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Abbreviations

Abbreviation	Full Term	Definition / Explanation
AI	Artificial Intelligence	Computer systems capable of performing tasks that normally require human intelligence (e.g., reasoning, learning).
AI Act	European Union Artificial Intelligence Act	Proposed EU regulation for harmonizing AI standards, ethics, and liability.
DESI	Digital Economy and Society Index	An EU composite indicator measuring digital performance and competitiveness.
EDIH	European Digital Innovation Hub	EU-funded entities supporting digital and AI adoption in SMEs and public institutions.
EU	European Union	A political and economic union of 27 European countries promoting regional integration and cooperation.
GDPR	General Data Protection Regulation	EU regulation on data protection and privacy, influencing AI governance.
IoT	Internet of Things	Network of physical devices collecting and exchanging real-time data.
ISO	İstanbul Sanayi Odası	İstanbul Chamber of Industry; a leading institution representing the industrial sector in Türkiye.
KPI(s)	Key Performance Indicator(s)	Metrics used to measure success or performance outcomes of AI initiatives.
KVKK	Kişisel Verilerin Korunması Kanunu	Türkiye's Personal Data Protection Law, aligned with the EU GDPR framework.
LLM	Large Language Model	Advanced AI model trained on large text datasets, capable of generating human-like language (e.g., ChatGPT).
MESS	Türkiye Metal Sanayicileri Sendikası	Turkish Employers' Association of Metal Industries; project coordinator for WP2.
PESTLE	Political, Economic, Sociocultural, Technological, Legal, Environmental	Analytical model to assess macro-environmental factors impacting transformation or innovation readiness.
R&D	Research and Development	Systematic activities aimed at innovation, technology development, and new product/process design.
SMEs	Small and Medium-sized Enterprises	Businesses with limited scale, employee count, and turnover, critical to industrial ecosystems.
SWOT	Strengths, Weaknesses, Opportunities, Threats	Strategic planning framework to evaluate internal and external factors affecting an initiative or system.
TÜBİTAK	Türkiye Bilimsel ve Teknolojik Araştırma Kurumu	The Scientific and Technological Research Council of Türkiye; main public R&D funding and coordination agency.

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Publishable Summary

The "Deliverable D2.1: Gap Analysis and Stakeholder Map" presents a strategic and evidence-based assessment of Türkiye's industrial readiness for artificial intelligence (AI) and digital transformation, as part of the AI EDIH Türkiye initiative funded under the Digital Europe Programme. Anchored in the objectives of Work Package 2 – Client Journey, this report examines the maturity levels, structural gaps, and transformation enablers across industrial sectors, with a particular emphasis on small and medium-sized enterprises (SMEs).

The report identifies a growing awareness of AI's potential across Turkish industry, yet highlights considerable challenges in translating this awareness into operational capability. Using a multi-dimensional maturity benchmarking model and stakeholder-informed diagnostics, the analysis reveals systemic gaps in six foundational areas: strategic vision, investment planning, infrastructure readiness, human capital, process integration, and executive governance. Key barriers include limited AI investment appetite, legacy IT systems, lack of internal expertise, and insufficient leadership engagement.

Despite these constraints, the report underscores significant opportunities for Türkiye to leapfrog maturity stages by leveraging national policy momentum (e.g., Türkiye National AI Strategy 2021–2025), international innovation partnerships, and a tech-savvy demographic base. The SWOT and PESTLE analyses provide a robust contextual framework, demonstrating how both internal and external dynamics shape transformation potential.

To bridge the maturity gap, the report offers six strategic recommendation pillars:

1. **Sectoral AI Roadmaps & Strategic Alignment**
2. **Talent Development & Upskilling Ecosystems**
3. **Incentive Mechanisms & Investment Mobilization**
4. **Infrastructure Platforms & Digital Commons**
5. **Executive Engagement & Governance Culture**
6. **AI-Driven Policy & Public–Private Dialogue**

Finally, the stakeholder map delineates the institutional architecture critical for successful AI integration—spanning strategic policymakers, implementation enablers, industrial actors, and knowledge partners. The report concludes with a call to action for coordinated, inclusive, and scalable transformation—enabling Türkiye's transition from digital potential to AI-driven industrial performance on the global stage.

1. Introduction

1.1 Purpose of the Report

This report has been developed as a key deliverable under Work Package 2 (WP2): Client Journey, within the scope of the AI EDIH Türkiye initiative, co-funded by the European Union under the Digital Europe Programme. The primary aim is to conduct a strategic and evidence-based maturity gap analysis that evaluates Türkiye's industrial readiness for artificial intelligence (AI) and digital transformation across manufacturing sectors—with a particular focus on the needs and capabilities of small and medium-sized enterprises (SMEs).

In today's rapidly evolving industrial paradigm, where AI technologies are reshaping global value chains and competitive dynamics, it is imperative for Turkish manufacturers to assess their digital maturity, identify structural bottlenecks, and formulate future-proof transformation strategies. This report serves as a foundational instrument to guide that process.

Specifically, the objectives of the report are to:

- Diagnose the current state of AI adoption, digital readiness, and organizational capacity within Türkiye's industrial ecosystem.
- Benchmark performance against a multi-dimensional AI Maturity Framework, covering six strategic pillars: strategic vision, investment planning, infrastructure adequacy, human capital, process integration, and executive governance.
- Analyze internal and external transformation enablers and inhibitors using SWOT and PESTLE methodologies.
- Offer actionable, evidence-based strategic recommendations for bridging identified maturity gaps through coordinated policy, investment, capability-building, and governance measures.
- Provide a stakeholder roadmap, enabling alignment between firm-level transformation journeys and national industrial policy priorities.

Moreover, this report integrates a Stakeholder Map to clarify the institutional architecture supporting Türkiye's AI transition—spanning public authorities, implementation agencies, industrial actors, and knowledge partners. This mapping is critical for designing inclusive and scalable transformation pathways that mobilize collective capacity across the ecosystem.

By offering a data-driven, strategic, and collaborative lens, the report aspires to catalyze Türkiye's leap from potential to performance, and to support the emergence of a globally competitive, AI-empowered industrial base.

1.2 Literature Review

The intersection of artificial intelligence (AI) and industrial digitalization has emerged as a strategic axis in shaping future competitiveness, productivity, and resilience in manufacturing economies. This section synthesizes key academic and policy-oriented literature that frames the Turkish context within broader global dynamics, offering both foundational and applied perspectives.

Recent scholarly work underscores the transformative potential of AI in enabling intelligent automation, predictive analytics, real-time optimization, and adaptive manufacturing systems (Bughin et al., 2018; Wamba-Taguimdje et al., 2020). Within Industry 4.0 paradigms, AI is increasingly positioned not only as a set of technologies, but also as a catalyst for organizational reinvention—driving new value chains, business models, and ecosystem interdependencies (Ransbotham et al., 2020).

Benchmark nations, particularly in the EU (Germany, Netherlands, Sweden) and East Asia (South Korea, Japan), have institutionalized national AI strategies that emphasize coordinated public-private investment, talent pipelines, regulatory frameworks, and sectoral pilots. These cases offer valuable comparative insights for economies like Turkey, which seek to leapfrog maturity gaps through targeted policy design and industrial mobilization.

The maturity of AI adoption has been conceptualized across several core dimensions: awareness and leadership vision (Lee et al., 2021), investment capacity and risk appetite (OECD, 2021), infrastructure and data readiness (Accenture, 2019), workforce capability and upskilling (McKinsey, 2020), and business process integration (PwC, 2022). These frameworks converge on the need for systemic alignment between technological infrastructure, human capital, strategic governance, and innovation culture.

Readiness models such as the AI Readiness Index (Oxford Insights, 2023) and Digital Economy and Society Index (DESI, European Commission, 2024) offer multi-layered benchmarks for comparing national or sectoral maturity levels. Notably, Turkey's rankings in these indices highlight moderate digital awareness but lagging performance in integration, data management, and executive adoption—reflecting a partial readiness landscape.

The Turkish academic and policy literature increasingly recognizes AI as a transformative imperative for industrial restructuring. Studies by TÜBİTAK (2022), the Ministry of Industry and Technology (2021), and the Turkish Informatics Foundation (TBV, 2023) converge on common themes: fragmented infrastructure, insufficient human capital development, lack of SME-specific strategies, and low levels of AI adoption outside pilot environments.

Moreover, empirical research on Turkish manufacturing firms (e.g., Yıldız et al., 2023; Ercan & Karakuş, 2022) reveals that awareness levels are rising, but operational implementations remain isolated and primarily driven by large exporters or technopark-affiliated companies. Cultural resistance, executive hesitancy, and regulatory uncertainty are cited as major inhibitors, reinforcing the need for targeted governance interventions and ecosystem orchestration.

Despite a growing body of work, significant analytical gaps persist:

- There is limited research tracking AI maturity in Turkish industry.
- Few studies offer integrated multi-dimensional frameworks that combine technology, human capital, governance, and investment lenses.

- There are few empirical assessments of the effectiveness of national strategies or funding programs.

This report aims to bridge these gaps by offering a structured, benchmark-driven, and industry and public sector-focused gap analysis—one that not only diagnoses the current state but also maps out a calibrated pathway toward AI maturity in Turkish industry and beyond.

1.3 Methodology

The analytical framework employed in this report is multi-dimensional, evidence-based, and benchmark-oriented. It combines diagnostic assessment tools, a quantitative data collection survey, and multi-dimensional analysis frameworks (e.g., Benchmarking, SWOT, PESTLE).

The methodology is grounded in a six-dimensional AI readiness model, covering:

1. Strategic Awareness and Vision
2. Investment Planning and Financial Commitment
3. Technological and Infrastructure Readiness
4. Human Capital and Skills Availability
5. Operational Integration and Use Cases
6. Executive Commitment and Governance Structures

These dimensions are internationally recognized as foundational pillars of organizational AI maturity and form the basis for all gap assessments and benchmarks.

To ensure a holistic and stakeholder-informed view, the study employed the following instruments:

- **AI Readiness Survey**: A structured questionnaire administered across manufacturing and public sector organizations to capture perceptions, practices, and expectations related to AI.
- **Literature and Policy Scan**: A review of national strategy documents, global AI adoption reports, and sectoral digital transformation blueprints.
- **Ecosystem Stakeholder Inputs**: Semi-structured feedback from industrial associations, technopark representatives, and innovation hubs (where applicable).
- **Secondary Data Sources**: Sectoral investment trends, talent availability indexes, and technology penetration metrics from open datasets.

This multi-source structure enables vertical deep dives (within thematic gaps).

The collected data were processed through an integrated analytical model comprising:

- **Maturity Benchmarking**: Current-state responses were mapped against a 5-point ideal maturity scale to identify delta values across six key dimensions.

- **SWOT Analysis**: Internal capabilities (strengths and weaknesses) and external dynamics (opportunities and threats) were synthesized to identify strategic enablers and constraints.
- **PESTLE Framework**: Macro-environmental factors—Political, Economic, Sociocultural, Technological, Legal, Environmental—were analyzed to contextualize organizational readiness within broader structural forces.

Ultimately, this framework supports decision-makers in transitioning from AI **awareness** to **execution**, from **potential** to **performance**—anchored in empirical insight and strategic foresight.

2. Current State Analysis: AI and Digitalization In Turkish Industry

The current state of AI adoption and digital transformation in Turkish industry reflects a landscape of growing awareness, yet limited operational maturity. Despite increasing interest in artificial intelligence (AI) and its potential benefits, most organizations remain in early stages of readiness, both technologically and organizationally. Based on the findings of a recent ecosystem-wide survey, several key observations have been made across multiple dimensions:

2.1 AI Utilization Level

A significant portion of respondents—37 %—reported no active AI implementation within their companies. Among those who have started exploring AI, usage is largely limited to either awareness activities or external service procurement, rather than internal capability development. Only a small fraction of organizations currently deploy AI solutions at an operational level, such as in production, quality assurance, or maintenance processes.

This reveals a considerable gap between AI awareness and practical implementation, with most organizations lacking the necessary technological infrastructure, human capital, or integration capability to transform awareness into tangible impact.

2.2 Investment Trends

When asked about AI-related investment intentions, nearly % 50 of the firms indicated no short-term investment plans, or stated that current investment levels would be maintained without expansion. nearly % 50 of the organizations demonstrated a proactive investment outlook, with only a handful planning to increase AI investments by up to 100% in the near term.

This signals a broader hesitation at the strategic decision-making level, where AI has not yet been fully recognized as a core driver of competitiveness or operational efficiency. Particularly among SMEs, budgetary constraints, uncertainty around return on investment (ROI), and limited internal capacity continue to pose significant barriers to more assertive AI adoption.

On the other hand, organizations that demonstrate investment readiness are beginning to realign their transformation strategies with AI positioned as a central enabler. This divergence suggests that the majority of firms remain at a "scaling threshold," where investment decisions are guided by a cautious, phased, and risk-aware mindset.

Unless a clearer strategic commitment is formed, AI's integration into the core value chain is likely to remain partial and opportunistic rather than systemic and transformative.

2.3 Key Barriers to Adoption

The study identified several recurrent barriers hindering broader AI adoption in Turkish industry:

- The twin structural bottlenecks of infrastructure and capability form the most pressing challenges to AI scalability.
- Notably, process integration uncertainty reveals that even with technical capacity, most organizations lack operational transformation knowledge.
- Ethical and security concerns indicate a growing need for trustworthy AI frameworks, compliance-by-design practices, and ethical governance.
- Though executive support was mentioned less frequently, its absence likely underlies many other technical and cultural barriers.

These barriers that summarized in Figure 1, point to a structural immaturity that must be addressed through both internal capability-building and ecosystem-level support mechanisms.

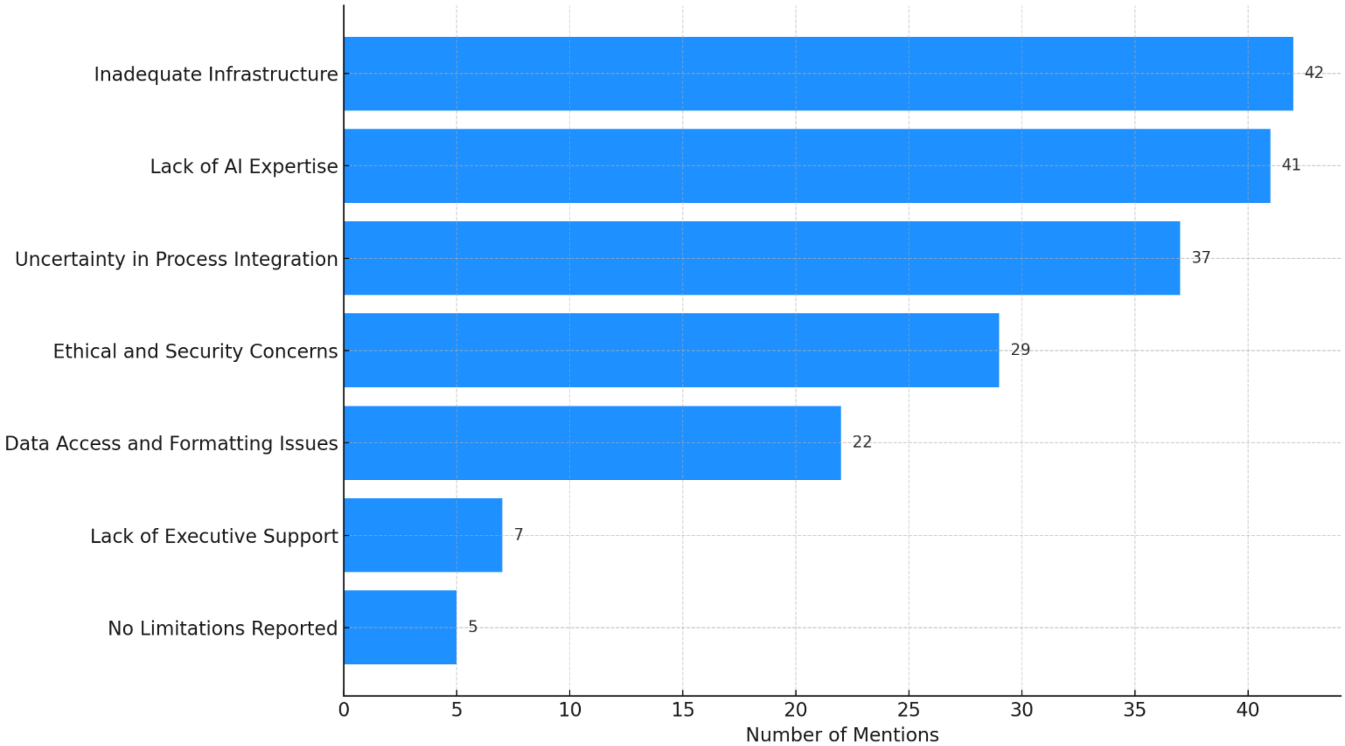

Figure 1: Key Barriers to AI Adoptation in Turkish Industry

2.4 Application Areas and Strategic Objectives

Despite the implementation challenges, industrial organizations in Türkiye highlight several high-impact and high-priority domains for AI deployment:

- Production Planning and Optimization: Real-time scheduling, demand forecasting, and adaptive resource allocation
- Process Efficiency and Automation: Streamlining repetitive tasks, quality control, and workflow automation
- Operational Cost Reduction: Intelligent energy use, maintenance optimization, and waste minimization
- Decision Support Systems: Data-driven insights for tactical and strategic decision-making
- Sustainability & Energy Management: Monitoring carbon footprint, predictive control for energy consumption
- Competitiveness & Innovation Enablement: Enhancing market responsiveness and time-to-market efficiency

However, these benefits that are visualized given in Figure 2 are often aspirational. The gap between strategic vision and operational reality persists due to infrastructure limitations, talent shortages, and integration complexity. Unlocking value from AI will depend on closing this readiness gap through focused investments in capabilities and data maturity.

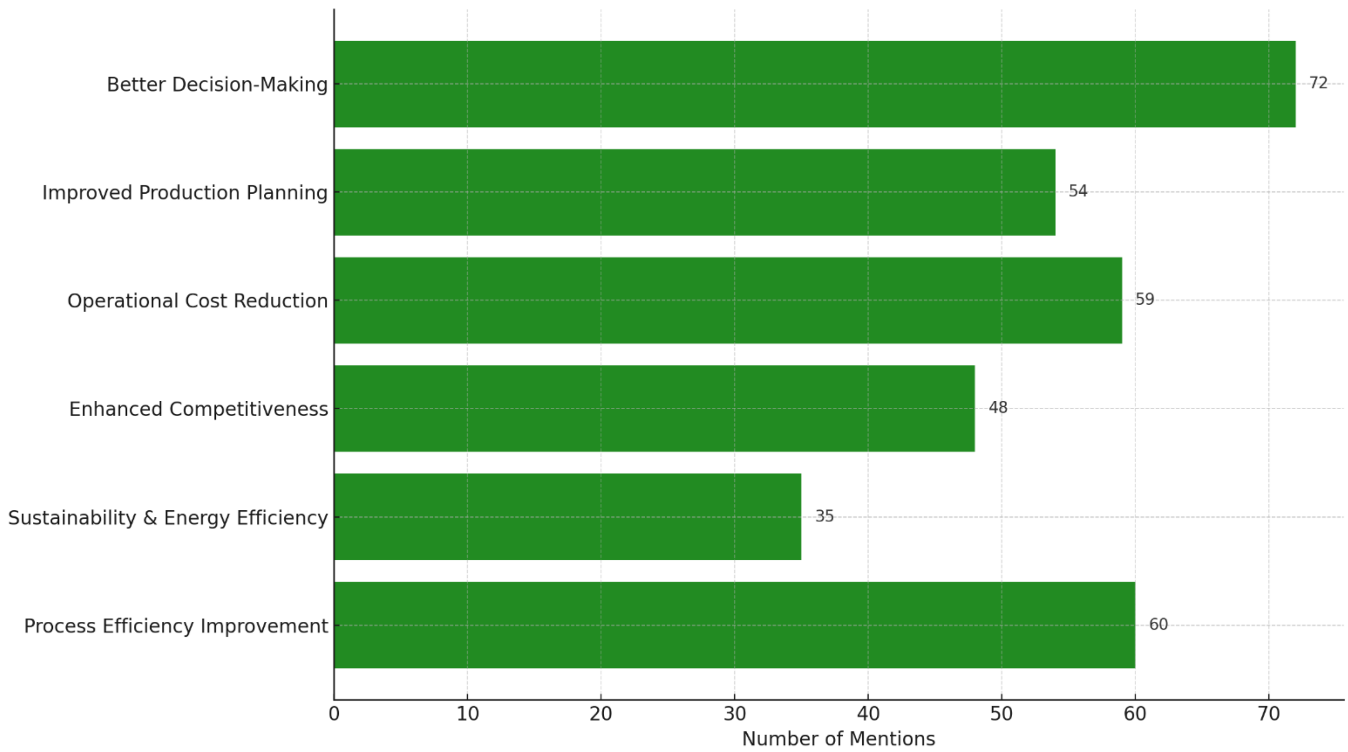

Figure 2: Perceived Strategic Benefits of AI Adoptation

2.5 Cultural and Organizational Readiness

Beyond technology and investment, cultural readiness emerges as a critical limiting factor. Many organizations encounter internal resistance to change, low levels of digital literacy among staff, and a lack of clear communication about the value of AI.

Additionally, the absence of structured change management processes and insufficient incentives for innovation discourage proactive engagement with AI.

In conclusion, the current trajectory of artificial intelligence (AI) and digitalization in Turkish industry presents a paradox: while interest in AI is undeniably on the rise, its implementation remains largely fragmented and aspirational. Survey findings reveal that most organizations are still navigating early-stage readiness, lacking the foundational technological infrastructure, internal capabilities, and change-oriented leadership required to operationalize AI at scale.

The limited utilization of AI, with 37% of firms reporting no active use, underscores a gap between conceptual awareness and real-world execution. Investments in AI are similarly polarized—while nearly half of the organizations exhibit an optimistic investment mindset, a significant proportion either remain stagnant or defer decisions due to perceived risks, unclear ROI, and capacity constraints. This divergence places many firms at a strategic "scaling threshold," where transformation ambition exists but is not yet activated through structured investment planning and roadmap execution.

Structural barriers—particularly in infrastructure, integration capability, and talent—continue to restrain AI's potential. Moreover, ethical concerns and security anxieties signal the urgent need for responsible AI governance frameworks. Executive sponsorship, while often underemphasized, is a latent enabler that must be cultivated to drive organization-wide alignment and accountability.

Despite these limitations, Turkish industry clearly identifies AI as a transformative lever across critical business functions such as production planning, cost efficiency, quality optimization, and sustainability. Yet these opportunities are not self-executing—they demand targeted interventions to close the readiness gap through digital literacy programs, skill development initiatives, robust data governance, and sector-specific policy support.

Cultural readiness has emerged as a defining constraint. Resistance to change, weak communication on AI's value proposition, and the absence of structured change management systems inhibit organizational mobilization. Without cultural and leadership alignment, even the most sophisticated AI strategies are likely to underperform.

In summary, the successful adoption of AI in Turkish industry will require a synchronized effort across five dimensions:

- Infrastructure modernization,
- Capability development,
- Investment strategy,
- Cultural transformation, and

- Executive commitment.

Only through a holistic and coordinated approach can Turkish firms transition from early-stage experimentation to sustained, value-driven AI integration—thereby securing long-term competitiveness in a rapidly evolving global economy.

3. Target State Benchmark

The target state, grounded in a structured scoring methodology derived from the responses to the “AI Readiness Survey in Industry”, defines the ideal maturity level for artificial intelligence and digital transformation within the Turkish industrial ecosystem. This comprehensive framework operates on a standardized 5-point scale:

1. Not at all / Completely absent
2. Very limited / Ad-hoc practices
3. Emerging / Initial structuring
4. Operationalized / Partially integrated
5. Fully embedded / Strategically aligned

Respondent inputs were numerically encoded (1–5) and aggregated by thematic dimension. For multi-item categories, an average score was calculated to represent the overall maturity level of the specific domain. To ensure balanced evaluation, all dimensions were equally weighted, reflecting strategic, technical, and organizational readiness elements in an integrated manner.

Each benchmark dimension corresponds to a core pillar of AI readiness, and collectively, these pillars form a holistic vision of digital competitiveness, guiding Turkey’s industrial sector toward sustainable and innovation-driven growth.

3.1 AI Awareness and Strategic Vision

While the conceptual understanding of artificial intelligence is present across most organizations, a formalized and integrated AI strategy is often lacking. The current average maturity level stands at **2.5**, indicating a **2.5-point gap** from the ideal state of **5.0**. In the ideal scenario, AI is embedded within the company’s strategic roadmap—featuring clearly defined use cases, measurable KPIs, and executive-level sponsorship. The strategic objective is to position AI as a foundational pillar of long-term business and innovation planning, empowered by vision-driven leadership and organizational commitment.

3.2 AI Investment Planning

Current approaches to AI investment remain largely ad-hoc, with limited alignment to broader business objectives or structured financial planning. The present maturity level is assessed at **2.5**, revealing a **2.5-point gap** from the ideal state of 5.0. In the ideal scenario, AI-related investments are systematically planned and budgeted, with clear links to performance metrics. Funding mechanisms support both research and development activities as well as pilot implementations. Moving forward, the strategic priority is to establish sustainable and scalable investment models, leveraging a combination of internal R&D budgets, strategic partnerships, and public funding instruments, thereby ensuring that AI becomes a consistently resourced driver of innovation and competitive advantage.

3.3 Infrastructure Adequacy and Digital Readiness

A significant number of organizations continue to operate with legacy IT systems, fragmented data architectures, and insufficient digital capabilities, limiting their ability to deploy AI solutions at scale. The current maturity level is measured at **2.0**, indicating a **3.0-point gap** from the ideal benchmark of 5.0. At the ideal level, companies are expected to maintain robust and modern IT infrastructures, supported by clean, integrated, and accessible data environments, cloud-native platforms, and real-time analytics capabilities. Bridging this gap requires strategic, long-term investment in digital infrastructure modernization, alongside the development of comprehensive data governance frameworks that enable operational agility, system interoperability, and AI scalability.

3.4 AI Expertise and Human Capital

Despite growing awareness of AI's transformative potential, many organizations face a shortage of in-house AI talent and lack structured, continuous upskilling programs. The current maturity level stands at **2.5**, reflecting a **2.5-point gap** from the ideal level of 5.0. In a fully mature scenario, organizations actively employ qualified AI professionals, invest in ongoing training and development, and promote a culture of innovation, experimentation, and continuous learning. Closing this gap requires a strategic shift toward building a hybrid workforce—one that combines deep domain expertise with strong digital and analytical capabilities—thereby enabling scalable and resilient AI adoption across the enterprise.

3.5 Integration into Business Processes

At present, AI applications within most organizations remain isolated, experimental, or confined to pilot initiatives, with limited impact on core operational workflows. The current maturity level is assessed at **2.0**, reflecting a **3.0-point gap** from the ideal benchmark of 5.0. In the ideal state, AI solutions are seamlessly integrated into end-to-end business processes, including areas such as production planning, predictive maintenance, customer service, and supply chain optimization. Achieving this level of integration necessitates a dual approach: business process reengineering to align workflows with AI capabilities, and technology co-design efforts to ensure that AI solutions are embedded contextually and functionally within day-to-day operations. This alignment is essential for realizing AI's full value proposition at scale.

3.6 Executive Commitment and Governance

The absence of strong, senior-level ownership remains a critical barrier to the scalable adoption of AI across organizations. The current maturity level is positioned at **2.5**, indicating a **2.5-point gap** relative to the ideal level of 5.0. In the ideal scenario, C-level executives not only champion AI transformation but also define clear accountability structures and proactively lead the cultural shift required for AI integration.

To bridge this gap, organizations must establish robust governance models in which executive leadership sponsors, guides, and monitors AI initiatives with measurable outcomes. This leadership alignment is essential to ensuring strategic coherence, resource allocation, and long-term impact of AI programs.

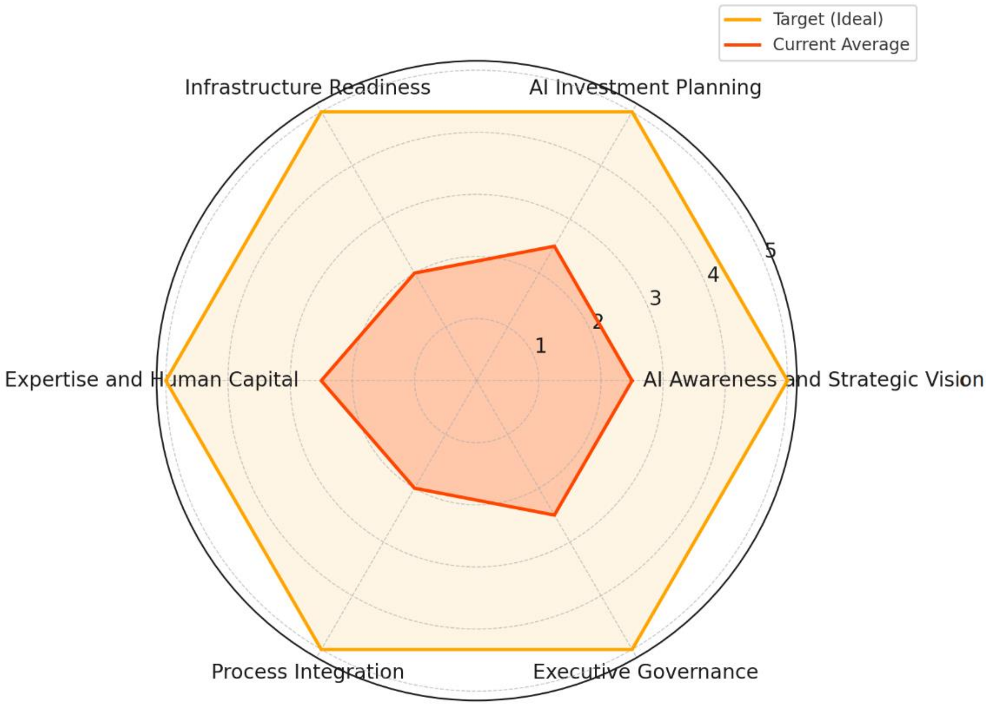

Figure 3: AI & Digital Maturity Radar Chart – Benchmark Assessment

The benchmark assessment given in Figure 3 reveals consistently wide gaps across all six areas, particularly in:

- Infrastructure
- Integration

This diagnosis highlights the need for targeted interventions not only at the firm level but also through **ecosystem enablers** such as:

- Public funding mechanisms
- Open innovation platforms
- AI literacy programs
- Sectoral best practice repositories

Achieving the ideal state requires cross-functional transformation—combining leadership, culture, investment, and technological upgrades. This benchmark will serve as a north star for tracking progress and calibrating national AI policies with industrial realities.

4. SWOT Analysis: AI and Digitalization Readiness

The SWOT (Strengths, Weaknesses, Opportunities, Threats) framework offers a strategic lens through which the AI and digital transformation landscape of Turkish industry can be evaluated. This structured assessment not only highlights internal capabilities and deficiencies but also external enablers and systemic risks that shape the trajectory of AI adoption across the ecosystem.

4.1 Strengths

1. **Growing Awareness and Willingness:** There is a clear and accelerating awareness among firms regarding the importance of AI for future competitiveness. Many industrial stakeholders express a willingness to explore and learn about AI, even if implementation is not yet mature.

2. **University–Technopark Collaborations:** Turkey hosts a dynamic network of technoparks and university-based innovation hubs, offering access to academic expertise, R&D potential, and early-stage AI research projects. These platforms create an interface between theory and practice.

3. **Pilot Project Momentum:** Certain sectors (e.g., automotive, white goods, defense industry) have begun to experiment with AI through pilot implementations. These test beds, while limited, help validate use cases and generate localized success stories.

4. **Existing EDIH Infrastructure and Testbeds:** Türkiye benefits from an emerging network of Digital Innovation Hubs such as AI EDIH Türkiye that offer industrial-scale testbeds, high-performance computing resources, and AI experimentation environments—providing a practical foundation for use case validation and SME engagement.

4.2 Weaknesses

1. **Lack of Strategic Planning:** Most firms do not have a structured roadmap for AI adoption. AI is often treated as a one-off project rather than an ongoing strategic capability, leading to fragmented or short-lived efforts.

2. **Infrastructure Deficiencies:** Legacy IT systems, poor data quality, and siloed operations hinder the ability to collect, process, and utilize data for intelligent decision-making. The lack of foundational digital readiness prevents advanced AI deployment.

3. **Shortage of Qualified Talent:** There is a systemic shortage of AI-literate professionals across engineering, data science, and business domains. Furthermore, limited internal training programs prevent upskilling of existing personnel, creating a persistent talent bottleneck.

4. **Lack of Ethical and Regulatory Awareness:** Many firms—particularly SMEs—lack awareness or preparedness for ethical AI design, data protection obligations (e.g., KVKK/GDPR), and the emerging EU AI Act, posing legal and reputational risks in cross-border markets.

4.3 Opportunities

1. **National AI Strategy Framework:** Turkey has launched a National AI Strategy (2021–2025) which sets ambitious targets and recognizes AI as a national priority. This provides a clear policy signal for stakeholders and opens avenues for public-private collaboration.
2. **EU Funds and Innovation Programs:** As an associated partner in several EU frameworks (Horizon Europe, Digital Europe), Turkey can benefit from co-financed projects, consortium building, and international knowledge transfer.
3. **Young, Tech-Savvy Population:** Turkey's demographic advantage—with a large, young, digitally inclined population—offers a long-term foundation for building AI capabilities if supported by the right education and employment policies.
4. **AI for Twin Transition:** AI presents a unique opportunity to accelerate sustainability through applications in energy efficiency, emissions monitoring, and circular economy—aligning Turkish industry with the EU's twin transition agenda and emerging compliance frameworks like CBAM and DPP.

4.4 Threats

1. **Dependence on Foreign Technology:** AI-enabling technologies such as GPUs, cloud platforms, and large-scale models are predominantly sourced from global vendors. This creates vulnerability in cost, sovereignty, and continuity of access.
2. **Limited Financial Capacity of SMEs:** Small and medium-sized enterprises (SMEs), which form the backbone of Turkish industry, often lack the capital and human resources to invest in transformative technologies like AI.
3. **Digital Divide Within the Ecosystem:** There is a growing risk of bifurcation between advanced firms (mostly large-scale exporters) and lagging firms (SMEs and traditional manufacturers). Without inclusive policies, this divide may deepen, limiting nationwide productivity gains.
4. **Brain Drain to Global Markets:** High-skilled AI professionals often migrate to international tech hubs, drawn by better research funding, salaries, and innovation ecosystems—limiting the domestic capacity to scale AI across industry.

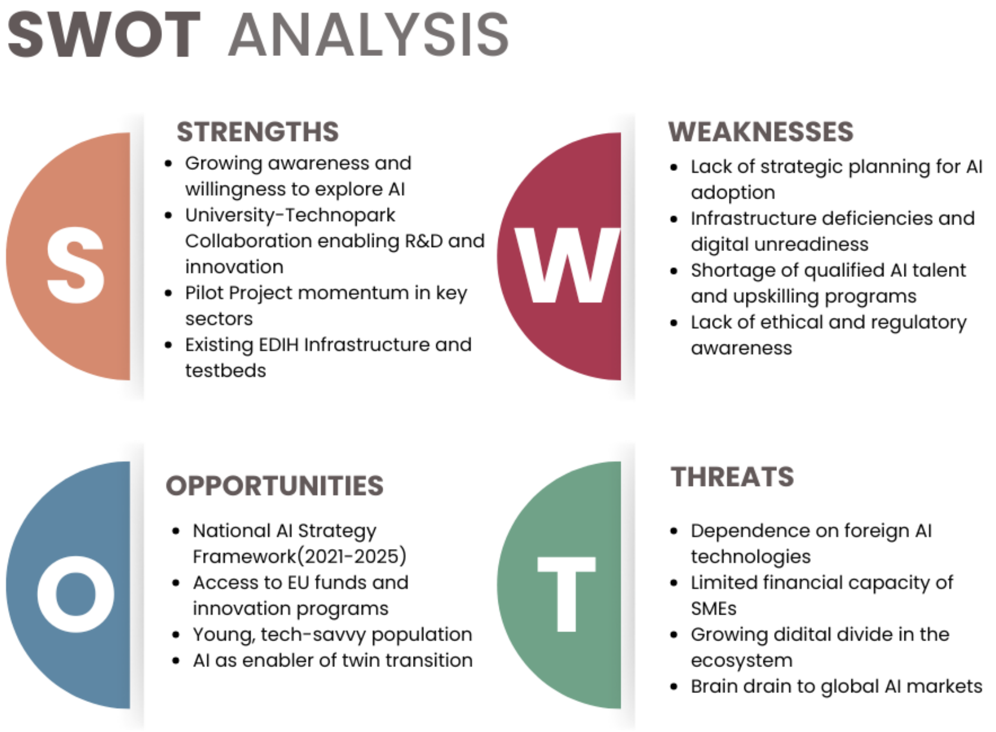

Figure 4: SWOT Matrix: AI and Digitalization Readiness

Strategic Implications of the SWOT summarized in Figure 4:

- The strengths and opportunities signal a strong foundation for growth—if leveraged through systemic coordination.
- The weaknesses and threats point to urgent structural reforms in infrastructure, policy enforcement, and capacity building.
- Bridging these gaps will require multi-actor partnerships, combining public policy incentives, industrial leadership, academia, and civil society initiatives.

This SWOT analysis offers a reality check on the Turkish AI ecosystem and underscores the importance of targeted, inclusive, and innovation-oriented strategies to move from vision to execution.

5. PESTLE Analysis: External Environment

The PESTLE framework enables a comprehensive assessment of the external macro-environmental factors that influence the adoption and maturity of artificial intelligence (AI) and digital technologies within Turkish industry. Understanding these factors is essential for aligning corporate strategies with policy, market, and social realities—and for designing adaptive, future-resilient transformation pathways.

5.1 Political Factors

- **National AI Strategy in Place:** Turkey published its National AI Strategy (2021–2025), setting out clear objectives for increasing AI adoption across sectors, improving R&D capacity, and boosting AI exports. This strategic framework creates a high-level policy foundation and an important legitimacy mechanism.

- **Limited Private Sector Incentives:** However, sector-specific funding mechanisms, tax incentives, and regulatory sframeworks for AI remain underdeveloped. Especially for SMEs, the lack of tailored public support limits the translation of national goals into enterprise-level action.
- **Geopolitical Dependencies:** Political tensions and trade dependencies on foreign technology providers (e.g., U.S., China, EU) introduce risks in AI value chains—particularly for hardware, cloud services, and intellectual property.
- **Regional Development Policy Alignment:** Regional development agencies and smart specialization strategies increasingly emphasize digital transformation. However, policy fragmentation across regions leads to uneven support and duplicated efforts.

5.2 Economic Factors

- **High Implementation Costs:** AI systems require sustained investments in data infrastructure, talent, and software/hardware integration. These upfront and operational costs remain prohibitive for many organizations, especially SMEs operating with narrow margins.
- **Economic Volatility and Inflation:** Turkey's macroeconomic fluctuations, including currency instability and rising interest rates, create an uncertain investment climate. Firms tend to prioritize short-term operational continuity over long-term innovation.
- **Digital Divide in Capital Allocation:** Larger, export-oriented firms are better positioned to absorb digital investment risks. In contrast, traditional sectors and regional industries often lack access to venture capital, grants, or innovation finance.
- **AI Skills–Jobs Mismatch:** Despite a growing number of AI graduates, employers struggle to find candidates with practical, domain-specific AI expertise. This limits immediate economic returns on digital investment.

5.3 Sociocultural Factors

- **Low Digital Literacy:** Many employees, especially in manufacturing-heavy industries, lack basic digital skills, which hinders organizational change and the absorption of AI solutions.
- **Resistance to Change:** Organizational cultures that favor manual control, traditional methods, or hierarchical structures often exhibit resistance to automation and algorithmic decision-making.
- **Emerging Awareness Among Youth:** On the other hand, Turkey’s younger workforce demonstrates a high affinity for digital technologies. If mobilized through targeted training, this demographic can become a strategic asset.

- **Inclusion Gaps in AI Workforce:** Participation of women and underrepresented groups in digital and AI-related careers remains low. Without inclusive workforce development, AI adoption risks exacerbating social inequality.

5.4 Technological Factors

- **Inadequate Infrastructure:** Access to high-quality, real-time data is limited. Sensor networks, IoT systems, cloud architecture, and cybersecurity frameworks are either missing or fragmented in many enterprises.
- **High Dependency on External Platforms:** Most AI tools (e.g., cloud AI, LLMs, training frameworks) are developed abroad. This makes local firms reliant on global tech providers for model access, customization, and support.
- **Emerging National Capabilities:** A nascent but growing community of local AI startups, university labs, and research centers provides an opportunity to build sovereign capabilities over time.
- **Limited Technology Transfer Mechanisms:** Weak linkages between academic AI research and industrial implementation delay innovation uptake. Existing tech transfer offices often lack AI-specific commercialization capacity.

5.5 Legal and Regulatory Factors

- **Data Protection Regulations (KVKK):** Turkey's data protection law (KVKK) is broadly aligned with GDPR, but its interpretation and enforcement vary significantly across sectors. Firms often view it as a compliance risk rather than a data governance opportunity.
- **Lack of AI-Specific Legislation:** As of now, there are no dedicated laws regulating AI ethics, liability, algorithmic transparency, or autonomous decision-making. This legal vacuum creates ambiguity, particularly for regulated industries (e.g., health, finance, defense).
- **Export Controls and Licensing:** Firms in defense or high-tech sectors may face additional licensing burdens when adopting or exporting AI-related technologies.
- **Emerging Compliance Pressure from EU AI Act**: Turkish companies exporting to the EU or serving international clients will increasingly face pressure to comply with the EU AI Act's high-risk classification, conformity assessments, and documentation obligations.

5.6 Environmental Factors

- **Neglected Sustainability Impact of AI:** The environmental footprint of AI (e.g., energy use in training large models, electronic waste from data centers) is not yet part of corporate sustainability agendas in most Turkish firms.
- **Lack of Green AI Incentives:** No policies currently exist to promote "Green AI" development or the integration of AI into environmental monitoring, emissions control, or energy optimization.

- **Circular Economy Linkage Potential:** If aligned properly, AI can support **circular economy initiatives** such as smart recycling, predictive maintenance for energy savings, and eco-design. However, awareness and infrastructure for such integration are still weak.
- **AI as a Tool for Decarbonization**: AI can enable low-carbon production through process optimization, energy monitoring, and emissions forecasting—yet few industrial firms currently link AI to their climate strategies.

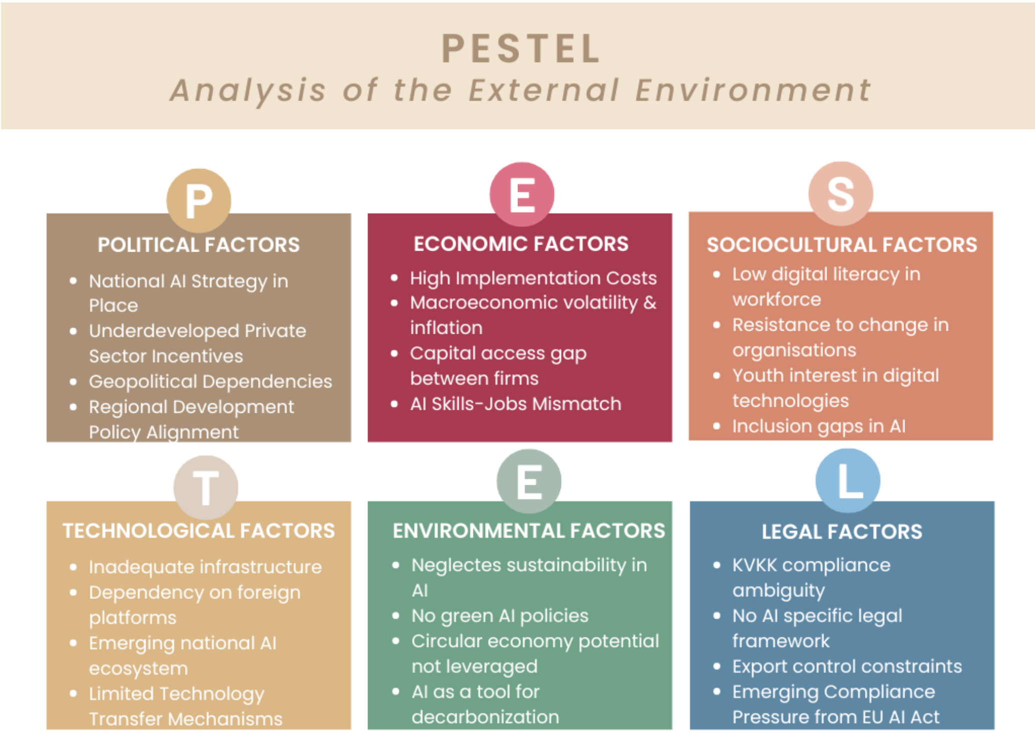

Figure 5: PESTLE Analysis: External Environment

Strategic Interpretation of PESTLE Analysis summarized in Figure 5:

- Politically and demographically, Turkey has a favorable positioning for AI adoption.
- Economically and legally, however, there are significant coordination and capability gaps.
- Technologically, the challenge is not only access to tools, but also the ability to localize, secure, and sustain digital systems.

To accelerate national progress, a coherent policy mix is needed—combining AI-specific regulation, fiscal incentives, infrastructure investment, and educational reforms. Only then can PESTLE's external constraints be transformed into strategic enablers.

6. Strategic Recommendations: Bridging the Gap

In light of the gap, SWOT, and PESTLE analyses, it is clear that Turkish industry requires a multi-layered, inclusive, and scalable transformation strategy to accelerate AI adoption and digital maturity. The following recommendations offer a comprehensive roadmap, structured around six strategic intervention areas—ranging from national policy to organizational culture.

6.1 Strategic Alignment and Sectoral Roadmaps

To accelerate AI adoption in a way that reflects the unique dynamics of each industrial segment, it is essential to integrate artificial intelligence into sector-specific strategies and operational frameworks. This requires both top-down policy coordination and bottom-up ecosystem engagement.

As a priority, **sectoral AI roadmaps** should be co-developed in partnership with industry associations, chambers of Commerce and Industry, and key stakeholders from sectors such as automotive, textiles, defense, and food processing. These roadmaps must define sector-tailored priorities, use cases, and capability pathways.

Simultaneously, **national AI policy objectives** must be synchronized with **regional development agendas**, particularly in emerging industrial zones. Such alignment ensures that policy initiatives are grounded in local economic contexts and support the decentralization of AI capabilities.

To measure and monitor progress, **industry-level digital maturity benchmarking programs** should be carried out. These initiatives would enable firms to conduct structured self-assessments, set realistic goals, and track advancement over time—fostering a culture of continuous improvement and data-driven transformation.

By operationalizing these steps, the outcome will be a set of targeted, high-impact interventions that empower sectoral ecosystems with context-sensitive, scalable AI capabilities, laying the foundation for long-term competitiveness and innovation.

6.2 Talent Development and Workforce Upskilling

A sustainable and scalable AI transformation in industry requires the development of a resilient, adaptive, and AI-literate workforce. Human capital must be positioned at the core of the digitalization agenda, with dedicated mechanisms to close the talent gap and future-proof industrial capabilities.

To this end, it is essential to **introduce vocational AI training programs and micro-credentialing systems** through collaborative platforms involving universities, technoparks, and leading industrial actors. These programs should be tailored to different occupational levels and industrial needs, emphasizing practical application over abstract theory.

Companies should be **encouraged to establish internal AI academies**, focusing on hybrid skill development that combines sectoral domain expertise with digital and analytical capabilities. Such initiatives can foster internal innovation capacity and enable workforce adaptability in dynamic industrial environments.

Moreover, organizations should be motivated to **designate AI Officers or AI Ambassadors**—professionals responsible for promoting digital transformation, facilitating knowledge transfer, and driving cultural change from within.

The long-term impact of these efforts will be a significant reduction in talent bottlenecks and the emergence of an industry-aligned, technology-ready human capital base, capable of supporting Türkiye's AI-driven industrial growth.

6.3 Investment and Incentive Mechanisms

Accelerating AI adoption across industry requires not only technological readiness but also the strategic mobilization of financial resources. To overcome hesitation and reduce perceived risk, targeted incentive structures must be introduced that support both early experimentation and long-term capability building.

A key priority is to **design public funding mechanisms** that actively support **AI-focused research and development, prototype creation, and pilot implementations**—with a strong emphasis on **small and medium-sized enterprises (SMEs)** that typically face greater capital constraints.

In parallel, **tax reliefs, direct grants, and co-financing programs** should be deployed to incentivize firms that invest in AI infrastructure, talent development, and organizational transformation. These instruments can help shift AI from a discretionary to a strategic investment area.

Additionally, the establishment of a **Digital Innovation Fund** would prioritize **high-risk, high-impact AI projects**—particularly those aligned with broader policy goals such as the **green transition**, **strategic autonomy**, and **resilient value chains**.

Collectively, these mechanisms will stimulate more confident, forward-looking AI investments, while democratizing access to innovation capital, ensuring that firms of all sizes can participate in Türkiye's digital transformation journey.

6.4 Infrastructure and Technology Platforms

A robust AI transformation requires not only policy alignment and talent readiness but also the establishment of shared, secure, and sovereign technological infrastructure. Without accessible and scalable platforms, AI experimentation and deployment remain costly and fragmented—particularly for mid-sized and resource-constrained firms.

To address this, the development of **national AI sandbox environments** is crucial. These controlled platforms would allow companies to **test, validate, and iterate AI models using real data**, while complying with privacy and security regulations. Such sandboxes would de-risk innovation and accelerate learning cycles across industry.

At the same time, there is a pressing need to **promote open-source AI toolkits and curated datasets** that are specifically adapted to local industrial contexts. This would lower entry barriers and ensure that AI tools are relevant, inclusive, and easily adaptable for SMEs.

Moreover, the creation of **regional industrial cloud platforms** is essential. These platforms would provide **scalable, on-demand access** to computational resources, storage capacity, and advanced analytics—enabling companies to prototype and scale AI solutions without the burden of high fixed costs.

Together, these infrastructure initiatives would enable cost-effective experimentation, foster ecosystem-wide innovation, and make AI adoption technically feasible and economically viable, especially for the broader industrial base.

6.5 Executive Engagement and Governance Culture

The successful integration of AI into industrial strategy requires more than technical capability—it demands visible, sustained leadership commitment and a culture of accountability at the highest levels of the organization. To achieve this, executive awareness and ownership of AI must be institutionalized as a strategic imperative.

A key step is the introduction of **"AI Masterclass for Executives"** programs, developed in collaboration with leading business schools and industry associations. These programs should equip senior leaders with a clear understanding of AI's strategic implications, risks, and value creation potential across the enterprise.

In parallel, companies should be encouraged to **establish Digital Transformation Committees** that include **C-level leadership and cross-functional stakeholders**. These governance structures can help break organizational silos, ensure alignment, and institutionalize oversight of AI initiatives.

To reinforce this commitment, organizations should also **integrate AI-related Key Performance Indicators (KPIs)** into their corporate performance management systems—linking executive accountability directly to measurable innovation outcomes.

Collectively, these actions will help reposition AI from being viewed merely as a technical initiative to becoming a core strategic leadership priority, thereby fostering deeper internal alignment, more consistent execution, and long-term value realization.

6.6 Policy, Regulation, and Public–Private Dialogue

For AI adoption to mature into a sustainable and value-generating national capability, cultivating an enabling policy environment—one that offers legal clarity, encourages responsible innovation, and fosters broad-based stakeholder collaboration is important. A shared vision, supported by coherent rules and aligned incentives, is essential to build trust and accelerate momentum.

A critical first step is to **modernize the existing legal framework** to address AI-specific regulatory challenges, including **algorithmic transparency**, **liability mechanisms**, and **ethical compliance standards**. This will ensure that both innovators and regulators operate under a common understanding of responsibility and risk.

In parallel, **establishing a National AI Governance Council** composed of representatives from **government, industry, academia, and civil society** is recommended. This body would oversee policy coherence, advise on standards development, and mediate cross-sector interests to ensure inclusive and balanced governance.

Furthermore, actively **pursueing international partnerships** aimed at **knowledge exchange**, **regulatory harmonization**, and **co-investment**—particularly in alignment with evolving frameworks such as the **EU AI Act**. would enhance Türkiye's global positioning and facilitate participation in international AI value chains.

Together, these measures will strengthen institutional trust, reduce legal uncertainty, and align Türkiye's AI trajectory with global best practices, creating a more predictable and innovation-friendly environment for all stakeholders.

6.7 Integrating Diversity, Equity, and Inclusion into AI Industrialization

To ensure that Türkiye's AI-driven industrial transformation is **socially sustainable**, **regionally balanced**, and **demographically inclusive**, it is essential to embed **inclusion and equity** as cross-cutting priorities across all strategic pillars. This calls for deliberate and systemic efforts to close gender gaps in technical fields, mitigate regional disparities in digital capabilities, and address the digital divide that disproportionately affects SMEs and underserved communities.

A central focus must be placed on **gender inclusion**, through the introduction of gender-balanced participation targets within AI education, leadership development, and workforce strategies. Reskilling and upskilling programs should be specifically tailored to attract and retain women in industrial technology roles, fostering a more diverse and innovation-capable talent pool.

In terms of **geographical equity**, public support mechanisms and infrastructure investments should prioritize less digitally developed regions—particularly Anatolian industrial zones—through the creation of regional excellence hubs. These hubs would serve as catalysts for equitable innovation diffusion and capacity building across Türkiye's industrial landscape.

To tackle the **digital divide**, inclusive AI access programs must be designed to empower small and resource-constrained enterprises. This includes providing subsidized access to digital platforms, curated and context-relevant datasets, and foundational digital literacy toolkits. In addition, the establishment of community-based digital innovation centers can serve as local anchors for informal sector actors and micro-enterprises, enabling bottom-up participation in the digital economy.

By integrating these inclusive design principles into Türkiye's national AI roadmap, a more **resilient, equitable, and cohesive digital ecosystem** can be fostered—one that enhances industrial competitiveness while ensuring that **no region, gender, or enterprise is left behind**. Strategic Recommendations are summarized in Table 1.

Table 1: Strategic Recommendations

Strategic Area	Primary Objective	Key Actions	Expected Outcome
1. Strategic Alignment & Sectoral Roadmaps	Integrate AI into sector-specific strategies and regional development agendas.	Develop sectoral AI roadmaps Align national AI goals with regional priorities Launch maturity benchmarking programs	Targeted and high-impact interventions supporting sectoral ecosystems.
2. Talent Development & Workforce Upskilling	Develop a resilient and AI-literate workforce across industry.	Introduce vocational AI training & micro-credentials Launch internal AI academies Appoint AI Officers/Ambassadors	Expanded human capital aligned with technological transformation.
3. Investment & Incentive Mechanisms	Mobilize resources and reduce investment risk in AI adoption.	Create public funding schemes for AI R&D and pilots Provide tax incentives & co-financing Establish a Digital Innovation Fund	De-risked AI investment and democratized innovation access.
4. Infrastructure & Technology Platforms	Establish accessible, secure, and scalable tech platforms.	Set up national AI sandboxes Promote open-source toolkits & datasets Deploy regional industrial cloud platforms	Cost-effective AI experimentation and ecosystem-wide scalability.
5. Executive Engagement & Governance	Institutionalize leadership commitment and accountability.	Deliver 'AI Masterclass for Executives' Form Digital Transformation Committees Integrate AI KPIs into performance systems	Shift from technical deployment to strategic leadership priority.
6. Policy, Regulation & Public - Private Dialogue	Build a coherent regulatory ecosystem and foster multi-stakeholder collaboration.	Modernize legal framework for AI Form National AI Governance Council Pursue international alignment (e.g., EU AI Act)	Trust-building, regulatory clarity, and global strategic alignment.
6.7 Integrating Diversity, Equity, and Inclusion into AI Industrialization	Ensure socially inclusive, regionally balanced, and demographically equitable AI transformation across Türkiye's industrial landscape.	Set gender participation targets Prioritize AI capacity in underserved regions Enable SME access through subsidized platforms and community hubs	Inclusive AI ecosystems with enhanced diversity, regional cohesion, and broad-based participation—strengthening national competitiveness and digital resilience.

By executing these strategic actions in a coordinated manner, Turkish industry can transition from **AI potential to AI performance**—bridging today's maturity gap and positioning itself as a globally competitive, future-ready manufacturing hub.

7. Stakeholder Map: Strategic Actors and Institutional Contributions

The successful adoption of artificial intelligence (AI) and digital transformation within Türkiye's industrial ecosystem necessitates far more than isolated or company-level efforts—it requires a strategically coordinated, multi-actor governance model that mobilizes the collective capabilities of public institutions, private sector actors, academic bodies, and intermediary organizations. In this regard, transformation is not merely a technological upgrade but a systemic and structural shift, embedded within complex institutional, economic, and social contexts.

The maturity assessments, SWOT, and PESTLE analyses presented in previous sections of this report clearly indicate that Türkiye's readiness for AI deployment is not only dependent on the technological capabilities of individual firms, but is also shaped by the institutional architecture, policy alignment, and collaborative ecosystem in which these firms operate. Structural readiness, therefore, hinges on the ability of diverse stakeholders to engage in coherent action, share knowledge, align incentives, and co-create frameworks that accelerate responsible and scalable AI adoption.

The Stakeholder Map—as visualized below in *Figure 6*—categorizes the primary actors shaping Türkiye's AI transformation journey into four distinct yet interdependent groups:

- Strategic Policymakers, who set the national vision, allocate resources, and steer regulatory frameworks;
- Implementation Enablers, who provide the technical, financial, and infrastructural support required for execution;
- Knowledge and Capacity-Building Partners, who generate research-based insights, build skills, and foster innovation capabilities; and
- Industrial Stakeholders, who represent the demand side of transformation and offer real-world implementation feedback and market relevance.

Each of these actor groups brings unique competencies, mandates, and leverage points to the AI transformation agenda. Their interplay forms the basis of an inclusive and distributed innovation model that is capable of bridging current maturity gaps and generating high-impact outcomes at scale.

Understanding this stakeholder constellation is not only critical for mapping existing capacities, but also for designing actionable transformation pathways that are realistic, collaborative, and adaptive to the evolving dynamics of industrial modernization. In essence, Türkiye's long-term competitiveness in AI will be determined by how effectively it can orchestrate this multi-stakeholder ecosystem toward a common digital vision—grounded in shared priorities, mutual accountability, and continuous learning.

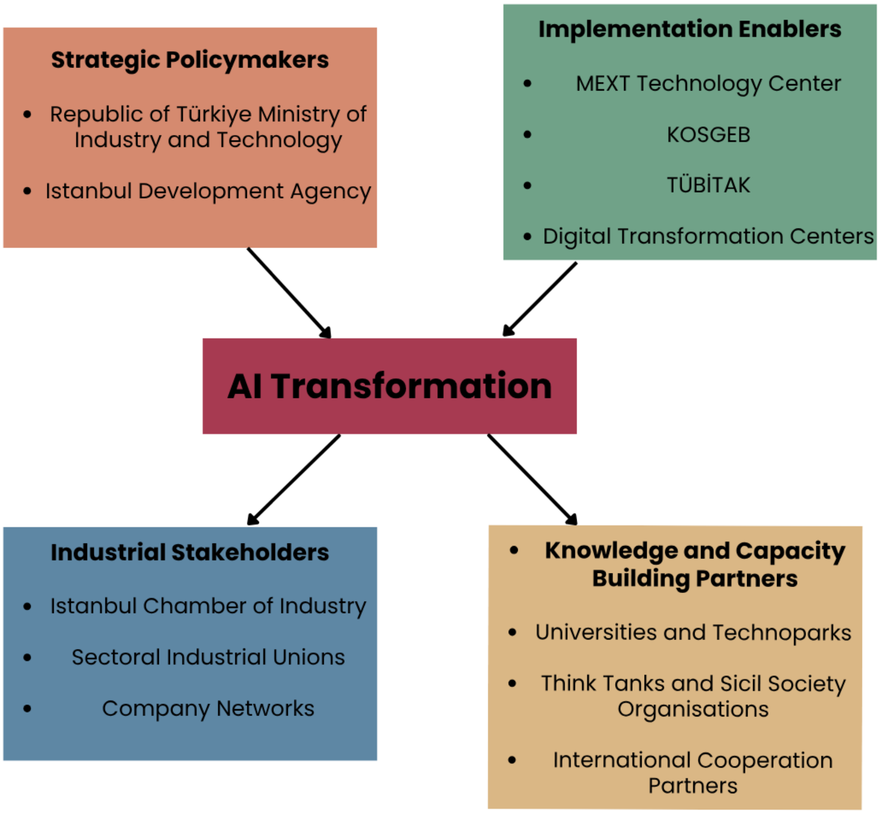

Figure 6: Strategic Stakeholders Driving Turkish Industry' s AI Transformation

8. Conclusion: From Potential to Performance

The findings of this gap analysis underscore a central reality: Turkish industry stands at a pivotal intersection—where the ambition to embrace artificial intelligence (AI) and digital transformation is high, but the operational and structural readiness is still evolving.

Despite the emergence of a national AI strategy, visible awareness, and early-stage pilots, the maturity levels across key dimensions such as infrastructure, talent, investment planning, and executive leadership remain below global competitiveness thresholds.

Key Takeaways from the Analysis

- **Readiness gaps are systemic**: Every pillar of digital transformation—awareness, infrastructure, integration, talent, and governance—shows a measurable lag compared to the ideal benchmark.
- **High variance across firms**: While some large-scale firms have achieved partial operationalization of AI, the majority—especially SMEs—are still in the awareness or conceptual stage.

- **Structural inhibitors persist**: Internal organizational barriers (such as low digital literacy, process rigidity) are amplified by external challenges (policy fragmentation, limited financial incentives, regulatory ambiguity).
- **Opportunities remain strong**: Turkey possesses key strategic assets—including a young and tech-oriented workforce, a growing AI research ecosystem, and access to European and global innovation networks.

Strategic Imperatives

To transform potential into performance, stakeholders must adopt a **coordinated, inclusive, and future-oriented national strategy**, grounded in five imperatives:

1. **Prioritize AI in industrial policy**: Embed AI and digitalization within broader industrial development, export, and competitiveness agendas.
2. **Democratize access to digital infrastructure and skills**: Ensure that SMEs, regional firms, and low-tech sectors are not left behind.
3. **Activate executive leadership**: Promote AI literacy and strategic ownership at the boardroom and C-suite levels.
4. **Design AI-specific support mechanisms**: Move beyond generic innovation policy towards tailored funding, regulation, and public-private partnership models for AI.
5. **Monitor and benchmark progress**: Institutionalize measurement tools, readiness indices, and maturity models to track transformation dynamically.

Final Reflection

The transition to AI-powered industry is **not solely a technological endeavor**—it is an economic, social, and governance transformation. It demands leadership vision, workforce empowerment, ethical foresight, and systemic alignment.

The gap is real—but so is the opportunity. With the right interventions, **Turkish industry can leap from experimentation to scaled implementation**, becoming not just an AI adopter, but an AI innovator on the global stage.

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