learning opportunities.

This study addresses the above gap and evaluates TxDOT's pavement asset management maturity through a document-based assessment of key management documents against ISO 55000/55001 principles and other frameworks. It aims to determine the alignment of TxDOT's practices with best practices and identify areas for improvement. The study benchmarks TxDOT against international and federal standards, providing an objective maturity rating and highlighting opportunities for enhancement. It aims to inform TxDOT's strategy and offer a framework for other state DOTs to assess and improve their asset management maturity.

Literature Review and Conceptual Framework

Asset management in infrastructure is defined by ISO 55000 as “the coordinated activity of an organization to realize value from assets” (ISO, 2014). This broad definition encompasses the strategic and systematic processes by which an agency plans, operates, maintains, rehabilitates, and replaces assets (such as pavements) to balance cost, risk, and performance over the assets' life cycles. It emphasizes the importance of utilizing high-quality data, proactive risk management, and ongoing process improvement (Barros, 2024). The foundation of this framework is derived from three key sources: the ISO 55000/55001 standards, GFMAM maturity guidance, and FHWA and AASHTO transportation asset management publications, which collectively define the criteria for mature asset management and served as a basis for evaluating TxDOT.

ISO 55000 and ISO 55001 Principles

The ISO 55000 series outline global best practices for asset management, with ISO 55001 detailing the requirements for establishing and enhancing an asset management system. Key components include leadership, planning, support, operations, and continuous improvement, focusing on balancing cost, risk, and performance for life-cycle value (ISO, 2014). Compliance with ISO 55001 signifies basic asset management structures are present, but true effectiveness demands cultural integration and data-driven decision-making beyond mere adherence to standards. Relevant literature showcases case

studies of agencies, such as Metro Trains Melbourne, that enhanced asset management maturity through ISO 55001 certification efforts (Godau & McGeoch, 2016). Transportation agencies in Europe and some U.S. infrastructure agencies are increasingly adopting ISO 55001 frameworks, signaling a trend toward global best practices. These instances underscore the goal of achieving an asset management system that seamlessly integrates with agency operations and strategy.

GFMAM Maturity Guidelines

GFMAM offers a detailed asset management maturity model, highlighting 39 subject areas divided into six domains: strategy & planning, decision-making, lifecycle delivery, asset information, organization & people, and risk & review (GFMAM, 2019). Organizations are encouraged to conduct maturity assessments on a scale from 1 (Initial/Ad Hoc) to 5 (Excellent/Leading practice) to evaluate their strengths and weaknesses. Higher maturity levels are associated with benefits such as improved asset performance, optimized costs, and enhanced risk management. A mature organization displays transparent policies, data-driven decision-making, and proactive risk management, critical for anticipating disruptions, especially in the context of climate resilience. The GFMAM model offers a framework for assessing an agency's progress in optimal asset management, with many DOTs adopting maturity models for self-evaluation (National Academies, 2025). This literature indicates that conducting a maturity assessment can serve as an effective diagnostic tool, guiding agencies in their improvement initiatives.

FHWA and AASHTO Frameworks

In the U.S., transportation asset management is primarily shaped by federal mandates, particularly through MAP-21 and FHWA regulations. State Departments of Transportation (DOTs) are required to create risk-based Transportation Asset Management Plans (TAMPs) that encompass asset inventory, condition assessments, performance measures, risk management, financial planning, and investment strategies for optimal resource allocation (AASHTO, 2020). FHWA encourages TAMPs to be dynamic documents guiding daily operations rather than mere compliance tools. Additionally, AASHTO provides essential guidance, notably the 2020 update of the Transportation Asset Management Guide, which includes a maturity scale for agencies to assess their asset management practices and emphasizes the integration of performance-based decision-making and improved data capabilities.

Other U.S. centric literature, such as NCHRP reports, highlights the organizational aspects of Transportation Asset Management (TAM) programs, documenting benefits gained through advanced TAM practices, including efficient fund use and improved asset conditions (National Academies, 2018). FHWA peer exchanges and case studies reveal variability in TAM implementation among state DOTs, with some using their TAMPs for strategic project selection while others focus merely on compliance (Varma & Proctor, 2020; Akofio-Sowah, 2013). This underscores the necessity of evaluating TxDOT against a comprehensive framework to assess its maturity in leveraging TAM as a strategic tool (Tripathi et al., 2024).

Crosswalk of Key Criteria

Despite differences in terminology, the ISO, GFMAM, and FHWA/AASHTO frameworks share common themes. Table 1 presents a crosswalk of fundamental asset management criteria across these frameworks. These criteria represent the dimensions along which TxDOT's maturity will be evaluated in the Findings section.

Table 1. Crosswalk of Asset Management Framework Criteria

SLO	Asset Management Criteria	ISO 55000 / 55001 (Management System Elements)	GFMAM (AM Landscape Subjects)	FHWA / AASHTO Elements
1.	Strategic Policy & Organizational Alignment	Context of the Organization, Leadership	Strategy and Planning	Objectives and Performance Measures.
2.	Asset Data and Information Management	Support: data, systems, documentation.	Asset Information	Asset Inventory and Condition
3.	Decision-Making, Investment Strategies, and Budgeting	Planning & Operation	AM Decision-Making	Investment Strategies and Financial Plan
4.	Lifecycle Management and Asset Preservation Strategies	Planning & Operation	Lifecycle Delivery	Lifecycle Cost Analysis
5.	Risk Management and Resilience	Planning and Improvement	Risk & Review	Risk Analysis and Mitigation
6.	Organization, People, and Culture	Leadership & Support	Organization and People	TAM Governance and Culture
7.	Performance Management and Improvement	Performance Evaluation	Performance Monitoring	Performance Gaps and Monitoring

Methodology

This study employs a document-based qualitative research approach to evaluate TxDOT’s pavement asset management maturity. Rather than collecting new data via interviews or surveys, we rely exclusively on existing documents, a form of unobtrusive research, well-suited for assessing institutional practices as officially described. The methodology consists of: (1) document selection, (2) coding and analysis procedures, and (3) a maturity scoring rubric for interpreting the findings with explicit evidence-to-score decision rules to support traceability.

Document Selection

A range of publicly available TxDOT and FHWA documents was selected to collectively reflect TxDOT’s asset management policies, plans, and performance reporting such as:

- Texas Transportation Asset Management Plan (TAMPs) (TxDOT TAMP 2019-2023,2019; TxDOT TAMP Update, 2022)
- TxDOT Strategic Plans (Strategic Plan 2025-2029, 2024; Strategic Plan 2021-2025, 2020; Strategic Plan 2019-2023, 2018)
- Four-Year Pavement Management Plan Guidance and Annual Reports (Four-year pavement management plan guide, 2019; Four-Year Pavement Management Plan FY 2019–2022 Analysis Report, 2022)
- Pavement Management Information System (PMIS Annual Report FY 2020-2023, 2023)
- Performance Dashboards and Reports (TxDOT performance dashboard, 2025)
- FHWA correspondence and audits (FHWA, 2020)

Coding and Content Analysis

A directed content analysis (Hsieh & Shannon, 2005; Bhattarai et al., 2023) was conducted by creating a codebook based on criteria developed from the Literature Review, as outlined in Table 1. Documents were reviewed, and passages indicating the presence or absence of key practices were coded accordingly. Elements in the TAMP were categorized under “Risk Management,” including a formal risk register in Chapter 5, while pavement condition forecasts related to funding scenarios were coded as “Lifecycle Planning” and “Investment Optimization.” References for continuous improvement, including those found in Chapter 7 concerning enhancements to TxDOT’s TAM processes, were coded. The unit of analysis was documentary passages (e.g., paragraph-level text, tables, and figure captions) that provided explicit evidence of a criterion. Coded passages were recorded in a concise evidence log (criterion, source document, section/page pointer, and short paraphrase) to preserve an audit trail within the page-limit constraints.

A deductive approach based on established categories was primarily utilized, while inductive insights were also considered. The observations contributed to an understanding of the potential impact of the legislative environment on TxDOT’s asset management maturity, indicating that such requirements may enhance maturity in planning and reporting. Coding was conducted manually due to the manageable quantity of documents and pages (Saldaña, 2013). Excerpts were compiled for each criterion. A second pass verification was conducted to ensure reliability, involving a re-reading of the documents with the draft findings in mind to confirm that interpretations were supported by the text, like an analyst triangulation step in qualitative analysis. During this verification, criterion-level interpretations and assigned scores were cross-checked against the evidence log to confirm that each score was supported by documented, criterion-relevant excerpts. Due to the nature of this document analysis, multiple coders were not employed to calculate inter-coder reliability. However, the use of well-defined categories derived from established frameworks served to reduce ambiguity in content classification.

Maturity Scoring Rubric

The maturity of TxDOT in each criterion area was assessed using a five-level scoring rubric adapted from the AASHTO/IAM maturity scales previously discussed. The rubric levels were defined as:

- Level 1 (Initial/Ad Hoc): Little to no evidence of the practice; any activities are uncoordinated or reactive.
- Level 2 (Awakening): Some awareness or early development of the practice; documented in a limited way or pilot stage.
- Level 3 (Structured): The practice is established and documented in TxDOT’s processes or plans; applied consistently in core areas (pavements) but perhaps not across the board.
- Level 4 (Proficient): The practice is well-integrated and optimized within TxDOT’s asset management approach; evidence of data-driven decision making and continuous improvement in this area.
- Level 5 (Best Practice/Leading): TxDOT demonstrates an innovative or best-in-class approach in this area, possibly exceeding standard requirements.

Score assignment rules were applied to keep the 1–5 scale discrete and consistent. The information in Table 1 was evaluated based on documentary evidence. Only detailed documentation was utilized for qualitative assessment. Documents may signify objectives that are not quite realized, although the scope is deliberately constrained to recorded maturity. Scores were utilized to assess stated competence rather than audited performance. Specifically, Level 3 required documentation of an

established practice (defined processes or guidance), Level 4 required evidence of institutionalized use and improvement (integration into decision-making and feedback/monitoring), and Level 5 required consistent evidence of best-in-class practice (enterprise optimization and/or innovation) beyond routine compliance. When evidence spanned adjacent levels, the lower level was assigned unless Level 4/5 indicators were corroborated across multiple sources. Aspirational statements were treated as lower-weight evidence unless paired with implementation artifacts (e.g., procedures, recurring cycles, or performance outputs).

The methodology is designed to reflect an audit-style assessment or desk review. Similar approaches have been employed in various contexts; for instance, surveys were utilized by Oti and Gharaibeh (2018) to quantitatively assess DOT data management maturity, while maturity models for the people, process, and technology dimensions of DOTs were developed by Tripathi et al. (2024). The concept is adapted to a qualitative document analysis, deemed appropriate due to the rich narrative content of strategic plans and TAMPs. The selected methods facilitate a systematic evaluation that is traceable through coded excerpts and grounded in established criteria.

Findings

Analysis of TxDOT's pavement asset management documentation indicates a mixed maturity profile. TxDOT shows strengths in foundational practices, alignment with strategic goals, strong data systems, and established performance reporting, while several advanced practices remain at intermediate maturity. Results for each assessment dimension are summarized below with the assigned maturity level and supporting documentary evidence.

1. **Strategic Policy & Organizational Alignment:** TxDOT's documents show strong alignment between asset management objectives and agency strategy. The Strategic Plan 2025–2029 prioritizes “Preserving our Assets,” emphasizing pavements and data-driven, risk-based project selection. The TAMP Executive Summary links asset management to stewardship and delivery, and the TAM Steering Committee demonstrates formal organizational commitment. Together, these elements support a Level 4 rating.
2. **Asset Data and Information Management:** The documents indicate that TxDOT maintains a detailed inventory of pavements, conducting regular condition assessments. For pavements, the Pavement Management Information System (PMIS) assigns a standardized score (0-100) to roadway segments, and the latest data show that about 88% of lane-miles are in "good" condition (score ≥ 70). TxDOT's performance targets are roughly 90% in good condition. Transparent reporting (including dashboards) and ongoing data integration efforts support a proficient data management capability. TxDOT demonstrates a Level 4 (proficient) maturity in data management, indicating strength in data-driven decision-making. Progression to Level 5 would require fully integrated asset data across classes and routine use of advanced predictive analytics.
3. **Decision-Making, Investment Strategies, and Budgeting:** TxDOT's decision-making approach has become more structured and performance-oriented and is assessed as Level 4 (proficient). The Four-Year Pavement Management Plan standardizes district planning by requiring project categorization and forecasts under alternative investment levels to support trade-off analysis. The TAMP also describes performance-based allocation and programming through the Unified Transportation Program. Achieving Level 5 would require consistent cross-asset optimization and more advanced risk–return integration in budgeting.

4. Lifecycle Management and Asset Preservation Strategies: TxDOT applies preservation principles and documents life-cycle planning, but optimization is constrained, assessed as Level 3: Structured. The TAMP includes a 10-year scenario analysis comparing preservation and worst-first strategies and notes that sustained preventive maintenance can improve conditions and reduce long-term costs. Supporting tools (e.g., Life Cycle Cost Analysis guidance and maintenance tracking systems) reinforce structured practice. Advancement beyond Level 3 will require stronger feedback-driven refinement of life-cycle models and planning under constraints such as cost escalation and disruptions.
5. Risk Management and Resilience: TxDOT documents key risks—funding shortfalls, rising construction costs, and extreme weather—and includes mitigation strategies, supported by a formal risk register. However, documentation does not yet demonstrate an enterprise-scale quantitative risk framework with defined tolerances and recurring reassessment, limiting the criterion to Level 3. Progression to Level 4 would require more systematic, agency-wide integration of resilience and risk governance into programming and life-cycle decisions.
6. Organization, People, and Culture for TAM: TxDOT’s organizational asset management capability is evolving but not fully mature, currently assessed at Level 3. Asset management responsibilities are distributed across divisions with coordination through the TAM Steering Committee. Evidence supports structured practices, including district engagement and emphasis on accountability and transparency. However, documentation provides limited detail on workforce development, formal training pathways, incentives, or routine internal audit mechanisms. Further institutionalization would be needed to reach higher maturity.
7. Performance Management and Improvement: TxDOT’s robust performance management practices linked to asset management outcomes, (assessed at Level 4: Proficient rating), indicated by clear targets for pavements (e.g., 90% in good condition for pavements). The agency regularly monitors performance against these goals using dashboards and reports, showing results that often exceed federal standards. TxDOT employs a "Plan-Do-Check-Act" mindset, highlighted by a TAMP with a Gap Analysis identifying improvement areas. Updates to the TAMP occur every four years, fostering continuous evaluation and adjustment. Strategic goals require accountability from TxDOT leadership. Moving towards Level 5 maturity could involve external benchmarking and advanced techniques like predictive analytics. Overall, TxDOT’s proactive approach to performance management is notable for its ambition and diligence.

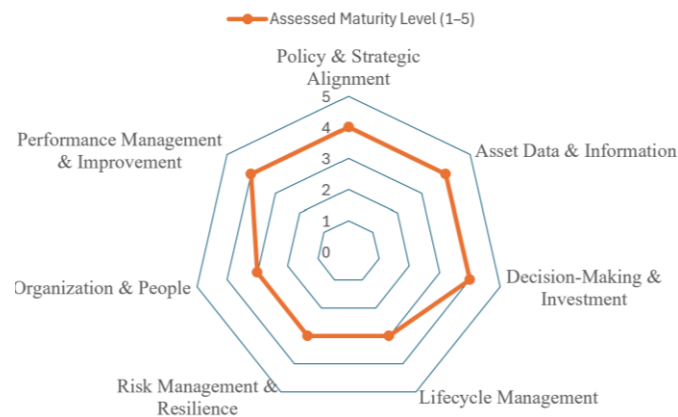


Figure 1. TxDOT Pavement Asset Management Maturity Radar

Figure 1 provides a summary of TxDOT's asset management maturity. Overall, the maturity profile ranges from Level 3 (Structured) to Level 4 (Proficient) across the assessed criteria. The results indicate strong technical and planning capabilities, with comparatively lower maturity in enterprise risk governance and organization-wide institutionalization. Alignment with ISO 55000 and GFMAM principles therefore presents an opportunity to move from established practice toward a more fully integrated, continuously improving asset management system.

Discussion

TxDOT's documentation demonstrates a strong foundation in pavement asset management, robust inventories, established performance monitoring, and clear links between planning and outcomes, yet the maturity profile remains uneven across criteria. Benchmarking against leading frameworks suggests that TxDOT has institutionalized core planning cycles and reporting, while key characteristics of top-tier programs remain less evident in documentation, including enterprise risk governance, consistently applied improvement mechanisms across functions, and cross-asset optimization embedded in routine decisions.

To close these gaps within a practical implementation pathway, TxDOT could: (i) formalize an asset management system manual by mapping existing processes to ISO 55001 clauses to identify and close specific gaps (e.g., stakeholder engagement, decision criteria transparency, governance), (ii) conduct periodic maturity reassessments (e.g., every 2–3 years) to set targets and track progress, (iii) strengthen risk and resilience integration by incorporating climate screening, vulnerability assessment, and explicit resilience metrics into lifecycle planning and programming, and (iv) expand advanced analytics (predictive models and integrated data workflows) to improve timing decisions and investment trade-offs. Peer benchmarking with agencies that have implemented cross-asset optimization and risk governance at scale would further support progress toward higher maturity.

Limitation

This study serves as a document-based assessment that relies on publicly available TxDOT sources. It is acknowledged that unrecorded practices may be overlooked and that aspirational language may exaggerate implementation. However, an emphasis on verifiable evidence, such as adopted plans and reported outcomes, has been implemented to mitigate bias. Maturity ratings are determined through qualitative assessments based on ISO, GFMAM, and AASHTO frameworks, employing a thorough review process; it is possible for different expert panels to assign adjacent levels. The scope is focused only on pavements, and should not be generalized to ancillary assets, facilities, or transit. The findings are indicative of the current state from 2025 as benchmarks and expectations evolve, it is anticipated that ratings may change in subsequent cycles. Future validation could be achieved by triangulation with interviews/surveys and decision case studies, and repeating maturity self-assessments periodically to confirm implementation and track progress.

Conclusion

This document-based assessment, which is established in ISO 55000/55001, GFMAM, and FHWA/AASHTO guidance, indicates that TxDOT's pavement asset management is at an intermediate-to-proficient level. It is federally compliant, data-driven, and associated with measurable outcomes, such as stabilized pavement conditions. However, it is noted that there is a lack of full optimization in areas such as risk/resilience integration, cross-asset tradeoffs, and agency-wide continuous improvement. In order to address aging assets, rapid growth, and climate pressures, it is

recommended that TxDOT advance beyond foundational practices and institutionalize a systematic improvement loop. The formalization of an ISO 55001–aligned asset management system manual is prioritized, along with the conduct of regular maturity self-assessments (AASHTO/IAM). The TAMP is to be treated as a living document, while the acceleration of advanced analytics (predictive models/digital twins) in life-cycle decisions is emphasized. Additionally, the embedding of climate risk and resilience in programming is to be undertaken, and benchmarking with peers is to be conducted to refine cross-asset optimization and governance. Advancements in these areas are likely to result in increased investments leading to enhanced network performance and public value, characterized by smoother and more resilient pavements as well as more efficient fund utilization. The journey of maturity is characterized by targeted system-level enhancements, positioning TxDOT to progress from strong compliance to leading practice in pavement asset management.

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