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National AI Strategies and Preparedness in the Arab Countries

A Comparative Analysis Through NLP, Cluster Analysis, and the IMF's AIPI Framework

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Abstract

The rapid evolution of artificial intelligence (AI) requires profound government strategy and real-world preparedness. This paper offers an overview of national strategies on artificial intelligence (AI) and explores the important relationship between desired strategy objectives and achieved preparedness in eleven Arab counties named: Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, QATAR, Saudi Arabia, UAE. The analysis uses a novel mixed-methods approach, which includes natural language processing (NLP) of strategic documents, the IMF's AI Preparedness Index (AIPI) statistics, and cluster analysis to map the regional milieu and to develop strategic opportunities and gaps. Our analysis reveals an interesting paradox: economies with less preparedness now have higher ambition, while more advanced nations have complacency, as their policy ambitions do not support their realized capabilities.

The study delineates three different strategic clusters: "High-Tech Hubs" characterized by sophisticated infrastructure but lacking ethical governance; "Nascent Innovators" with robust human capital and burgeoning innovation ecosystems; and a "Digital Catch-Up" category necessitating basic expenditures. A key result is the pronounced mismatch between the extensive incorporation of ethical concepts and much lesser preparedness for execution, as AIPI scores average below worldwide standards. This underscores an immediate necessity to convert ethical obligations into binding legislation and institutional capabilities.

This study offers policymakers a comprehensive framework for choosing interventions according to cluster-specific characteristics. It provides researchers with a reproducible framework for conducting strategic gap analysis. We advocate for varied policy strategies and suggest the creation of a regional AI observatory to track advancements, promote collaboration, and improve accountability. Ensuring ethical and successful AI deployment in the area need policies that are both imaginative and anchored in solid operational frameworks, bolstered by reginal and international collaboration.

Keywords: Artificial Intelligence (AI), AI Strategy, AI Preparedness Index (AIPI), Natural Language Processing (NLP), Clustering Analysis, Policy, Governance, Ethics, Regulation, Arab countries.

JEL Codes: O33; L51; O57; C81; Z13

I. Introduction

Artificial intelligence (AI) is rapidly transforming economies and industries, probably one of the most significant implications for the world since the industrial revolution, creating an opportunity to remake and enhance economic systems and ways of doing business. The potential for augmenting industries from customer experience to software to life sciences represents trillions of dollars of value generated, and for generative AI to create $6.1 trillion to $7.9 trillion of annual value, and how our societies operate (McKinsey Global Institute, 2023), could surpass historical industrial transformations. Transformative AI is about to begin a new, more powerful industrial revolution by making human intelligence a replicable commodity; this might yield proliferating economic improvement but will also need referrals to traditional economic policies (NBER, 2024).

Governments and global organizations are increasingly prioritizing AI preparedness and governance, which have rapidly ascended to the top of the global policy agenda (OECD AI Principles 2019, UNESCO Recommendation on the Ethics of AI 2021, European Union AI Act 2024). At the International Monetary Fund (IMF), central bank policymakers recognize two elements of AI: their productivity-boosting potential, along with the societal burdens it may introduce. This has led to calls for a balanced approach to maximize AI's promise while considering equity and employment security, where AI exposure is expected to be high in advanced economies (~60% of jobs) and lower in emerging ones (~40% of jobs) (IMF, 2024). Concurrently, prestigious global organizations such as the World Economic Forum-are referring to this moment as the "Intelligent Age" and advocating for collaborative governance as a means to benefit from AI while ensuring its benefits are equally distributed (Schwab, 2025). In line with efforts to benchmark and rank AI's preparedness internationally, the IMF launched an AI Preparedness Index (AIPI) in 2023. The AIPI includes 174 countries and is based on four dimensions of AI preparedness; digital infrastructure; human capital; technological innovation and regulatory frameworks providing an interesting guide on how to compare countries and provide a framework for AI preparedness.

In the last years, the Arab region has clearly begun to see greater interest and activity on national AI strategy. Arab countries including the UAE (2018), Qatar (2019), Saudi Arabia (2020), Jordan (2020), and Egypt (2021) have begun to release national AI or digital strategies with AI strategies built in. This represents a shift from autonomous pilot initiatives to a coherent strategic plan concerning AI at the level of government (Arab Reform Initiative, 2024; UAE Government, 2021). Comparative studies report that several strategies and investment initiatives prioritize economic diversification, public sector reform, and generating talent (UN ESCWA, 2025). However, there is a significant variation across the region in both the maturity of strategies and the depth of implementation. Countries in the Gulf Cooperation Council (GCC)—most notably the UAE, Saudi Arabia, and Qatar—have invested considerable resources in establishing AI infrastructure, dedicated institutional units with ministers or officers for AI (i.e. offices of AI), large public–private partnerships and initiatives, and flagship projects aimed specifically at driving adoption (Boston Consulting Group, 2025; Oxford Insights, 2024). In contrast to other Arab economies, which are still moving in building basic digital infrastructure, regulatory frameworks and pathways to advanced-skilled labour, these countries tend to be ahead when it comes to aggregation of measurable inputs, such as data centres, cloud capacity and dedicated funding for AI (World Bank, 2022; OECD, 2017).

Beyond the GCC–non-GCC divide, analysts and international agencies observe significant heterogeneity in policy emphases and governance arrangements. Some approaches are heavily technocratic and growth oriented, with formal commitments to R&D projects, investments, and smart-city agendas, while in contrast, other plans emphasize inclusion, capacity building, and sectoral applications in health, education, and public service provision (UNDP, 2023; UN ESCWA, 2025). Independent analysis of national AI strategies in the Arab countries also revealed some common deficiencies including a little focus on enforceable regulatory frameworks, lack of foresight about institutional fragmentation, and uneven approaches to addressing ethics and human rights protections as part of implementation plans (Arab Reform Initiative, 2024; Oxford Insights, 2024).

At the regional level, these multilateral and development entities have emphasized a strong commitment to digital transformation as a tool for sustainable development and economic diversification. The UNDP (2023), World Bank (2022), and OECD (2017) have been proactive in launching regional programs and roadmaps to bolster digital government, increase the digital workforce, and integrate AI into public service provision, including the Sustainable Development Goals. These developments indicate a growing ecosystem of technical assistance, benchmarking, and knowledge sharing that aims to address capacity imbalances across the Arab regional context.

Overall, the overall picture is one of fast policy and high ambition - the latter especially for the GCC - and a large variability in both abilities to implement and governance maturity across the region. The variance suggests a need for diagnostics that recognize the regional context (such as the AIPI alignment, utilised in this study), thoughtful policy design for clusters, and common monitoring frameworks to facilitate peer learning and targeted technical assistance (Boston Consulting Group, 2025; Arab Reform Initiative, 2024).

While more Arab countries than ever have articulated ambitious national AI strategies, translating those aspirations to operational capacity has proved to be a challenge. Because the gap between aspiration and preparedness is also well-documented in the global AI governance literature, which suggests that policy makers are almost always ahead of the managerial and technical capacity (Floridi et al., 2018; OECD, 2021).

This disparity becomes increasingly obvious across the Arab region in many critical areas. While most of the national strategies refer to ethical principles and values, enforcement mechanisms and oversight bodies are under-developed (UN ESCWA, 2025). The national strategies do not often contain legislative instruments or regulatory authorities that can hold entities accountable even when the mission to regulate exists (OECD, 2021; Arab Reform Initiative, 2024). On one hand, a clear fragmentation in institutional arrangements, the abilities of public institutions to deliver, implement, and evaluate AI solutions remain weak (World Bank, 2022; Boston Consulting Group, 2025). On the other hand, although most documents focus on talent development and recruitment, the acute shortage of AI-related skills, particularly in non-Gulf economies, threatens the overall effectiveness of AI policies (Oxford Insights, 2024).

Despite the surge in AI strategies across the Arab world, there is no systematic evaluation from a comparative perspective of the similar AIPI as suggested by the IMF (IMF, 2025). Global assessments of AI strategies or AI preparedness illustrate an inequitable or differing global evaluations from OECD (2021) to Oxford Insights (2024) that do not typically assess the comparative ambition available for AI policy aspirations and development alongside the

available operational delivery capacity from those national strategies. This represents a serious gap, not least due to variation across the Arab world, from high-income and resource-heavy strategies by GCC countries, whilst others have adopted a more modest phased approach to foundational digital transformation (UN ESCWA, 2025; World Bank, 2022). Consequently, initiatives to track and compare levels of AI preparedness across the region for informed policymaking presents a daunting challenge for policymakers, as regionally contextualized, data or evidence-based, continuing monitoring and evaluation strategies do not appear to be available. This study seeks to address this gap by **using an AI approach to analyse AI strategies and preparedness** and will demonstrate a new methodological approach where the a combination of NLP processes based content analysis of national AI strategies can become clustered for ranking purposes and under the auspices of the AIPI which supports a data-driven, evidence-based approach for reliable, regionally contextualized targeting of AI policy interventions while enabling ongoing and future acquiescence to measure progress against the strategic plan.

This paper systematically analyses the strategic ambitions of Arab states in Artificial Intelligence (AI) against actual operational preparedness to pursue those ambitions. It is grounded in the Artificial Intelligence Preparedness Index (AIPI) implemented by IMF (IMF, 2025). This study introduces a comprehensive, multidimensional analysis designed to assess national and story AI preparedness. Using four dimensions of AI preparedness (digital infrastructure, human capital, innovation capacity, and governance & ethics), this analysis is intended to provide a holistic basis for assessment. This research aims to achieve three primary objectives. First, it utilizes computational text analysis using natural language processing (NLP) and unsupervised machine learning on the national AI strategy documents to identify clusters. In this context, we are categorizing countries with shared strategic priorities to enable more focused comparative analysis and identify potential collaboration opportunities, based on the IMF's AI Readiness Index framework. Second, the study systematically utilizes the IMF's AI Preparedness Index (AIPI) framework to engage in benchmarking actual capability for each of the countries assessed so that strengths and limitations can be thoroughly assessed across crucial factors like talent development, ethical frameworks, and regulatory governance. Finally, the analysis will determine and assign quantifiable measure of the strategic alignment gap between the countries assessed, measuring the distance between the stated policy ambition (strategic intent) and the countries' actual implementation capacity (preparedness scores), identifying critical areas for policy intervention and allocation of resources. The final goals of this analysis will create policy recommendations supported by the strategic ambitions and actual preparedness of selected Arab countries along a preparedness cluster. In conclusion, this paper aims to address the strategic ambition to create AI policies/project, and operational capability to design better policy making; build governance processes and ultimately improve the AI preparedness ranking, from Arab region.

This study contributes three key features. It combines a qualitative data analysis of strategies with a quantitative analysis of the AI preparedness index available to produce a replicable, data-based protocol that can be used to empirically study Arab countries strategic preparedness framework. For policy makers, this study provides actionable insights that can assist Arab countries with strategic preparedness gaps and relevant intervention to strengthen capability in internet governance or artificial intelligence ethics. Academically, this study has addressed wider debates on AI-governance in developing contexts through context- specific comparative

analysis that addresses a meaningful gap in the extant literature (Tjondronegoro, 2024; IMF, 2025).

The study is structured to provide a systematic progression from contextualizing the content to actionable insights. Section 2 presents the literature review. Section 3 discusses the data used, overall methodology, analysis tools included the NLP methods & clustering algorithms with AIPI framework. Section 4 presents the results analysis and findings discussion - the clustered country groups and a gap analysis. Lastly, Section 5 conclusions the study by outlining the most salient insights and provides recommendations for each clustered group and proposing areas for future research.

II. Literature Review

A large and growing corpus of recent literature analyses national AI strategies globally & regionally, by using different comparative methods to illuminate the different ways that countries and regions are addressing or approaching AI development and governance.
The recent global examples have involved various frameworks to analyse national AI strategies. Dunford et al. (2023) notably analyse national AI strategies for 34 countries through a cluster analysis process and using the following six characteristics: data management, algorithmic governance, capacity building, industry focus and role, and public services. Their analysis indicates heterogeneity in how countries are approaching their AI strategies, with Western countries' strategies largely concerned with regulatory obstacles and risk management, whereas countries like China are concerned with research and development, and the application of AI in their industries. Examples like that some major AI strategies, such as the USA's AI strategy has been noted to be extensive, but the effective implementation will provide more evidence.

A comprehensive 2024 UNESCO report, which examined 56 national AI strategies, confirmed that higher education institutions are the foundation upon which almost everything is built, and the primary source of both talent development and innovation in this vital field. The analysis shows there is agreement among all actors, of which 81% explicitly mention the higher education sector and 67% have dedicated funding allocations for developing AI curriculum, research centres, and establishing innovation partnerships. This alignment exists largely because HEIs play a critical role in national research ecosystems; HEIs contribute nearly 38% of AI research output. This report shows major inconsistencies in this engagement. Involvement in the development of key ethical and governance frameworks is uneven; while 55% of strategies formally recognize HEI-industry collaboration, only 33% include HEIs in the development of clear data governance protocols. Most striking are global inequities in capacity building. There is a big gap in how prepared faculty are; 18% of Global South countries have faculty retraining and development, compared to 42% of OECD countries. Similar gaps can be seen with ethics education; 64% of OECD countries have ethics education as part of their programs, while fewer than 28% of emerging economies. This shows that even as HEIs are recognized to be critical actors, there is an urgent need for more equitable and comprehensive policies across the board to remedy global capacity gaps and to better utilize higher education's role in the ethical development of AI (UNESCO, 2024).

Additionally, and thoroughly A global report on AI infrastructures in 2023 states that there is no one significant approach to AI; nations are creating their own AI strategies that reflect local values, needs and priorities (Singh et al., 2023). They introduce a similar concept called "AI Wardrobes" and use more sophisticated computer science methods that include NLP methods (including Latent Dirichlet Analysis and ensemble-LDA) to analyse 213 documents on national AI

strategies from 54 nations. The study outlines that West European countries have different country-level approaches towards growing and advancing AI; for example, the European Union highlights ethical AI while the US is focusing on whatever is built through basic research. An analysis of the study identifies unique country groupings, and the analysis identifies regions that had a type of similarity of strategic priorities (i.e., differentiated regional clusters). The study emphasizes the distinction between "performative" strategies, which are broad declarations and "substantive" strategies that involve detailed & concrete policies. The report highlights that countries that have patient, ecological and leading AI ecosystems exhibit greater "policy depth" and dedicate considerable institutional and financial resources for focused areas: education, transportation, etc. The report concludes with recommendations to policymakers advocating for contextual & goal-oriented mechanisms for AI governance, as well as public trust building.

Looking at the regional level again, the different policies and challenges are revealed again. In Europe, for example, the EU joint research centre (2022) realised tensions and differences in AI research funding and adoption and use between key western European leaders, such as Germany and France, and eastern European countries, suggesting that the EU's coordinated approach to AI progress is staggered. At the Asia-Pacific region level, Xu et al. (2024) evidenced movement toward "hard" regulation based on telecommunications policymaking. In this context, Singapore's frameworks emphasize economic pragmatism towards AI development and follow strict data sovereignty frameworks, while India is orientating to a relatively laissez-faire approach focused on digital public goods and undirected data solution.

Hendawy and Kumar (2024) analyse the Middle East and North Africa (MENA) region, where most industry impacts focused on economic growth and job creation, but were also reliant on "soft" regulation - defined by authors as a reliance on non-enforceable ethical principles rather than enforceable laws. This paradigm lends itself to "ethics washing," where a company is compliant (non-liable), but ethical behaviors are not actually being conducted or also at the highest ethical standard because ethically sound practices were not enshrined in law; the ethical principles that are used are all conditional and thus classified and more related to corporate compliance and risk management. For Africa and specifically, the report created by CIPIT (2025) tracked some interesting trends in countries like Kenya, South Africa, Nigeria, and Egypt, but still documented necessary infrastructure like electricity, internet uptime, and even the consistent governance across the continent, remain a core challenge. In 2022, the Organization of Economic Cooperation and Development (OECD) and the CAF Development Bank of Latin America published a report to assist national governments in Latin America and the Caribbean (LAC) (OECD & CAF, 2022) in their use of AI to promote public sector digital transformation. The report was designed to provide a baseline for current activities and capacities in the region with regard to the use of AI in the public sector. The authors reviewed the AI strategies and commitments for each country that include their commitment to the OECD AI Principles. Additionally, the report examined efforts to build governance capacity and implementation of key prerequisites for AI in the public sector. A series of recommendations for governments across the region to enhance their ability to utilize AI to become more efficient, effective, and responsive governments and to cooperate in a regional vision for AI use in the public sector concluded the report.

Aderibigbe et al. (2023) study highlights on the potential role of AI in developing countries and focusing on the gap between what AI can do and what is done with it. As AI technologies continue to evolve and become more ubiquitous around the world, their effect on socio-economic development will only grow more important, particularly where there is substantial diversity in

terms of challenges. This paper considers the current state of AI adoption, including potential benefits, challenges and ethical considerations. This paper is a literature review with five case studies - exploring paths of efficacy, in education, food and agriculture, healthcare, and the environment - to develop methods of harnessing the transformative power that AI offers. The findings of this article offer evidence that can be drawn on, collectively, to help build capacity, encourage public-private sector partnerships, and develop policy frameworks tailored to maximise the interventions offered by AI and its uses, while recognising the need to build software and hardware infrastructures and skills gaps that are present. This research helps to deepen understanding of the complexities involved in implementing AI in developing countries, adding another lens from which to observe studies in international and development education. This paper will be useful to researching and practicing educators, policymakers, and researchers.

Shi (2025) studies national AI strategies (NAISs) from 50 countries, to help classify educational policy priorities, strategies, and support resources in order to develop a competent and capable AI-relevant workforce. The study identifies an important need for focus on Human Resource Development (HRD) to better prepare the workforce for increasingly automated, algorithmic, and data-driven workplaces. Analysis of the studies revealed that only 13 countries primarily in Europe, which are developed economies, had prioritization in their NAIS with clear objectives and measures. The findings have implications for HRD, particularly in the development of inclusive, AI-ready, workplace-related curriculum and policies that will legitimize institutional, contextual, and cultural priorities. More broadly, Shi identified 6 categories of education and training strategies for developing AI talent and reskilling the workforce, plus 4 kinds of supportive resources for the key investments that would facilitate the strategies.

The existing literature has successfully characterized AI preparedness disparities on a global scale, along with the contrasting strategy priorities across countries (OECD & CAF, 2022; Shi, 2025; Singh et al., 2023 with Singh et al.) uniquely using NLP for their analysis). Nonetheless, there remain significant gaps in quantitatively and qualitatively mapping the extent of overlap between national AI policy ambitions and the actual capabilities realized. Most reports thus far have classified strategy and implementation in a binary manner. In this study, we engage this gap through an application of an AI-specific mixed-methods framework that links the IMF's AI Preparedness Index (AIPI) to an NLP analysis of strategy documents and a cluster analysis to systematically diagnose the ambition-capability paradox based on AI and ML capabilities. Other than identifying a gap, we also contribute to explicating the nature of the gaps. Through the identification of three strategic clusters—“High-Tech Hubs”—“Nascent Innovators”—and “Digital Catch-Up”—we hope to advance a describable and actionable framework for public policy leaders to implement targeted cluster intervention strategies, as well as convert the theoretical discussion on ethics and infrastructure into a measurable plan of action for accountability and regional collaboration, filling a significant gap in the strategic treatment of AI development at a global and regional level.

III. Data & Methodology

For conducting a deep and comprehensive analysis, our research employed a systematic and data-driven approach, focusing on two overarching determinants: (1) the extent to which a country's AI strategies had aligned with AI preparedness and (2) the country’s ability to implement those strategies through its AI preparedness ranking. The research design followed the IMF’s AI Readiness Index (AIPI), which establishes a consistent methodology and enables

countries to objectively compare aspirations with their preparedness to enact them. The IMF's AIPI framework is a useful point of reference, but we also acknowledge its limitations. Thus, we do not employ AIPI as one of the judgments or assessments of absolute performance. The AIPI was used as a baseline, supplemented and enriched through our analysis of the governance context and basis of evidence in NLP, to present an informed reading that encompasses complete, comprehensive, and practical evaluations of national & regional AI preparedness.

1. Data

The study uses two prominent types of data:

1.1 National Strategy & textual dataset

This is a curated collection of eleven publicly accessible official national AI and digital transformation strategies from Arab nations. These documents are publicly available on government portals, official announcements, and public repositories and include qualitative data on each country's policy objectives, governance structure, and plans for implementation. The dataset (alphabetically) includes:

- *Algeria_Digital_Strategy.pdf (included AI)*
- *Bahrain_AI_Policy.pdf*
- *Egypt_AI_Strategy.pdf*
- *Jordan_AI_Strategy.pdf*
- *Kuwait_AI_Strategy.pdf*
- *Lebanon_Digital_Strategy.pdf (included AI)*
- *Morocco_Digital_Strategy.pdf*
- *Oman_AI_Strategy.pdf*
- *QATAR_AI_Strategy.pdf*
- *Saudi_AI_Strategy.pdf*
- *UAE_AI_Strategy.pdf*

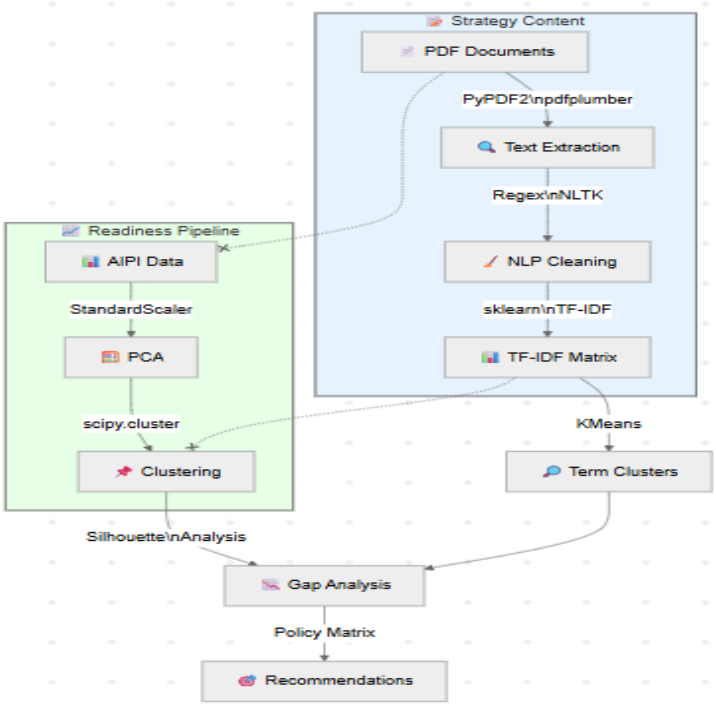
1.2 AI Preparedness (AIPI) Dataset

Quantitative indicators are sourced from the IMF's AIPI dataset. The dataset provides a standard set of preparedness indicators across various four dimensions—such as digital infrastructure, human capital, innovation ecosystem, and policy frameworks—to compare preparedness between countries in the Arab region and to compare some of these indicators against the regional and global context.

2. Visual Analytical Framework

The flowchart of this study contents two parallel and interconnected analytical pipelines as follows:

Figure 1: Visual Analytical Framework



This flowchart above (Figure 1) provides a depiction of the two-track process used in this assessment. This analysis examines the two side-by-side, interconnected tracks:

- Strategy Content Pipeline (Blue, Right Side): Qualitative data analysis of documents for national AI and digital transformation strategy using Natural Language Processing (NLP) methods, which is a set of quantitative methods.
- Preparedness Pipeline (Green, Left Side): A quantitative evaluation of each country's actual preparedness using IMF's AIPI indicators.

The tow pipelines converge in a comparative **Gap Analysis**, which examines the alignment between strategic vision and implementation capacity. To ensure both indices contribute equally and meaningfully to the final analysis and to further prevent the AIPI's fixed, low scale from artificially dominating or undervaluing the TF-IDF scores we used a Min-Max Normalization procedure on the TF-IDF scores. The visual framework highlights the systematic, transparent, and evidence-based approach guiding the policy recommendations in this study.

3. Analytical Procedures

This analysis takes a dual-method approach, using text analysis of national AI strategies and quantitative country preparedness measurement. First, we conduct text analysis, using Natural Language Processing (NLP), to identify key policy themes embeds in the text, and then map them to the IMF's AIPI framework. Second, we conduct a statistical cluster analysis to analyse preparedness, clustering countries. We then fully integrate these results in a gap analysis, comparing priorities to preparedness, which forms the basis for our recommendations.

3.1 Country Coverage and Strategy Document Review

The countries selected for this study are those for which both official national AI or digital transformation strategies and corresponding AIPI data are publicly available. The analysis

encompasses the following Arab countries: Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

3.2 Strategic Content & textual Analysis: Unpacking Vision and Priorities

A structured Natural Language Processing (NLP) driven content analysis based on the "taxonomy-guided topic modelling" method. The methodology utilizes a predetermined taxonomy that is linked to the IMF's AIPI pillars to extract comparable policy themes into categories (see appendix 2):

- **Text Preprocessing:** All texts were normalized using advanced NLP techniques, followed sometimes by careful manual verification to preserve contextual accuracy.
- **Key Term Extraction:** Using Term Frequency–Inverse Document Frequency (TF-IDF) analysis, we identified the most salient terms and themes that reflect core national AI and digital strategies. The theme identification approach enhances the standard TF-IDF method by providing semantic grouping to build cohesive policy themes. It is a combination of four methods: taxonomy-based categorization to map terms into a weighted thematic structure; integration of n-grams to emphasize phrases in context; a hierarchical model of theme aggregation, confirmed using PCA/t-SNE, to maintain consistency across documents; and an additional semantic validation to exclude nonsense words or terms of no substance. All these features will assist in ensuring the analysis has captured interpretation-rich policy concepts, rather than word frequency (See appendix 1 & 2).
- **Alignment with AIPI Pillars:** Extracted themes were systematically mapped to the four pillars of the IMF's AIPI framework:

    1. Digital Infrastructure
    2. Human Capital
    3. Innovation and Economic Integration
    4. Regulatory and Governance Structures

The theme to Pillar Matching Methodology builds upon the previously identified policy themes by structuring them within a semantic mapping process. In this approach, we link identified and established policy themes to specific AIPI pillars and assign theme terms at the level of the pillar, utilizing a pre-defined taxonomy dictionary (See appendix 2) for specific, exact and partial string matching with controlled n-grams component of our proforma. Subsequently, we will apply a weight to each term to quantify its significance or value in the matching process. This approach is expected to maintain an organized, coherent, and semantically rooted linkage between the identified policy themes and existing dimensions of the AIPI.

3.3 Preparedness Evaluation: Measuring Implementation Capacity

In parallel to the strategy analysis, a preparedness assessment using quantitative data derived from the IMF's AIPI indicators.

- **Dimension Scores:** Each country was given a score for each of the AIPI dimensions, which measured their current preparedness and capacity for AI implementation.
- **Clustering Analysis:** We used K-Means clustering and compound principal analysis (CPA) technics Instead of simply relying on standard PCA, so countries were clustered into sets of preparedness profiles by their similarities in capacity and existing strengths

and progress in preparedness for AI. K-Means clustering was chosen because it allows for pre-defined, meaningful groupings that are critical for analyzing policy strategies while ensuring that every country is placed in a cluster for comparison. The data used for the K-Means clustering have been reduced and pre-processed using PCA, which accorded with K-Means assumptions of well-separated spherical clusters. The determination of the number of clusters was obtained using the elbow method. In contrast to algorithms like DBSCAN that look for outliers, K-Means enables comprehensive inclusion and is easy to visualize, which is also important for development of strategic positioning, reproducibility, and policy recommendation development (Mandon, 2025).

- **Statistical Validation:** We validated the clusters using silhouette scores to test proximity of the clusters. The cluster validity was assessed using silhouette analysis and the elbow method. The optimal number of clusters (k=3) was determined by maximizing silhouette scores while ensuring each cluster contained sufficient countries for meaningful policy analysis, along with other statistical measures of whether groupings were valid and meaningful (Mandon, 2025; Yi et al., 2024).

3.4 Integrative Analysis: Bridging Strategy and Capacity

For measuring the levels of alignment or misalignment between strategic intent and implementation capacity, we created two composite indices on the AIPI framework: the Strategic Intent Index and the Preparedness (Standardized AIPI) Index. These metrics allow for a structured comparison between a country's policy ambition and its operational capacity.:

- **Strategic Intent Index:** This index measures the intensity of and thematic relevance to AIPI-related terms in each of the national AI strategy documents. Through a TF-IDF-based text analysis, we quantify the intensity of emphasis in each country's strategy on the four AIPI preparedness pillars. The resulting scores provide information about each country's strategic intent (or its policy priority) across these four pillars.
- **Preparedness Index:** This index is not a distinct or newly developed but rather a standardized functional transformation based on the IMF's AIPI scores. This standardization indicates each country's actual preparedness through the same four pillars. Standardizing allows for interoperability, comparison between countries, and alignment with the strategic intent index.
- **Gap analysis:** This analysis compares a country's strategic intent (aspirations) with its preparedness (capacity) to identify significant policy-pillar misalignments. This exercise produces two actionable gaps:
  - **Strategic Overreach:** When intent exceeds preparedness capacity, there is potential to make a case for a gradual build of capacity or even for phasing an implementation if capacity or experience is low.
  - **Underleveraged capacity:** When the strategic intent overlooks existing capacity, it presents a potential opportunity to integrate policy options.

  This method results in the collection of empirical evidence that supports reform priorities, sequences the implementation of reforms, and ensures a coherent policy strategy for improving education.

IV. Results Analysis & Discussion

This section presents the findings from our two-track methodology which assesses the degree of alignment between the strategic aspirations and actual implementation viewport looking to advance AI in Arab countries. First, we present the findings of the textual and cluster analysis on national AI strategies, categorizing the strategies and key policy priorities using the AIPI framework presented by the IMF. In the second part of this section, we present the findings from the AIPI ranking using quantitative data provided by the IMF AIPI map of the preparedness score. Finally, we attempt to bring the two findings together and provide a gap analysis, producing a data-driven view of strategic alignment of each country, as well as the basis for our policy recommendations. This section includes three subsections as follows:

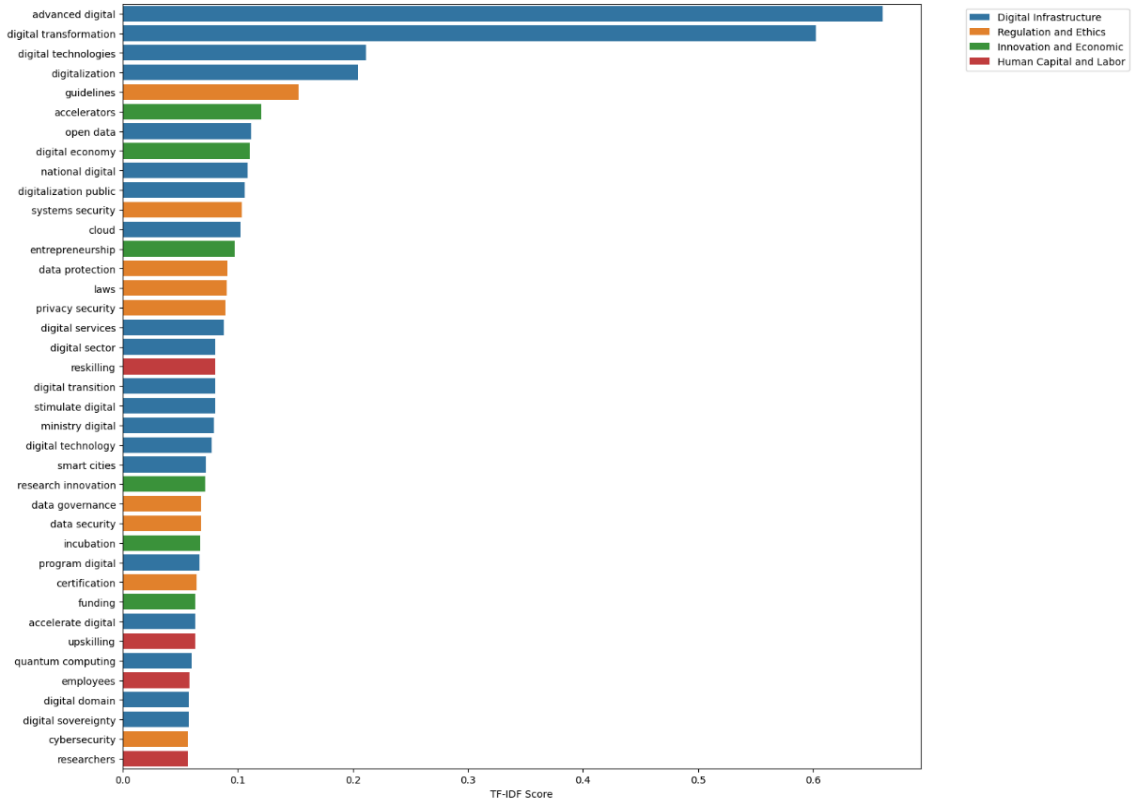
1. Results of Textual and Cluster Analysis

This subsection presents on the results of textual and corpus analyses of national AI strategies. Using natural language processing and TF-IDF analysis, we identified key themes and the most frequent words in each strategy and across the strategies. We categorized countries according to similarities in the strategic language used in strategy documents, which enabled identification of groups with indicators of identical strengths and policy intent. Text similarity was derived using cosine similarity on TF-IDF vectors before K-Means clustering was applied to group countries proximity to policy themes. These two points of TF-IDF and clustering quantifiably establish the analysis, while the thematic interpretation of the data to AIPI pillars establishes the qualitative evaluation base from these findings. By linking our analysis to the AIPI framework, we constructed an ordered assessment of divergence of strategic intent in Arab countries. This analytical assessment constitutes the qualitative basis for studying alignment of different strategies. This analysis comprises five axes as follows:

1.1 Priority Areas Identified (Top 40 AIPI-Relevant Terms)

The analysis identifies the 40 most prominent policy terms using the Term Frequency-Inverse Document Frequency (TF-IDF) method—a statistical approach that underscores the relative significance of terms within each strategy document. Our analysis employed a taxonomy-constrained TF-IDF approach using a predefined vocabulary derived from the IMF's Artificial Intelligence Preparedness Index (AIPI) framework (see appendix 2). In order to mitigate potential document length biases, we applied L2 normalization to the TF-IDF vector, ensuring each document vector has unit length (Euclidean norm = 1), thereby preventing longer documents from biasing term importance scores, as every document contributes equally as they have the same scaled length. Figure 2 below summarizes the results:

Figure 2: *Top 40 AIPI Policy Terms by TF-IDF Score (Aligned with IMF AIPI Taxonomy)*



The bar chart displays the 40 terms that have been categorized along the four pillars of the AIPI framework and indicates the level of thematic emphasis in national strategies represented by colour.

- **Digital Infrastructure (Blue):** This pillar was represented by the most emphasized area overall across the strategies that were analyzed. "Advanced digital," "digital transformation," "digital technologies," and "digitalization," were some of the highest ranked of all the terms used, all indicating that there was overall agreement across the region that digital infrastructure should be considered fundamental as a strategic enabler for the national preparedness and implementation of AI activities.
- **Regulation and Ethics (Orange):** The terms "guidelines," "privacy security," and "laws" were all represented at the moderately higher end of frequency, indicating an explicit acknowledgement of the need for strengthening measures of governance frameworks and ethical safeguards, but again, they are secondary to the area surrounding infrastructure.
- **Innovation and Economic Integration (Green):** The terms such as “accelerators”, “digital economy”, “entrepreneurship” and “research innovation” suggesting a new policy emphasis on AI as an economic growth and diversification mechanism. This relates to a broader emphasis on development as innovation.
- **Human capital and labor market policies (Red):** Terms such as reskilling, upskilling, and employees emerged but were more subdued, confirming that skills development has still yet to fully emerge as a policy priority to ensure continuity and inclusiveness in strategy.

This analysis confirms that Arab national AI strategies are evidently focused on digital infrastructure development. Proposals relating to regulatory and innovation or human capital matters, though noted, are less pronounced. Through initial analysis we are detailing a stronger policy framework for the technological "what" - system and platform components associated

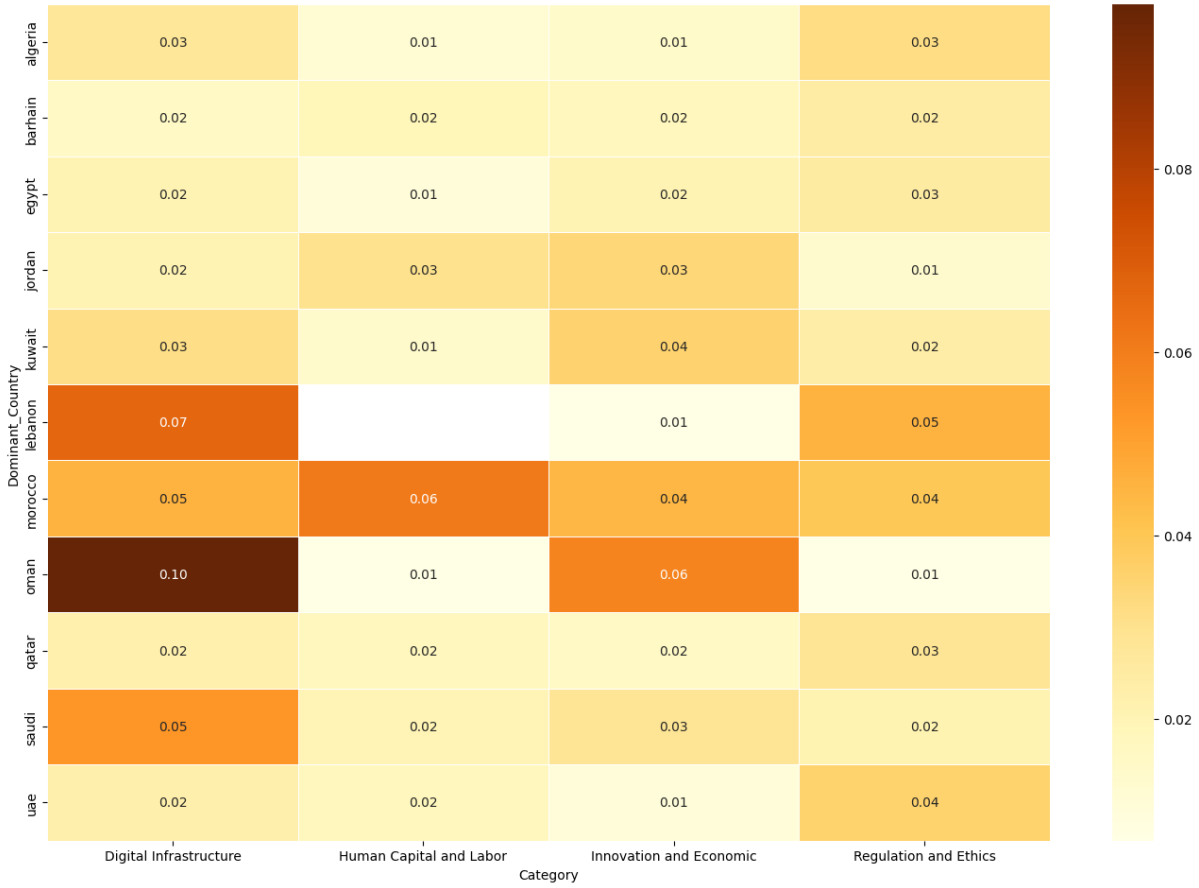
with the implementation of AI - as opposed to a framework for the "how", which incorporates societal implementation, moral guardianship and human capital preparedness. This indicates a future opportunity to sharpen strategic thinking to provide a more comprehensive approach that balances advancement in technology yet considers equitable and responsible policy making principles.

1.2 Comparative Coverage of AIPI Categories Across Arab National AI Strategies

This analysis evaluates policy-preparedness gaps based on TF-IDF scores as point estimates. Although this yields initial findings, we recognize it does not consider the statistical uncertainty linked to the TF-IDF estimation.

Figure 3 shows the top 10 most important policy terms for each country, as found by TF-IDF analysis with L2 normalization to the TF-IDF vector. The terms are grouped according to the International Monetary Fund's (IMF) AIPI taxonomy (see Appendix 2). This gives more context to the main thematic priorities in Arab national AI strategies. This analysis demonstrates which terms are the most important from a comparative perspective, providing a deeper understanding of how different aspects of AI strategy are articulated in national strategies.

Figure 3. *AIPI Category Coverage by Country (IMF Dimensions)*



This multi-panel visualization illustrates both common priorities and clear deviations in emphasis in terms of how Arab countries relate to the idea of AI policy. Importantly, some countries created their strategies before the release of the AIPI by the IMF and others have adopted additional national policies or regulations, especially around ethics, privacy and digital rights.

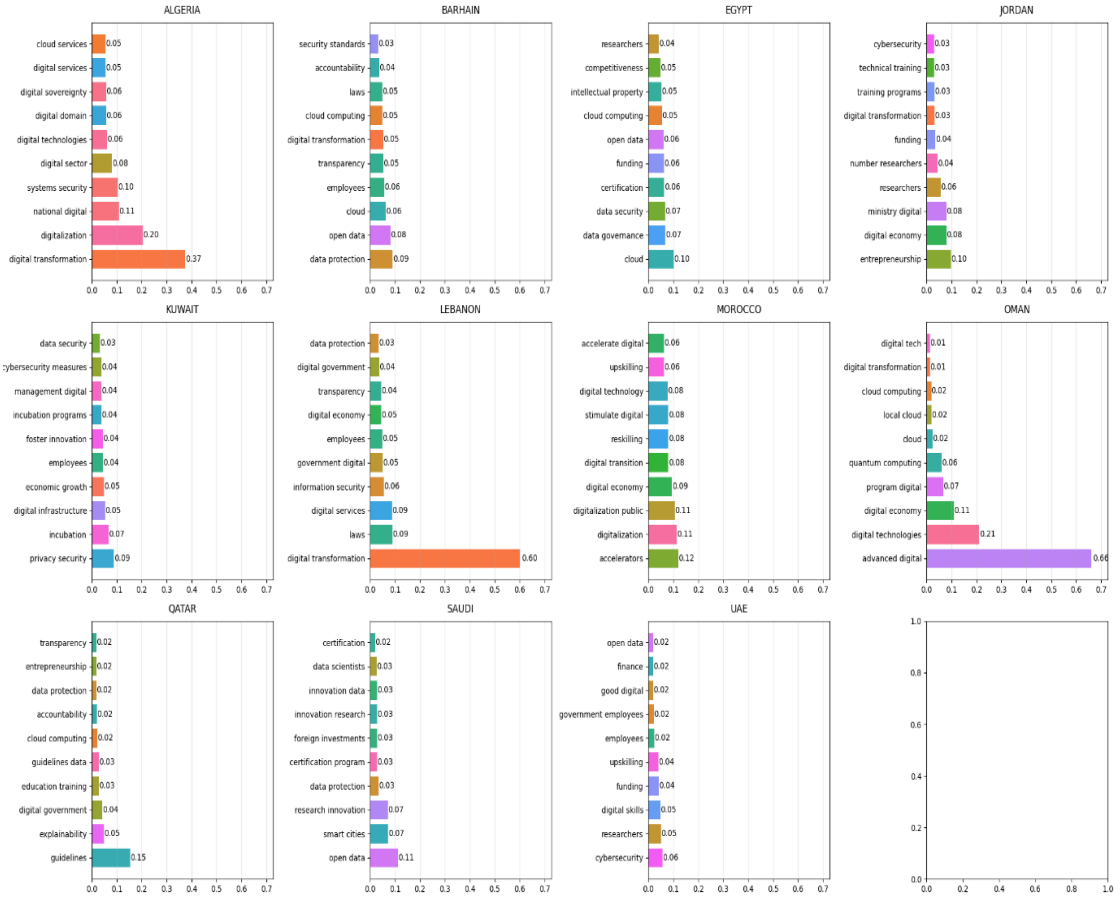
- **Digital Infrastructure and Transformation:** Nearly all of the national strategies focused on a component related to foundational digital development; terms like digital transformation, digitalization, and digital technologies were consistently ranked among the top terms in Algeria, Morocco, Saudi Arabia, Oman and Lebanon, with Lebanon (0.60) and Oman (0.66) having particularly high scores. The term digital presumably represents an organized category for both national development and computer science. Collectively, these countries are focused on establishing a digital infrastructure for broader AI advances.
- **Human Capital and Skills Development:** Some countries, like Morocco, Jordan, and the UAE, included phrases like reskilling, training programs, and researchers, demonstrating emerging commitments to development of the labour force. This supports different trajectories across each but reflects growing recognition of the need for human capital to be AI-ready.
- **Innovation and Economic Diversification:** A few of the countries—Morocco, Kuwait and Saudi Arabia—which included phrases like accelerators, innovation programs and foreign investments are showing that AI technology is increasingly being incorporated into broader economic diversification and innovation strategies.
- **Regulation and Ethics:** While not particularly emphasized in some national strategies on the part of regulation and ethics, it must be recognized the full policy context. For example, Kuwait, Qatar and Lebanon had relatively high scores on terms such as privacy security, laws, accountability and data protection. These countries may have legislated incidents that offered complementary legislation or national digital governance frameworks which admitted to ethical consideration outside their individual AI strategy.
- **Timing and Policy Change:** It is important to consider that countries like the UAE, Saudi Arabia and Egypt had published their AI strategies before the AIPI from IMF was released. Therefore, certain policy elements, particularly those related to ethics, labour adaptation or cross-sector integration, may have been diminished before implementation was transferred to individual sectors.

Our results through AI strategy textual analysis demonstrate that Arab countries have approached AI policy through diverse pathways shaped by national contexts, institutional preparedness, and policy timing. While There is clearly a strong consensus that digital infrastructure should be the top priority, there is room for enhanced coherence across the full spectrum of AIPI pillars. In particular, the visibility of governance, labor market resilience, and ethical safeguards may increase as countries refine and update their strategies in alignment with international frameworks and emerging digital norms. Recognizing the broader ecosystem of national policies will be critical to accurately assessing progress and guiding future AI policy development across the Arab region.

1.3 Country-Level Emphasis on AIPI Policy Terms (Top 10)

To provide additional context for the thematic priorities of the Arab national AI strategies, Figure 4 illustrates the top 10 policy terms by country identified through TF-IDF analysis and classified using the IMF's AIPI taxonomy. This analysis across all Arab countries provides an opportunity to investigate how specific areas of focus regarding AI policy expressed in national strategies.

Figure 4. *Top 10 AIPI Policy Terms by Country (IMF Taxonomy)*



This multi-panel visualization illustrates both shared priorities as well as strategic differences in how Arab countries are positioning and interpreting AI policy. It is also worth noting and is included because of its importance in a few of the cases, that some countries articulated their strategies prior to the IMF publishing the AIPI framework, and some countries adopted further national policies or regulations around the time of their national AI strategies, especially related to ethics, privacy, and digital rights.

National AI strategies in the Arab region point to several key areas of focus. Digital infrastructure and digital transformation are most prominently emphasized, with Algeria, Morocco, Saudi Arabia, Oman, and Lebanon framing digitalization as the starting point to develop AI. Human capital and skills development would be increasingly prioritized in countries like Morocco, Jordan, and the UAE as it pertains to reskilling and training initiatives, as well as research initiatives. Innovation and economic integration would be prioritized initiatives in Morocco, Kuwait, and Saudi Arabia in connecting AI to broader efforts of diversification and investment. Regulation and ethics would receive much less emphasis in some of the strategies, though some countries like Kuwait, Qatar, and Lebanon refer to these issues through governance and data protection, which are considered complementary to regulations. Lastly, countries such as the UAE, Saudi Arabia, and Egypt have progressed with their strategies and policies prior to the implementation of the IMF's AI policy framework, suggesting that the timing and evolution of these contests could provide a path forward. These developments could mean the emergence

of newer ethical or sectoral measures outside the content of the documents examined in this paper.

The analysis demonstrates that national AI strategy by Arab countries has taken various forms based on each country's national context, institutional preparedness and timing for policy. While it is clearly important to ensure foundational digital infrastructure is an overarching priority, there is also room for more coherence across the whole AI Policy and Investment (AIPI) pillars. In particular, the visibility of governance, labor market resilience and ethical safeguards will likely evolve as countries updated and refine their strategies in light of international frameworks and overall changing digital norms. It will be important to understand the widest possible ecosystem of national policies that are underway to accurately assess progress and support country-level AI policy development in the region.

1.4 Clustering of Arab Countries by AIPI Policy Strengths

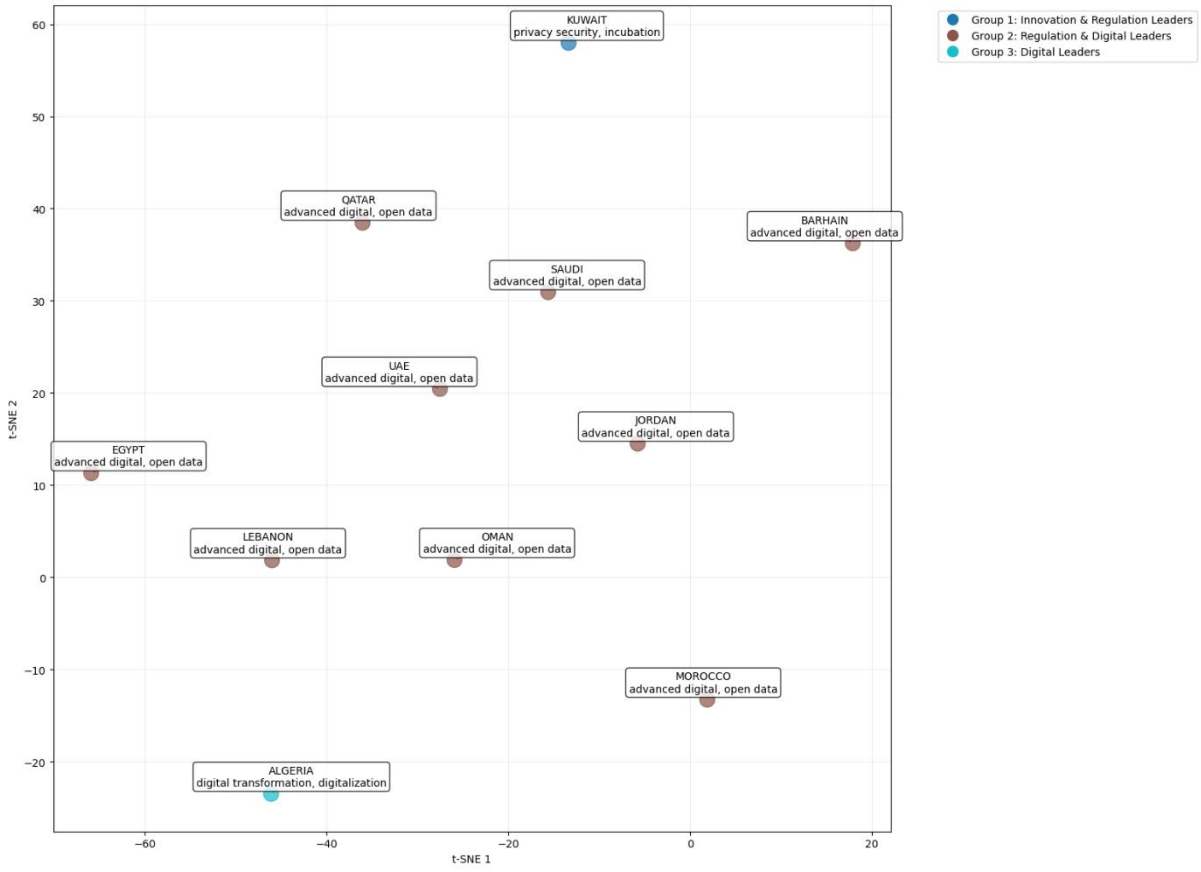
To explore how Arab countries align strategically in terms of their AI policy orientations, we used the t-distributed Stochastic Neighbor Embedding (t-SNE) technique, represented in Figure 5 as a nonlinear dimensionality reduction and visualization technique. While t-SNE is not a formal clustering algorithm, we used it here to create an illustrative two-dimensional map displaying the relative distance and similarities of countries based on the relative strength and the focus of their AI policy intervention indicators (AIPI) terms. This visual map provides some intuition regarding the alignment and differences of countries relative to their digital priorities, their governance orientation toward AI in markets, and their innovation orientation. For methodological consistency, we emphasize that using t-SNE to interpret these visual relationships replicates the PCA + K-means approach with silhouette validation used elsewhere in this study, offering a more formalized clustering method.

The Figure 5. highlights three broad groupings of countries based on dominant policy themes:

- **Group 1: Regulation & Digital Leaders (Brown - Majority):** The vast majority of countries- Bahrain, Saudi Arabia, Qatar, UAE, Jordan, Egypt, Lebanon, Oman, and Morocco -belong to a common cluster with a general orientation toward advanced digital systems and open data initiatives, which shows a common orientation regionally on digital infrastructure and data transparency priorities. While their strategies will not have captured the full articulation of the AIPI pillars, many of these countries are presently evolving their policy ecosystems based on multiple pathways of updates, regulatory changes and cross-fields strategies that may not have been recorded in the initial AI policy texts.
- **Group 2: Innovation & Regulation Leaders (Blue - Kuwait):** Kuwait is a stark outlier in this group, likely reflective of a distinct policy attention to privacy security and incubation that suggests a certain comfort level with an entrepreneurial ecosystem and data governance that places it clearly in the leadership category on the innovation-regulation dimension, which may also align with its other national digital initiatives to leverage and enhance with an AI strategy.
- **Group 3: Digital Leaders with Legacy Synergies (Cyan - Algeria):** Algeria's positioning indicates a substantial change arising from digital transformation and digitalization that had been captured in prior generation´s national digital policies. Unlike Algeria where the national AI strategy was based on original digital transformation instead of following the

IMF's AIPI framework because of less textual emphasis on regulatory and innovation issues associated to digital transformation.

Figure 5. *Country Clustering by AIPI Policy Strengths*



The separate cluster outputs reflect the varying relative journeys Arab countries are taking on developing their own national AI policies. There is regional coherence surrounding digital infrastructure and open data, but countries are pursuing varied approaches regarding regulatory safeguards, innovation ecosystem, and human capital. All these variations are based on some national priorities, but to a large extent based on the timing and circumstances around developing their strategies, the existing institutional frameworks, and existing policies, whether captured in one document or not under exists in their AI authorities.

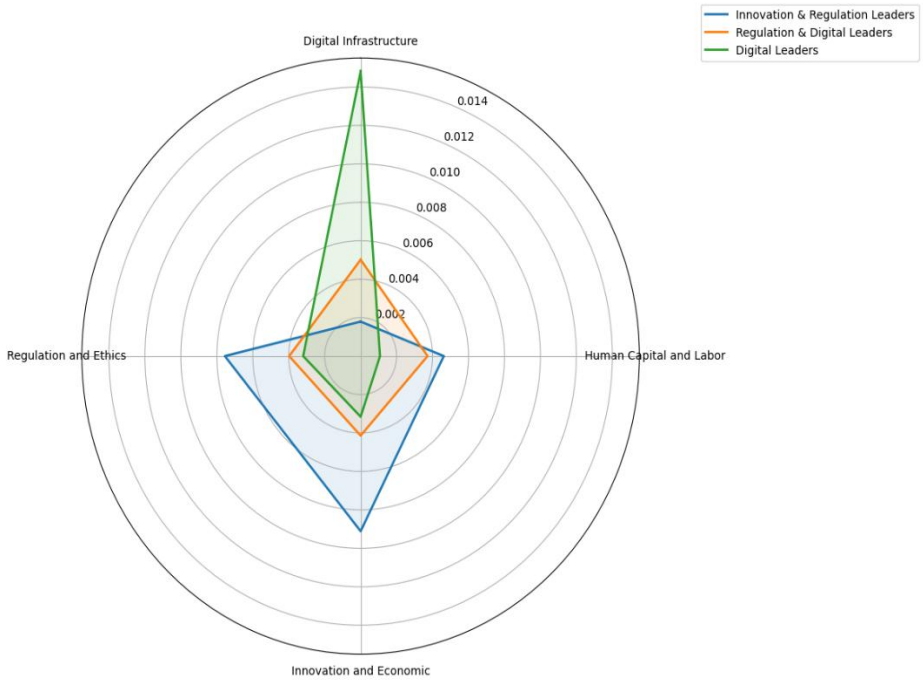
From policymakers' lens, the outputs show both that:

- If strategies really are being inherited, they can progress on broader scale towards being up to date with international frameworks like the AIPI framework.
- Understanding that regional coordination can still be framed around overlapping shared digital priorities with various gauge of approaches for governance and innovation.
- Engagement with AI strategies and AI in general can incorporate complementary policy initiatives, and accountability for measures that complement national AI strategy, particularly important for countries that develop AI and with ethics, privacy or policy guidelines.

1.5 Strategic Differentiation of Arab Countries Across AIPI Dimensions

We present the Figure 6. below for visualization the relative strengths of three distinct groups of Arab countries across the core dimensions of the IMF's AIPI framework. This comparative radar chart translates complex policy data into an accessible strategic snapshot, offering insights into how different countries have approached AI governance based on the timing of their strategies and their thematic priorities—such as ethics, regulation, infrastructure, and innovation.

***Figure 6**: Comparative AIPI Dimension Strengths by Country Groups*



The radar chart (Figure 6) displays the strengths disciplines of the AIPI and by countries as follows:

1. Innovation & Regulation Leaders (Blue Line):

- Provide a balanced and forward-looking profile over AIPI four pillars.
- Strongest on Innovation and Economic Integration and Regulation, but a good emerging score on Ethics.
- Moderate on Human Capital but slightly weaker on Digital Infrastructure.
- Typically, they represent "early adopters" which created their AI strategies before AI, but may not yet reflect AIPI principles, indicating some degree of visibility and institutional maturity.

2. Regulation & Digital Leaders (Orange Line):

- Highly ranked on Human Capital and Labor Market Policies, enabling the development of Knowledge- and skills-based AI related intelligences.
- Strong levels on Regulation and Innovation but require more investment logically score on Digital Infrastructure

- Represents a group of countries with relatively recent strategies that seem more aligned with the objectives of AIPI more quickly, reflecting more agility to affect policy change and reform more quickly.

3. Digital Leaders (Green Line)

- Are strong in their own right but in Digital Infrastructure historically benefit from early investment in ICT.
- Are also relatively weaker in Human Capital, Regulation, and Innovation suggesting there is not a fully considered policy landscape.
- Generally, represent countries in an earlier digital transformation strategy to AIPI and are still developing ethical governance and the cross sectoral integration of AI.

Strategic Implications

- **Group 1 (Innovation & Regulation Leaders)** can serve as models of possible future-oriented AI policy in an integrated way. Their early and balanced approaches may represent good learning opportunities for others wishing to create a role for their own AI ecosystem that is resilient and ethical.
- **Group 2 (Regulation & Digital Leaders)** can demonstrate how newer strategies when properly aligned with international frameworks like AIPI can generate rapid capability building—with an important focus on building talent and investing in regulatory institutions.
- **Group 3 (Digital Leaders)** have the basic digital infrastructure in place but need to revisit their strategic thinking to also include regulatory coherence, innovation incentives, and ethical enforcement—while ensuring that the digital movement is an inclusive and sustainable one.

The analysis underscores the advantage of strategic timing: countries caching digital policies early on may be experiencing new gaps in areas such as the clustering of innovation and AI ethics, which adds to the importance of periodically refreshing their policies and improving cross-sectoral alignment.

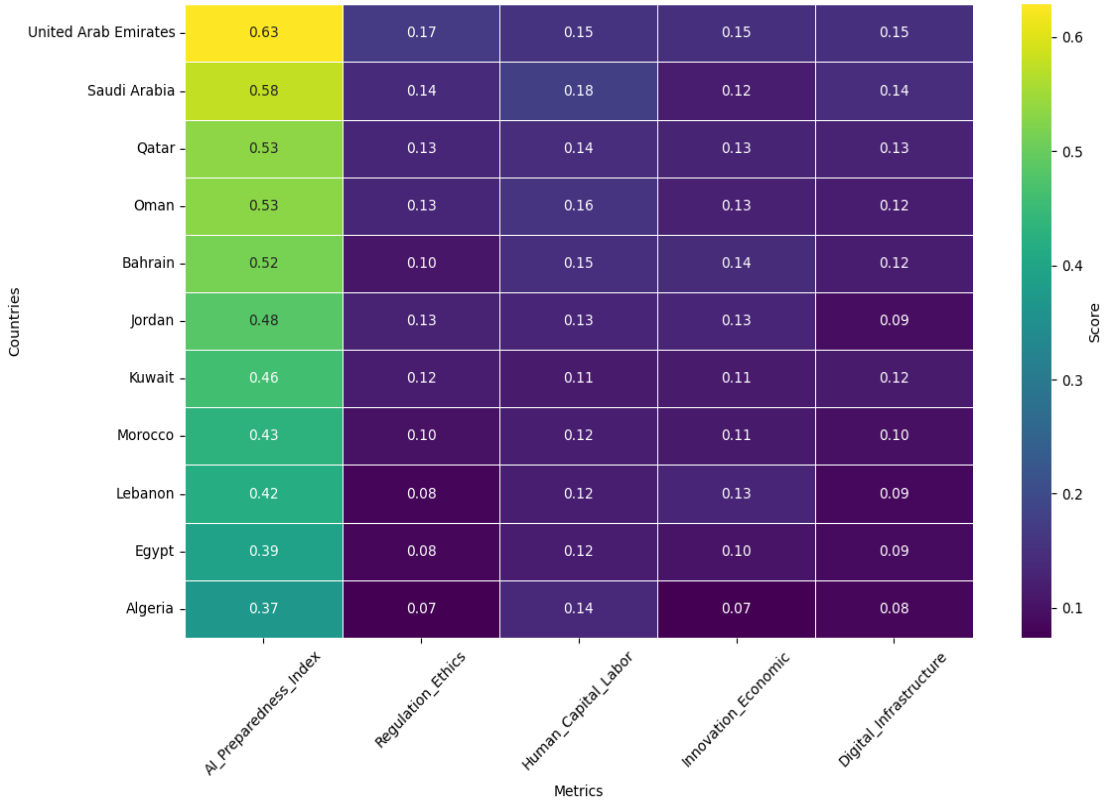
2. Results of AI Preparedness in the Arab World from the IMF AIPI

In this section, we provide numerical findings on the level of artificial intelligence preparedness across the Arab region through a full evaluation of the International Monetary Fund's Artificial Intelligence Preparedness Index (AIPI), including its four dimensions. We begin the chapter by mapping out the overall AI preparedness landscape - and thus provide a general overview of the region - before providing a descriptive statistical evaluation of the AIPI (and its dimensions) to visually represent the differences in the Arab countries under investigation. This is followed by a principal component analysis (PCA) and hierarchical clustering, which then allows us to differentiate the various groups of countries. The findings in this section ultimately provide a formal, data-driven perspective on preparedness for the implementation of AI, before we assess the extent of the discussions emerging strategic purposes for the AI landscape later in the research paper. The structure of this section consists of five subsections as follows:

2.1 Mapping AI Preparedness in the Arab World

This section analysis, based on the heatmap (see Figure 7) we have attached bellow, provides a picture of AI Preparedness index and it is four demission's at level of eleven Arab countries selected for this study. The heatmap indicates performance across five metrics regarding AI Preparedness, with colours representing the scoring performance in a country - from darker to brighter colours as performance increases.

Figure 7: Ranking Arab Countries by AI Preparedness and Key Dimensions (IMF AIPI Data)



2.2 Overall AI Preparedness Landscape

The AI Preparedness Index column illustrates a varied but progressive landscape of AI development in the region.

- **Top Tier:** The United Arab Emirates (0.63) and Saudi Arabia (0.58) are well ahead with the most advanced, developed AI ecosystems.
- **Strong Contenders:** Qatar (0.53) and Oman (0.53) are very strong performers, closely behind in AI preparedness with great capability to catch the stronger performers heading.
- **Developing Platforms:** Bahrain (0.52) and Jordan (0.48) clearly show strong, developed platforms, presenting excellent potential for aggressive progress in their AI preparedness.
- **Emerging Profiles:** Kuwait (0.46), Morocco (0.43), and Lebanon (0.42) show progress towards establishing AI preparedness, albeit slowly.
- **Opportunities developing:** Egypt (0.39) and Algeria (0.37) are just developing their frameworks towards validity as developing AI preparedness.

The detailed metrics reveal distinct patterns and areas of focus across the region:

- **Regulation & Ethics:** The UAE (0.17) leads in developing ethical and regulatory guidelines. The low scores across all countries highlight this as a nascent but critical area for regional cooperation and knowledge-sharing.
- **Human Capital & Labor:** Saudi Arabia (0.18) and the UAE (0.15) demonstrate the strongest focus on workforce development for AI. Notably, Algeria (0.14) shows considerable strength in this area, underscoring its valuable human resource potential.
- **Innovation & Economic Integration:** The UAE (0.15) and Bahrain (0.14) are at the forefront of integrating AI with economic development. This metric signals a clear opportunity for cross-border innovation and strategic partnerships.
- **Digital Infrastructure:** The UAE (0.15) and Saudi Arabia (0.14) showcase advanced technological foundations. The scores across the board indicate that digital infrastructure is a key strength for the region, with continued potential for expansion.

2.3 Descriptive Statistics and Regional Variation Analysis of AI Preparedness Metrics

In this section, we will look at the specific measures of centralization and dispersion in AI preparedness across eleven Arab countries, including the descriptive statistics associated with this overall index and each of the four dimensions reflected in it. The results show rates of centralization and dispersion across countries indicative of the overall degree of variability, rates of weaknesses and strengths among the regional countries, and implications for strategic future planning. Table 1 below summarizes the descriptive statistics.

Table 1: Descriptive Statistics of AI Preparedness Metrics (IMF AIPI Data)

Metric	N	Mean	Std	Min	25%	50%	75%	Max	IQR	CV
AI Preparedness Index	11	0.486	0.08	0.37	0.423	0.483	0.534	0.628	0.111	0.165
Regulation Ethics	11	0.115	0.03	0.074	0.092	0.117	0.134	0.171	0.042	0.261
Human Capital Labor	11	0.139	0.02	0.115	0.12	0.139	0.152	0.177	0.032	0.144
Innovation Economic	11	0.121	0.021	0.075	0.113	0.125	0.131	0.151	0.018	0.174
Digital Infrastructure	11	0.111	0.023	0.083	0.092	0.115	0.123	0.152	0.031	0.207

Where: **IQR**: Interquartile Range (Q3-Q1), **CV**: Coefficient of Variation (Std/ Mean).

This analysis provides a summary of the findings of a regional analysis of AI preparedness based on descriptions of the statistics of the AI index and its four dimensions comprising Regulation & Ethics, Human Capital & Labour, Innovation & Economic Integration, and Digital Infrastructure (IMF AIPI Data)[1]. The analysis presents areas of strength and areas for growth across the participating countries.

- **Overall AI Preparedness (Mean = 0.486):** The Arab region finds itself in a moderate position overall. This score places the region below Advanced Economies such as North

[1] https://www.imf.org/external/datamapper/RE@AIPI/ADVEC/EME/LIC

America (0.74) and Europe (0.63), while the Arab region is positioned above the Asia and Pacific region (0.52) and much stronger than Sub-Saharan Africa (0.34). A low standard deviation (0.08) and a low coefficient of variation (CV = 0.165) mean there is low variance in overall AI readiness in the Arab region, which means that almost all countries are close to the overall average score. Among this moderate grouping, the strongest country was the UAE (0.628) as part of the 6 countries in that grouping, while the weakest country was Algeria (0.37).

- **Regulation & Ethics - Significant Gap:** The Regulation & Ethics pillar is the most significant gap of preparedness in AI across the Arab region and has the lowest average score (0.115) of all pillars. It is considerably lower than average Regulation & Ethics scores in North America at (0.21), Europe (0.17) or Asia and Pacific (0.14), but higher than averages in Sub-Saharan Africa (0.09). Most notably, this pillar also had the highest coefficient of variation (CV = 0.261). The high coefficient of variation signifies a significant variation in level of regulatory maturity. In short, while leaders such as the UAE and Saudi Arabia received scores of over twice as much as some of the lowest scoring countries, such as Algeria and Lebanon, the overwhelming majority of the region is not yet adequately prepared for the establishment of law and/or ethics and principles relevant to the adoption of AI.

- **Human Capital & Labor:** This pillar was identified to demonstrate regional strength among the Arab countries and recorded the highest mean score (0.139) of all AIPI pillar scores and averages. The strong average score of 0.139 places the region nearly equivalent to Asia and Pacific (0.13), comparable to Europe (0.15), while being well above Sub-Saharan Africa (0.09), but lower than North America (0.18). Additionally, this pillar also has the lowest coefficient of variation (CV = 0.144) in all score metrics, indicating a lesser degree of variation and that the region is generally making a higher degree of effort towards the development of the workforce. Scores are tightly clustered which indicates improving talent and skills development is a shared priority and action. The shared priority of workforce improvement is indicative of the strong and consistent effort demonstrated by Saudi Arabia (0.177) and Bahrain (0.150), reflecting a strong efforts by all GCC countries to continue to build and nurture vital human capital to support AI.

- **Innovation & Economic Integration:** The Arab region achieved moderately moderate average performance levels in this pillar, with an average score of 0.121. The region's average was higher than that of sub-Saharan Africa (0.09), but similar to that of Asia and the Pacific (0.12) and well below the average for Europe (0.15) and North America (0.17). The dispersion analysis produces a clear "middle tier" phenomenon: evidenced by a small standard deviation (Std=0.021), we see that a dense concentration of countries cluster around the moderate average. The low variance in the data suggests that, overall, while many Arab countries have not fully utilized their innovation potential, there is shared baseline economic integration and research and development activity across all countries. The leaders in the region are the UAE (0.151) and Jordan (0.131), with Algeria (0.075) substantially lower and thus a significant opportunity for potential and growth in the important pillar of Innovation & Economic Integration. **Digital Infrastructure: Gap in the Region:** This pillar shows a big difference in maturity level across the Arab region with an average score of 0.111. Between other regions, this level puts the Arab region better than Sub-Saharan Africa (0.06), but worse than Asia and the Pacific region (0.13) and Europe (0.16) and North America (0.18).

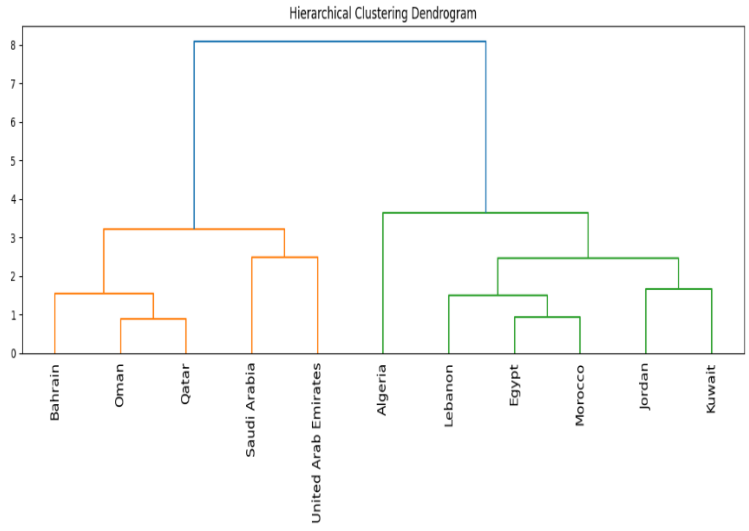
- The high Coefficient of Variation (CV=0.207) is important for noting another stark difference and much variability in the maturity level related to technology infrastructures in the Arab countries. On one end, GCC countries such as the UAE, Saudi Arabia, and Qatar have a more advanced level of infrastructure in place. Meanwhile, the countries in the digital maturity spectrum such as Lebanon (0.086) and Egypt (0.091) lag significantly and potentially will fall even more behind in the pace of digital transformation, unless they make substantial, targeted investments.

The discussion of the descriptive analysis highlights two urgent priorities for the Arab region AI development. Primarily, harmonizing regulations is essential to tackle the inconsistency in ethics governance throughout the region. Countries need to elevate their regulatory framework to the standards of regulatory innovators, such as the UAE. Second, the most significant obstacle to technological capabilities and inclusive economic growth in non-GCC countries will be the scaling of digital infrastructure. The region should leverage its strengths and existing competencies (i.e., the sustained growth of human capital) to advance AI across the sectors already set in motion in the Gulf region. Other potential emerging economies can identify and seek ways to replicate the UAE's way of aligning innovation and digital infrastructure to provide a strategic pathway to developing greater competitive strength. While a strong foundation for workforce preparedness exists, achieving equitable AI preparedness requires a heightened sense of urgency regarding regulatory adjustments and technology diffusion in countries where AI is still not yet visible. Regional scaling will be key to encouraging collaboration among teams and promoting a mindset that transforms perceived challenges into opportunities for mutual advancement.

2.4 Identifying AI Preparedness Groups with PCA and Hierarchical Clustering

In this section, we apply statistical approaches (Principal Component Analysis and hierarchical clustering) to identify countries that are similar to each other regarding AI readiness based on AIPI dimensions. These techniques provide important perspectives on the structural relationships between variables and normative values of AI readiness, but clustering methods rely heavily on scaling data and standardizing variables, and that can affect the grouping approach that comes from clustering; thus, the groupings resulting should be taken as representative sets of relative similarities and not absolute groupings.

Figure 8: hierarchical clustering of countries by AI Preparedness



A dendrogram (Figure 8) is a tree-like depiction that is popularly used in data science to depict the output of hierarchical clustering. It is a specific representation of data points—Arab countries in this case—grouped based on their similarity in terms of AI preparedness (at least in terms of the IMF AIPI dimensions).

The dendrogram is a structure that shows how countries are merged, one by one, based on their similarity. The vertical lines in the diagram represent the distance (or dissimilarity) between the merged clusters. The shorter the lines suggest a higher similarity, while the full structure signifies how countries cluster together and separately from one another.

The analysis identifies two clusters of countries with a similar AI preparedness profile across groups of countries that are either part of the GCC or the Northern African and Middle Eastern region.

Cluster 1: Countries with the High Similarity Across the GCC Countries

Cluster 1 is made up of the following countries:

- Bahrain, Oman, Qatar, Saudi Arabia, United Arab Emirates (UAE) – They are all tightly clustered together with an average distance of just one country from each other, which implies a higher level of similarity in AI preparedness, meaning AI readiness among these countries as a group.

Further to the cluster:

- Bahrain, Oman, and Qatar are actually comprised together into a small sub-cluster group of close-similarity countries; and
- Saudi Arabia and the UAE are also clustered together to be tightly linked countries with somewhat closer distances in the cluster.

Cluster 2: Common Characteristics Across the Non-GCC Countries

Cluster 2 is comprised of the following countries:

- Algeria, Lebanon, Egypt, Morocco, Jordan, Kuwait – While these groups of non-GCC countries are somewhat more heterogenous in terms AI preparedness, they exhibit similar AI profiles and have also created useful sub-cluster groups:
- Algeria and Lebanon are grouped together;
- Egypt and Morocco are also grouped into the same cluster;
- Jordan and Kuwait are also mapped together as a pair.

Discussion & Regional Implications

From what we can conclude from each cluster, the dendrogram provides these cautions to self-illustrated regional divisions within the groups.

- Cluster 1 consists of overwhelmingly of GCC, while also identifying an overall higher and more aligned AI preparedness or readiness level of the cluster than cluster two;
- Cluster 2 consists of non-GCC groups and represents both aligned and somewhat distinct levels of AI preparedness as previously illustrated. It is a mix of North African and

Levant economies, which exhibit lower and therefore less similar levels of AI preparedness characteristics when reviewing preparedness.

The height of the branches indicates the degree of dissimilarity in levels of AI preparedness from branch to branch, with greater vertical distances indicating more variation in levels of AI preparedness profiles from group to group.

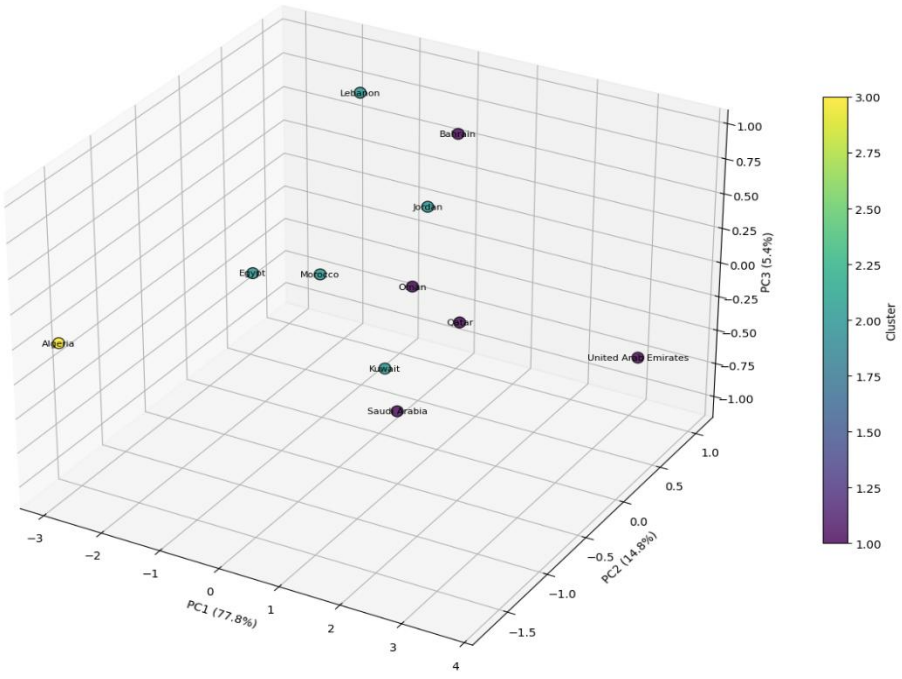
2.5 Principal Component Analysis of AI Preparedness in Arab Countries

To change from the exploratory view of all possible affinities to a definitive model of grouping the affinities, we supplement the hierarchical clustering with a Principal Component Analysis (PCA). The hierarchical analysis creates a nuanced 'family tree' of regional AI preparedness, which can aid in comprehending multi-level relationships. The PCA takes the work of the aforementioned analysis a step further by flagging a reduced set of principal components, which reflect the latent dimensions that best explain differences between countries and the number of clusters that most clearly points to strategic categorization that is actionable.

This section presents key outputs from a 3D PCA and hierarchical clustering of IMF's AI preparedness index dataset across Arab countries and the graph illustrates how this analysis is structured, capturing 98% of the variance in the data, while clustering the countries in three distinct clusters. When utilising this framework, it enables a logical and data-driven way for countries to progress AI development and direct policy interventions.

Three distinctive strategic clusters emerged from the analysis, as represented in the graph.

Figure 9: 3D PCA AI Preparedness (hierarchical clusters)



The three plotted axes correspond to the three principal components that define key dimensions of AI preparedness (Figure 9), which are:

- PC1 (77.8%) - refers to the maturity of foundational AI infrastructure, such as the innovation ecosystem and levels of strategic investment.

- PC2 (14.8%) - describes the complexity of governance, policy clarity, and regulatory frameworks; and
- PC3 (5.4%) - represents operational capacity, for example, skills of workforces and institutional alignment.

Cluster Analysis: Defining Regional Preparedness

The analysis identifies three strategic clusters (see Figure 9) representing various stages of AI advancement. The first, represented as a deep purple cluster, represents high-tech centres led by the region, having a clear vision, committed R&D investment, and innovation-driven regulations as nations continue to establish themselves as architects of the AI leadership, while maintaining global competitiveness.
The second cluster, turquoise teal in colour, represents nascent innovators. Opportunities for collaboration exist, they have the human capital, an evolving tech ecosystem, and have made a commitment to digitalization as seen in their changing governance regimes. While their commitment and evolving tech ecosystems show promise, targeted policy reform and investment will be required to increase their effectiveness as regional players.
A singular yellow marker emphasizes a significant catch-up scenario. Those with failing infrastructure and lagging on institutional factors present a scenario that should be dealt with immediately. It is a challenge, but also an opportunity where targeted capacity development could enable the capability in the space of AI integration, and in this case, its current foundational constraints.

The major strategic insights point to important regional trends: some countries (The UAE, Qatar, and Saudi Arabia) cluster at the extreme right end of the PC1 axis demonstrating above-average digital maturity with future focused policies ambitions, while others fit closely together indicating similar preparedness levels and strong potential to jointly begin policy reform. One economy stands on PC3 due to strong human capital and academic underpinnings, even though the broader challenges are present and could be levered for development down the road. Another's unique country location in this exercise makes a clear case for strategic investments and the need for a dedicated national AI policy to close gaps in preparedness and accelerate movement forward.

3. Alignment Between National AI Strategies and AI Preparedness Scores

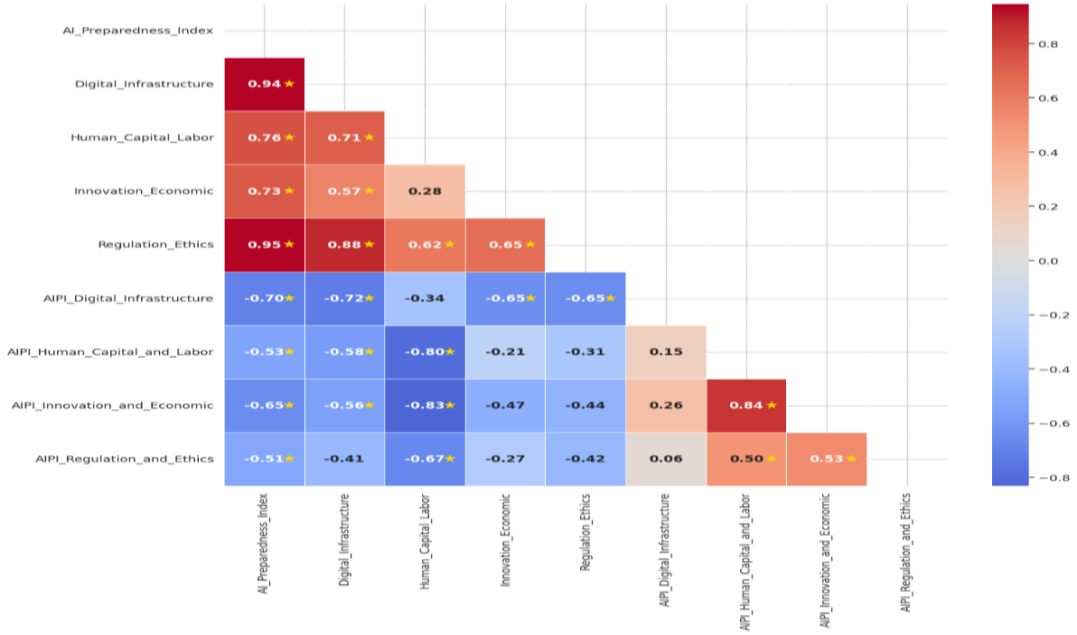
In this section, we examine how aligned are the regional AI strategies of Arab countries to their current AI preparedness level using the AIPI framework. The assessment will reveal instances in which AI preparedness and strategic pathways are out of alignment – examining risks, missed opportunities, and areas to build up.

3.1 Correlation Analysis: Bridging AI Preparedness and Strategy

Due to the small sample size (N = 11) and possible deviations from normality, Spearman’s rank correlation was applied rather than Pearson’s. This non-parametric test is more resilient to the assumptions of normal distribution and effects of outliers, which is useful in cases where individual countries may be values outliers materialized into the results. In addition to outliers, Spearman’s correlation measures association based on rank order rather than raw value. Given small sample sizes, Spearman’s correlation feels considerably less influenced by extreme observations when compared to other methods. The relationship between a country's preparedness for AI and its strategic priorities is complicated. While this analysis supports the conclusion that solid governance and infrastructure are the most critical drivers of AI

preparedness, it is clear that the AI Preparedness Index (AIPI) suggests a disconnect between a country's existing strengths and where they are directing their strategic priorities. The correlation analysis is represented in the figure 10 below:

Figure 10: Correlation Matrix Between AI Preparedness and Strategic Priorities



The key Findings from the Correlation Analysis (as shown on Figure 10) address the following:

- **Core Drivers of AI Preparedness:** The analysis confirms regulation & ethics and digital infrastructure to be the most crucial drivers of AI preparedness. These two metrics have strong positive correlations with AIPI with correlation coefficients of greater than 95%, 94%, respectively. This suggest that strong legal frameworks in place with good technological infrastructure are key prerequisites to AI preparedness and also suggest that AIPI methodology highlights these dimensions as the most critical when calculating a country's score.

- **The AI Preparedness -Strategy Paradox:** Throughout our analysis, we highlight a surprising strategic-preparedness paradox in national artificial intelligence (AI) strategy and planning. Using our TF-IDF-based Strategic Intent Index above, we found that countries with stronger AI capabilities consistently focus less on those domains in their strategic documents. We discover significant negative correlations between levels of preparedness and strategic focus in the domains of digital infrastructure (r = -0.70), human capital (r = -0.80), and innovation ecosystems (r = -0.83).

- These findings suggest the presence of a compensatory logic where countries are redirecting to weaker areas and ignoring efforts to build on their existing strengths. While attracting attention to closing gaps is valuable, there is a risk that strategic compensatory logic may lead to neglecting investments in areas where countries already have competitive advantages and the capacity for implementation, potentially causing them to fall behind in overall national competitiveness. The paradox identifies a crucial tension in AI strategies in using a gap-closing or advantage-building strategy that examines whether AI strategy and planning processes maximize existing capabilities for global competence.

- **The Implementation Gap:** There is also a negative correlation (r = -0.67) between preparedness in **regulation & ethics** and strategic focus for this dimension. This suggests that while a country has good regulatory frameworks/stabilizers in place that are improving its preparedness in this dimension, the activating force of policy enforcement could be unclear, and lack active reinforcement causing a gap in implementation.

Several factors could explain the disconnect aspects between AI preparedness and policy driving priorities:

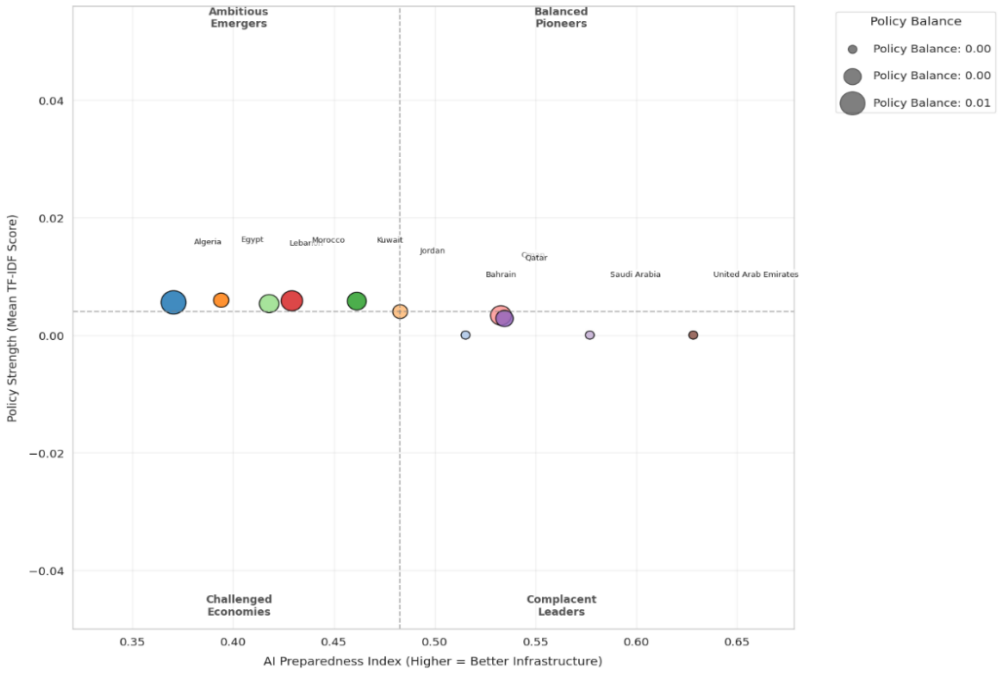
- **Timing and Awareness:** The AIPI launched by the IMF in 2023, but the majority of the national AI strategies were developed prior to this benchmark being available. Thus, some strategies may not capture the most recent reflections about key drivers of AI preparedness.
- **Informal Policies:** In some instances, countries are enacting AI-related policies and programs without a formal national AI strategy. This could lead to a misalignment in measurement because it may not capture or adequately incorporate those activities into preparedness indicators.

In summary, these results highlight the need for countries to consistently review their AI policies and ongoing priorities and periodically adjust their AI strategies in order to leverage strengths and compensate for weaknesses on the emerging AI challenges.

3.2 Strategic Position of Arab countries: AI Preparedness Index vs. Strategy Focus

Figure 11 shows what we can think of as the strategic position of Arab countries on the AI preparedness landscape by representing AI preparedness against policy focus. This scatter plot should provide poly makers important contextual information as they seek to assess the level of AI capacity of their nation and where they are prioritizing policies in AI to meet that capability, in order to see where the gaps are for effective and targeted policy.

Figure 11: Arab countries Strategic Positioning by AI Preparedness Index vs. Strategy Focus



Countries are positioned in the analysis based on two main axes. The horizontal axis is an AI Preparedness Index, which measures current preparedness based on digital infrastructure, human capital, innovation, and regulatory environment; nations to the right are more prepared for both AI technology adoption and development, and there is a center dashed line for high and low preparedness groups. The vertical axis is the Strength of Policy Focus, which qualitatively judges the strength of the focus by looking at the use of AI-related terms in key policy documents; Higher up the vertical axis on this diagram, means a greater focus on AI in the national agenda, and the horizontal median line separates high and low policy focus groups. In addition, the size of each data point is the Balance in Policy Focus across the four core sub-categories, whereby a larger bubble indicates a stronger, and therefore less holistic, strategic focus on one or more areas compared with balanced policy focus.

The quadrant analysis shows well-defined strategy profiles and policy implications. One group demonstrates low current AI preparedness and high policy focus, and is ambitious to close gaps through their own selected strategies (though in many cases unbalanced); for these emergers, the key focus should be expanding their policy agendas, ensuring that they are developing as holistically as possible across all foundational pillars of AI. A key finding is the lack of any country in the high-preparedness, high-policy-focus quadrant—which presents a key regional opportunity for the highest earners to develop from foundational capabilities to sophisticated, round strategies to innovate and govern sustainably. In addition, there is a separate group with high preparedness, but relatively low policy focus, which may represent a risk of excessive complacency; for example, to maintain global competitiveness, these leaders may need to recommit to policy priorities to sharpen regulation and stimulate next-wave innovation. Finally, the absence of countries in the low-preparedness, low-policy-focus quadrant is a good sign, indicating that all countries in the region have recognized, at a minimum, the strategic importance of AI.

The quadrant analysis provides key strategic considerations for Arab policymakers. The most important being the conclusion that we need to fill the preparedness-strategy gap which has emerged. Our analysis highlights a critical structural disconnect which has resulted in advanced capabilities being less of a policy priority for economies with high preparedness; careful preparation economy (CPE) frameworks must stress the avoidance of complacency through advancing the overarching foundations of infrastructure durability towards the development of more sustainable governance frameworks that incentivize ethically accountable forms of innovation and equitable economic development. Conversely, developing countries that strongly focus on initiating policy have considerable development momentum that they must now build on, by working to broaden their balance between contingencies, initiatives, and devising stronger implementation mechanisms to efficiently facilitate process generation and their ambitions into actual forms of contemporary capabilities. The fundamental conclusions taken collectively offer a clear framework which will provide national contexts; identify areas for strategic improvements; and customize interventions that enhance equitable and sustainable pathways towards improving technology efforts throughout the Arab region.

3.3 AI Strategy-Preparedness Gap Analysis in Arab countries

By utilizing a gap analysis between strategic focus and actual preparedness (which provides important information regarding AI capacity in the region), we can better understand the discrepancies within each of the dimensions examined. The gap score, the main metric of analysis, is calculated by a simple subtraction of preparedness [in our metric as shown in our Appendix] from strategic focus. A gap score that is positive indicates that the ambition of policy

is outpacing the capacity of the status quo, while negative gap score indicates that existing capacity is not being given commensurate policy focus.

To enhance meaningful comparisons and accurate calculation of the "gap," both datasets were normalized to a common 0–1 scale before any subtraction or direct comparison was made. This normalization step was critical and systematically performed in the data preparation pipeline.

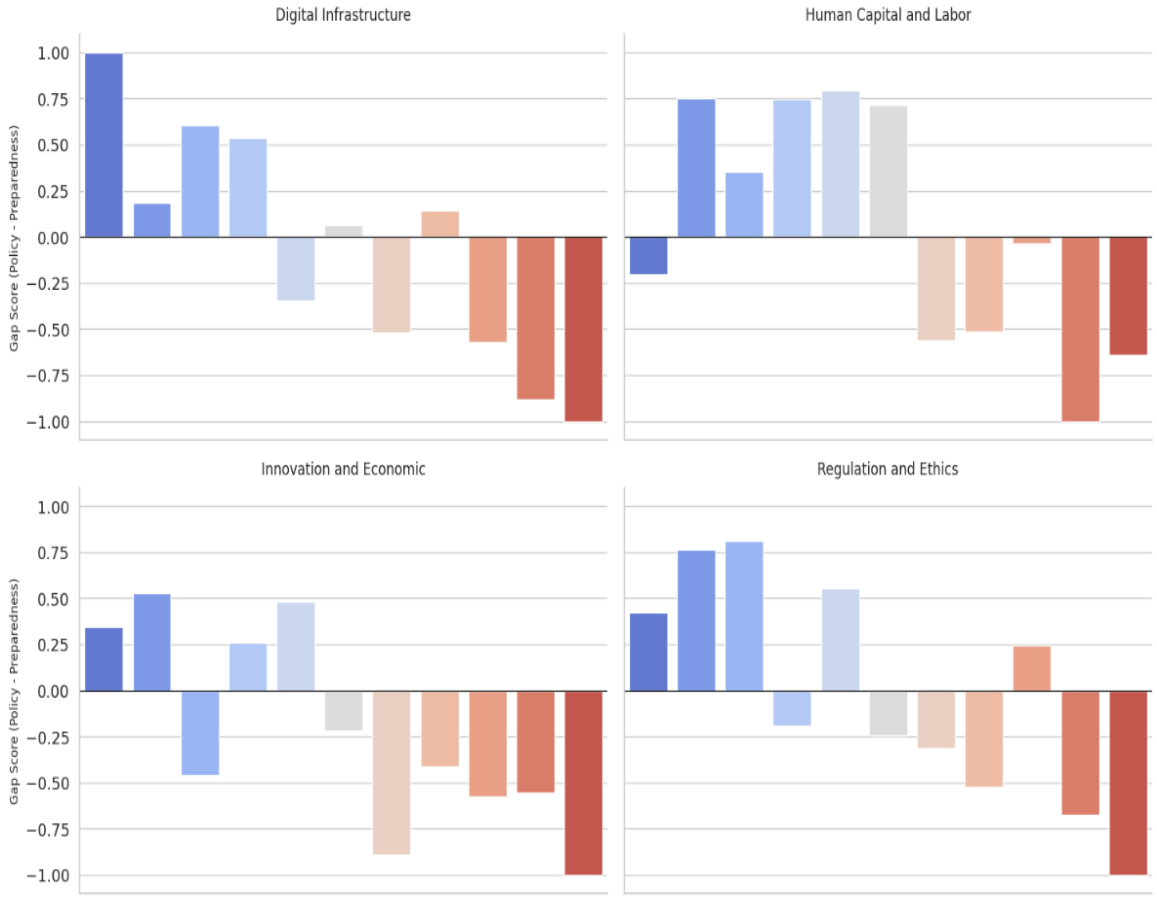
For each of the four AIPI dimensions, we applied a min–max normalization process. First, we normalized the existing AI preparedness scores, basing it on their range across the countries. Then, we normalized the computed Strategic Intent (TF-IDF) scores for corresponding policy terms based on their range.

The "gap" was calculated through the following formula:

Gap = Normalized Strategic Intent – Normalized Preparedness

By performing it this way, we can say that the gap represents a unitless, relative measure of alignment or divergence between policy intent and preparedness. Because both indices have been put on comparable scales, the analysis yields results that are methodologically consistent and analytically sound.

Figure 12: AI Strategy-Preparedness Gap Analysis by Dimension



This analysis of the gap score by dimension provided distinct patterns (see Figure 12). In most dimensions, including in digital infrastructure, we see distinct differences between the regions of developing, emerging and advanced economies. Countries that are less prepared to deploy AI give more strategic policy attention to enhancing their digital infrastructure, while countries that

are more advanced show a reduction in policy attention on this dimension. This reduction is not necessarily indicative of a neglectful or complacent mindset but can rather be viewed as a policy re-balancing effect, as countries that have robust digital systems will naturally shift their attention towards other emergent issues, such as innovation, governance, or ethics. From this perspective, a lack of policy focus does not indicate a contradiction, but rather a distribution of policy efforts according to the maturity of the infrastructure. Therefore, from this rationale, a lessened policy focus does not suggest a contradiction, but a redistribution of policy efforts based on the level of maturity of the digital infrastructure. It also means that the focus of policy changes as countries grow up, which means that the focus can change at any time based on the goals of the country and its level of maturity in developing, building, and improving the digital ecosystem. Within the human capital dimension, the data indicates that advanced economies, with high AIPI Human Capital scores, have much lower strategic emphasis on human capital in the policy documents (e.g. low TF-IDF scores). This suggests that human capital development may be a developed, institutionalized function in these countries and therefore receives less targeted emphasis in new AI strategy documents than in developing economies, where it is a central part of building new ecosystems. Innovation is a key driver of policy formation for transforming the economy in emerging economies; for the advanced economies, innovation is baked into any number of broader policy frameworks, so it runs the risk of being lost in the clutter, if viewed as a prior competency. Developing economies are also proactively developing ethical governance in AI, while we do not see as explicit focus in developed environments, where they too are at risk of lagging behind in making the necessary adjustments to their capacities to respond to AI's ongoing challenges. This analysis serves as a diagnostic tool for designing strategic interventions.

In summary, these two approaches represent clear policy gap perspectives. The first is the Aspirational and Proactive mindset, where nations with comparatively low current preparedness are using policy as a clear mechanism for improving on policy gaps; consistently having positive gap scores represents a forward-thinking and ambitious intention to create capacity building and future-ready ecosystems. A second mindset is the Implicit and Maintenance orientation that was more prevalent in the more prepared nations; scores of negative gaps indicate nations that were focused on maintaining their strengths rather than intentionally prioritizing them. While still a natural sign of maturity, this mindset carries with it higher risk of complacency, particularly around regulation and human capital that require consistent policy progress. Thus, these considerations provide an important navigation tool: emerging economies should look at the breadth of their policy portfolios related to holistic development, while more prepared nations need to consciously shift their efforts systematically back to the core dimensions so that they can preserve their leadership and maintain their competitive advantage over the long term.

V. Conclusion & Policy Recommendations

This paper has provided a holistic, evidence-based approach to supporting AI readiness and associated policy dimensions across Arab countries by combining quantitative readiness indicators from the IMF AI Preparedness Indices (AIPI) alongside text-mined Strategic Intent scores calculated from term frequency-inverse document frequency (TF-IDF) analysis of Arab national-level AI strategies. This method enabled the Strategic Intent Index to systematically assess each nation's policy priorities across the four AIPI dimensions, facilitating an empirical, cross-national, data-driven comparison of articulated priorities and their evaluated readiness. The combination of TF-IDF weighting for term frequency normalization, benchmarking readiness

against the AI Readiness Indices, Principal Component Analysis (PCA) (explaining 98% of total variance), and hierarchical clustering (with validation metrics) provides a data-driven framework for the comparative analysis of strategic alignment. The analysis has provided evidence of a tripartite clustering of nations: High-Tech Hubs (nations with significant infrastructure); Nascent Innovators (nations with strong human capital and postures toward growing ecosystems), and a scenario indicating real foundational urgency. The gap analysis combining AI readiness scores and Strategic Intent (TF-IDF) indicates a similar pattern across countries in the Arab region: a negative relationship between policy messaging and existing capabilities. Developing economies focus on the areas in which they are least ready; emerging economies target key capacities related to enhancing human capital and institutional capacity; and advanced economies demonstrate smaller gaps, but may be underprioritizing areas that are already strong and thus risk strategic stagnation. It is important to consider policy ambition against the overarching capacity, to be aware of an amounts of corrective focus that may detract from the development of capacity and competitive advantages, and overall, the analysis illustrates the value of using TF-IDF to monitor changing strategic intent across the various domains of AI.
This combined analysis indicates that the regional landscape is at a strategic crossroads. While there is almost consensus on the transformative potential AI must deliver new products and services into society, too few countries prioritize activity that gets them closer to preparation.

Drawing on the findings of this study, which combine AIPI metrics, TF-IDF Strategic Intent scores, PCA clustering and Gap Analysis, policymakers should pursue a tiered- and targeted approach:

B. Advanced / High-Preparedness Economies (High-Tech Hubs):

These countries exemplify the "Preparedness-Strategy Paradox," as they are capable in AI but have lower strategic emphasis in almost all key areas (r = -0.70 to -0.83).

1. Expand the focus beyond maintenance-oriented policies to address the low-frequency/high-impact identified through TF-IDF scores. Think about issues related to generative AI and commercialized R&D.
2. Explicitly codifying pre-existing high AIPI scores in regulation and ethics to formal frameworks and regional sandboxes can allow governments to exert soft power, set ethical norms and establish ethical leadership.
3. Ministries can incentivize the private sector to establish connections to read the intent of policy into investable innovation projects, linking the intent of public strategy to commercial R&D.

C. Regional Recommendations:

Cluster and gap analysis suggest opportunities for coordinating regionally in a structured manner.

1. Establish a Regional AI Observatory to monitor TF-IDF trends and evolution of AIPI gaps so as to provide evidence-based real time advice on policy adjustments.
2. Align standards across clusters through developing interoperable data standards, ethical standards and regulatory standards as a mechanism for regional integration and align with High-Tech Hub leadership as an example.

A. For Aspirational / Emerging Economies (Nascent Innovators & Catch-Up):

Some of these countries have a high emphasis in terms of strategy, but lower preparedness with TF-IDF scores never deviating far from a mean and the scores clustered in certain dimensions:

1. **Fill the Gaps Revealed in the Gap Analysis:** Focus on the dimensions with the greatest neglect in terms of preparedness in relation to strategy, (e.g., Digital Infrastructure, Human Capital, Regulatory & Ethics);

2. **Translate Strategic Intent into Actionable Programs:** Connect high-TF-IDF terms such as “digital skills”, “startup ecosystem”, and data to policies that are clear and actionable in a clearly defined time-period, with budgets and key performance indicators;
3. **Engage in Cluster-Based Peer Learning:** Use PCA clustering outputs to intentionally work with countries that are in the same preparedness profile, sharing policy blueprints of similar outcomes and/or initiating regional or international innovation efforts.

B. For Advanced / High Preparedness Economies (High-Tech Hubs):

The context around these countries corresponds to the "Preparedness-Strategy Paradox" - they have notable AI capability but do not place a high level of strategic emphasis on key foundational issues.

1. Transition from Maintenance Focus to Low-Frequency, High-Impact Foundational Issues: First, we recommend that you broaden the maintenance-focus approach to low-frequency, high-impact foundational issues from TF-IDF, like generative AI and commercializing R&D.
2. Codify Implicit Strengths into Leadership: Encourage countries to codify explicit high scores on the AIPI in Regulation & Ethics into formal legal frameworks and/or regional sandboxes, for example, to enhance soft power and ethical leadership.
3. Foster Linkages to the Private Sector: Encourage linking the industry to move forward with operationalizing a public strategy into investable innovation projects that simulate a commercial impact and articulate public R&D.

C. Regionally,

The cluster and gap analysis indicates space for structured coordination at the regional level.

1. **Develop an AI Regional Observatory:** A recommendation for developing an observable AI regional observatory that tracks the TF-IDF and AIPI gaps to produce real-time, evidence-based guidance directing changes to the policy environment.
2. **Standardization Across Clusters:** Develop standard standards that are interoperable for data, ethics, and regulation to allow for coordinated regional integration, in the form of High-Tech Hub leadership as a model.

This study has a lot going for it, but it has some limitations that the researchers think should be noted:

1. **Document Analysis:** The study's strategic analysis drew on publicly available policy documents, which may have selectively reported or overlooked unofficial strategies, internal discussions or implementation rates or effectiveness of what is set out in the statements about policy.
2. **Static Analysis:** This analysis is based on data from a specific time period. The nature of the dynamic policy context of AI means that we have given an important baseline to this time period not given a real-time analysis.
3. **Quantitative Limitations:** The preparedness index is still a composite index but the indicators and their respective weights that make up each of the sub-components do not deal perfectly in respect to each of the country’s individual context or priorities.
4. **Methodological Limits:** The text analysis recognized policy focus as term prominence – it did not evaluate the meaning, sentiments, or contexts to which the identified terms are applied in the documents.
5. **Private Sector Data:** This study examined governmental strategies and public preparedness, thus neglecting any data regarding the private sector’s adoption,

investments, or innovations, which are perhaps the most significant drivers of the ecosystem.

6. **The IMF's AIPI Framework limits:** A major limitation of this research has been its reliance on the IMF's AI Preparedness Index (AIPI) as a dependent measure. Though the AIPI provides a systematic and comparative framework, it compresses the multifaceted landscape of readiness for national AI into only four main dimensions. Further, in creating a composite index, the AIPI is made up of other datasets that are screened and further delayed in publication, thus the AIPI may not wholly capture the newest and fastest changes to national AI ecosystems at the time of data collection. Therefore, the gaps identified between stated strategic goals, and the measured readiness, should only be interpreted as a diagnostic of alignment with a temporal illustrated benchmark not as an absolute and fully current assessment of a country's readiness and potential success of advancing its AI ambitions.

For Future Research, despite the limitations, these factors present important research directions:

1. **Longitudinal Study:** If we can observe longitudinal change in both strategy and preparedness, we can notice trends and impacts related to specific policies.
2. **Qualitative Case Studies:** Case studies that do deep dives with key informant interviews in select countries can help examine the "why" behind the scores and what challenges come to bear with implementation or nuances around political economy to properly contextualize the situation.
3. **More complex text analysis:** Using contemporary techniques including natural language processing (NLP), such as topic modeling and sentiment analysis, might allow us to identify latent themes and rhetorical style in the policy texts.
4. **Metrics for implementation:** In the future research could be set up by developing metrics for implementation from policy to review including budget, number of projects completed, and legislation specific to AI developed.
5. **Integrated system of innovation study:** Including measurement of trends from venture capital in the private sector, patent registrations, and developments in industry adoption would provide an understanding of the national AI system of innovation in its entirety.
6. **Future Directions for AI Preparedness Index:** Using real-time, dynamic measures of AI readiness, with data on flows of investment, labor trends, and patenting activity. Aggregating multiple indices (e.g., the OECD Index, the WEF Index, the Stanford AI Index, and Saudi Arabia’s National Capability Index) would have a certain robustness to it and have a unique sense of comparability. The potential for these quantitative measures to be paired or supplemented with in-depth, country-specific case studies will capture the unique institutional, political, and cultural dynamics of each country, yielding broader insights for how and under what conditions strategic intent does indeed get operationalized, thus leading to more effective AI policy frameworks which are grounded in evidence.

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Appendices

Appendix .1: Term Frequency-Inverse Document Frequency (FT IDF)

TF-IDF stands for term frequency-inverse document frequency. It is a statistic that is used in Natural Language Processing (NLP) and is used to reflect how important a word is to a document in a collection or corpus. In a nutshell, the TF-IDF value increases proportionally to the number of times a word appears in a document, but is offset by the frequency of the word in the corpus, which helps to adjust for the fact that some words appear more frequently in general. In this way, we can filter out common words that serve little purpose (for example "the" and "a"), and obtain words that are unique and meaningful to the specific document. The TF-IDF score is the product of two values:

1. **Term Frequency (TF):** a ratio that measures how often a term appears in a given document, relative to the total number of terms in that document. A high TF score would indicate that the word is significant within that single document. An equation for TF is:

$$TF(t,d) = \frac{\text{Number of times term t appears in document d}}{\text{Total number of terms in document d}}$$

   Where: TF(t,d)=Total number of terms in document, d Number of times term, and t appears in document d.

2. **Inverse Document Frequency (IDF):** a measure of how rare a word is across the entire collection of documents in the corpus. Words that appear in a lot of documents will have a low IDF score. This is what helps discount common words. The formula is:

$$IDF(t,D) = \log\left(\frac{\text{Total number of documents D}}{\text{Number of documents with term t in them}}\right)$$

By multiplying these two values, you get the final TF-IDF score:

$$TF - IDF(t,d,D) = TF(t,d) \times IDF(t,D)$$

As it relates to this study, TF-IDF is useful because it can:

- **Highlight Key Priorities:** It can provide a relative analysis of a library of national strategies, TF-IDF will readily reveal the most important and unique policy words for every country's document. For example, if the word "data sovereignty" appeared prominently in only one country's strategy, TF-IDF would assign the word a high score. This indicates that the concept of data sovereignty is very important for that particular country.
- **Compare Strategies:** You use it as a heuristic in the comparative analysis, TF-IDF ultimately provides a quantitative framework for how to understand which national strategies emphasize which themes and concepts. This will be relevant for the Strategic Content Analysis section.
- **Filter noise:** TF-IDF will de-emphasize frequent non-special and other non-relevant words and phrases. Not to mention TF-IDF will allow you to focus on the fundamentally unique and substantive high-value terms that differentiate responses for each country's AI policy.

Appendix .2: AI Preparedness Index (AIPI) Taxonomy: Pillars, Keywords, and Weighting Framework

```
AIPI_TAXONOMY = {
    "Digital Infrastructure": {
        "terms": [
            "digital", "digital infrastructure", "ict infrastructure", "data centers", "5g
network",
            "broadband access", "cloud services", "internet connectivity", "network
development",
            "cybersecurity infrastructure", "spectrum allocation", "fiber optic",
            "digital platforms", "smart cities", "edge computing",
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