

Governance and measurement of responsible artificial intelligence on the GIRAI Index: an empirical study of Arab countries, 2024

حوكمة وقياس الذكاء الاصطناعي في مؤشر الذكاء الاصطناعي المسؤول: دراسة تجريبية
للدول العربية 2024

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Abstract

This study aimed to analyze and evaluate responsible artificial intelligence in Arab countries. The problem of study was to determine the level and classification of Arab countries in the Global Index for Responsible Artificial Intelligence in its first report for the year 2024. The number of Arab countries classified in this index was 15, and the descriptive analytical approach was used, relying on collecting and analyzing data and testing hypotheses using the SPSS program. This study reached a number of results, the main of which was that responsible AI governance contributes effectively to building sovereign AI. The study also stressed the need to integrate and enhance AI in its main sectors, and to adopt responsible AI at the individual and institutional levels, as well as at the national level.

Keywords: Artificial Intelligence, Sustainable development, Corporate Social Responsibility.

JEL Classification : O31; Q01; M14.

ملخص

هدفت هذه الدراسة إلى تحليل وتقييم الذكاء الاصطناعي المسؤول في الدول العربية، وتمثلت مشكلة الدراسة في الوقوف على مستوى وتصنيف الدول العربية في المؤشر العالمي للذكاء الاصطناعي المسؤول في تقريره الأول لعام 2024. فكان عدد البلدان العربية المصنفة في هذا المؤشر هو 15، وتم باستخدام المنهج الوصفي التحليلي والاعتماد على جمع وتحليل البيانات واختبار الفرضيات باستخدام برنامج SPSS، وتوصلت هذه الدراسة لعدد من النتائج تمثلت أساساً في أن حوكمة الذكاء الاصطناعي المسؤول تساهم بشكل فعال في بناء الذكاء الاصطناعي السيادي، كما أكدت الدراسة على ضرورة دمج الذكاء الاصطناعي وتعزيزه في قطاعاته الرئيسية، واعتماد الذكاء الاصطناعي المسؤول على مستوى الأفراد والمؤسسات، وكذلك على المستوى الوطني.

كلمات مفتاحية: ذكاء اصطناعي، تنمية مستدامة، مسؤولية اجتماعية.

تصنيف JEL: O31 ، Q01 ، M14، Q56.

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Introduction:

Artificial intelligence (AI) technologies are expected to have many and varied social Artificial intelligence (AI) is a branch of science that studies and develops intelligent machines. This scientific field was established in the 1950s, and at that time AI was described as a new science that methodically examines the phenomenon of "intelligence". To achieve this goal, computer simulations of intelligent processes must be used. The authors also explained that in AI, intelligence is considered a broad mental ability that includes a number of more specialized skills, including reasoning, planning, problem solving, understanding concepts, using language and learning. The Global Responsible AI Index evaluates countries using certain sub-indices or sub-components that are important for each country to improve its overall performance, but the important thing is to incorporate the requirements of responsible AI in its development strategies in the framework of Sustainable Development. The ranking and scores in the previous index of each country, especially the Arab countries, are more useful to know their real level, so the problem of the study appears clearly.

The Main Problem of the Study and Sub-Questions:

The research problem is around the following question:

Do Arab economies have a statistically acceptable score at a significant level (0.05) on the Global Responsible AI Index?

Based on the previously determined main question, a set of sub-questions can be formulated as follows:

- Is there a statistically acceptable score at a significant level (0.05) for Arab economies on the Government Frameworks sub-index?
- Is there a statistically acceptable score at a significant level (0.05) for Arab economies on the Government Actions sub-index?
- Is there a statistically acceptable score at a significant level (0.05) for Arab economies on the Non-State Actors sub-index?
- Is there a statistically acceptable score at a significant level (0.05) for Arab economies on the Human Rights and AI sub-index?

- Is there a statistically acceptable score at a significant level (0.05) for Arab economies on the Responsible AI Capacities sub-index?
- Is there a statistically acceptable score at a significant level (0.05) for Arab economies on the AI governance sub-index?

Study Hypotheses:

The following hypotheses were formulated:

- **The main hypothesis:** Arab economies have a statistically acceptable score at a significant level ($\alpha \leq 0.05$) on the Global Responsible AI Index.
- **The first sub-hypothesis:** There is a statistically acceptable score at a significant level ($\alpha \leq 0.05$) for Arab economies on the Government Frameworks sub-index.
- **The second sub-hypothesis:** There is a statistically acceptable score at a significant level ($\alpha \leq 0.05$) for Arab economies on the Government Actions sub-index.
- **The third sub-hypothesis:** There is a statistically acceptable score at a significant level ($\alpha \leq 0.05$) for Arab economies on the Non-State Actors sub-index
- **The fourth sub-hypothesis:** There is a statistically acceptable score at a significant level ($\alpha \leq 0.05$) for Arab economies on the Human Rights and AI sub-index.
- **The fifth sub-hypothesis:** There is a statistically acceptable score at a significant level ($\alpha \leq 0.05$) for Arab economies on the Responsible AI Capacities sub-index.
- **The sixth sub-hypothesis:** There is a statistically acceptable score at a significant level ($\alpha \leq 0.05$) for Arab economies on the AI governance sub-index.

The Importance of Study:

This study is important for all since it could be the appropriate framework for responsible AI adoption at regional or Arab region, national, company, and individual levels, where decision-makers, managers, and people in their behavior find AI useful and avoid its negative effects. Moreover, it has a real deferred value for academic research, especially by showing the Arab region level in the previous index during the period of study.

Study Objectives

The objectives of the study are based on the challenges that prevent the process of responsible AI in Arab countries and its important components, which are government frameworks, government actions, non-state actors, human rights, responsible AI capacities, and AI governance.

In addition, this study seeks to shed light and make AI useful at different levels of study and practice.

Study Methodology and Tools

In this study, we used an analytical-descriptive methodology to explain the different aspects of the studied variables and clarify the relationships between their components. We also used the case study method, which facilitates the application of theoretical concepts to real-world situations, by collecting data through the report of the Global Responsible AI Index and performing statistical analyses with the statistical programs Excel and SPSS.

Some previous studies

- **A study** (Karatzogianni, 2021) Entitled "Research Design for an Integrated Artificial Intelligence Ethical Framework," it is an article published by the Journal of Economic and Social Changes. This paper suggests a research design aimed at addressing this topic through direct collaboration with targeted stakeholders to establish principles of AI that are trustworthy, accountable, safe, fair, and non-discriminatory.

- **A study** (Batool, Zowghi, & Bano, 2023) Entitled "Responsible AI Governance: A Systematic Literature Review," it is an article published by the Journal of arXiv:2401.10896v1 [cs.CY]. This study seeks to analyze the literature in order to address the main questions: who holds responsibility for AI systems' governance, what components are being governed, when governance is integrated into the AI development life cycle, and how its execution is done by a variety of mechanisms, including standards, policies, frameworks, models, or tools.

- **A study** (Camilleri, 2023) Entitled "Artificial Intelligence Governance: Ethical Considerations and Implications for Social Responsibility," it is an article published by the Journal of [wileyonlinelibrary.com/journal/exsy](https://www.wileyonlinelibrary.com/journal/exsy). This paper seeks to fill the existing knowledge gap in the academic literature. The objectives of this contribution are threefold: Firstly, it describes AI governance frameworks. Secondly, it sheds light on the extant literature on 'AI governance' as well as on the intersection of 'AI' and 'corporate social responsibility' (CSR). Finally, it identifies key dimensions of AI governance.

1. The Artificial Intelligence (AI)

AI represents one of the most recent fields inside the realm of science and engineering. Work started in earnest soon after the second world war, while the name itself was created in 1956. In

addition to molecular biology, AI is frequently mentioned as the “domain I would most like to exist within” by scientists from various fields. (Okaibedi Eke, Wakunuma, & Akintoye, 2023) The concept of artificial intelligence (AI), regardless of its 70-year of existence (McCarthy et al. 2006), has become extremely notable from the mid-2010s. (Stahl, Leach, Oyeniji , & Ogoh) As noted by Schwab (2016), AI is a significant component of the fourth industrial revolution that will lead to fundamental changes in the manner which we work, live, and interact with one another. PricewaterhouseCoopers AI sizing the price report estimates that by 2030. (Okaibedi Eke, Wakunuma, & Akintoye, 2023) The economic potential of deployment of Artificial Intelligence has been widely highlighted by policy makers, technologists, academics and civil society around the world. (Kumar, february 2021)

1.1. Definition of AI

Currently, there’s no authoritative, consistent and overarching definition of AI. This space is characterized by fluidity and change with differing opinions, developing trends and diverse user scenarios. (Gillespie, Lockey , Curtis, Pool, & Akbari, (2023).) We have claimed that AI is exciting, but we have not said what is it (Gillespie, Lockey , Curtis, Pool, & Akbari, (2023).) The definitions on the left criteria success in terms of fidelity to human effective capabilities, Rationality on the other hand the ones on the right criteria against an ideal performance criteria, named rationality. A system is rational if it does the “right thing,” given what it knows. (J. Russell & Norvig, 2010)

Fig 1. Some definitions of artificial intelligence, organized into four categories.

Thinking Humanly “The innovative initiative seeks to make computers to engage in cognitive processes akin to those of machines with minds, in the full and literal context.” (Haugeland, 1985)	Thinking Rationally “The mental capabilities study by the application of computational models.” (Charniak and McDermott, 1985)
Acting Humanly “The art of establishing machines that perform functions which necessitate cognitive abilities when executed by people.” (Kurzweil,1990)	Acting Rationally “Computational Intelligence is the study of the design of intelligent agents.” (Poole <i>et al.</i>, 1998)

Source: (J. Russell & Norvig, 2010, p. 2)

Artificial intelligence is the capacity of a system to determine, interpret, draw conclusions, and acquire knowledge from data to achieve established organizational and societal targets”. (Mikalef,

Conboy, Eriksson Lundström, & Popovič, 2022) Therefore, Artificial intelligence (AI) refers to systems designed by humans that, given a complex goal, act in the physical or digital world by assessing their surroundings, analyzing the gathered structured or unstructured data, reasoning on the insight obtained from this data and defining the best actions to undertake (in accordance with determined parameters) to achieve the given goal. (The European Commission's, 2018) So, AI is an umbrella term that encompasses a range of interrelated techniques and technologies. (N, Lockey, Curtis, Pool, & Akbari, 2023)

1.2. The spectrum of AI

It can be divided into three: assisted intelligence, augmented intelligence. and autonomous intelligence. (Oxborough, Cameron, & Eggesfield, 2019)

1.3. AI model

A structure or framework which encapsulates the knowledge, patterns, or relationships gained through learning algorithms or alternative methods, allowing it to provide predictions, recommendations or to create content. (Reid, O'Callaghan, & Lu, June 2023)

1.4. AI system

The OECD defines an Artificial Intelligence (AI) system as a machine-based system that can, for a given set of human-defined make predictions, recommendations, or decisions influencing real or virtual environments. When utilized, AI has seven distinct use cases, known as patterns, which can coincide in parallel inside the same AI system. (OECD, 2019)

1.5. Generative AI (GAI)

Represents a substantial economic opportunity for Australia, with the potential to add tens of billions to the economy by 2030. (Technology Council of Australia, July 2023)

1.6. Artificial Intelligence between threat and opportunity for people's jobs

Artificial intelligence offers several advantages when used in daily life, such as making work easier and faster. (Jangam, Suryawnshi, & Patil, 2021)

2. The Responsible AI

The concept of responsible AI has garnered significant attention in recent years (Boden et al., 2017; Gwagwa et al., 2020; Nerietal., 2020; Arrieta et al. 2020). According to Boden et al. (2017), responsible AI is characterized by acting toward a situation that is desirable, positive, or socially acceptable. (T. Okolo, Aruleba, & Obaido, 2023)

2.1. Definition of responsible AI

It is a framework for developing AI safely and ethically based on the five core principles of fairness, transparency, accountability, privacy, and safety. Here's what you need to know. (<https://builtin.com/artificial-intelligence/responsible-ai>, 2024)

The concept is as slippery to define as AI itself. Dignum acknowledges that responsible AI means varied things to varied individuals, serving as a broad framework for a lot of views and subjects. (Yorke-Smith, 2020)

Responsible AI is human-focused and guarantees customers' confidence by ethical processes of decision-making. (GOLLNER, TROPMANN-FRICK, & BRUMEN, 2023)

2.1.1. Responsible AI principles

There is general accord that responsible artificial intelligence needs principles like transparency, objectivity, privacy, explainability, and human security. (<https://www.brookings.edu>, 2024)

2.1.2. Challenges to AI Adoption

The adoption and use of AI applications in the majority of countries raise some issues, including skills acquisition, ethics, programming, data integration, user attitude, government policy, and insufficient infrastructure and network connectivity. (Ade-Ibijola & Okonkwo, 2023)

2.2. Relationship between Trustworthy AI and sustainable development Goals

The interaction between economic, environmental, and social matters should be considered inside the definition of responsible AI. This interaction needs the expressive employment of standards for UN SDGs. (Prioritizing People and Planet as the Metrics for Responsible AI, 2023)

The requirements of socially helpful AI practices are enormous and lift a multitude of challenges. Various initiatives are trying to deliver a number of these requirements. For instance, the AI for Global Good Summit of the ITU is interested in motivating R&D in AI to actively participate to achieve the 17 Sustainable Development Goals (SDGs). (Ghallab, 2019)

3. Governance and measurement of Responsible AI

Responsible AI refers to "the development of intelligent systems according to fundamental human principles and values." (Vassilakopoulou, Parmiggiani, Shollo, & Grisot, 2022) The governance approaches presented in the national AI strategies look to depend on the ethical instructions and conceptual moral principles. (Gianni, Lehtinen, & Nieminen, 2022) Describes AI governance

frameworks, identifies key dimensions of AI governance, and elaborates on the promotion of accountability and transparency; explainability, interpretability, and reproducibility; equity and involvement; seclusion and health of end consumers; and, furthermore, the avoidance of threats and of cybersecurity matters from AI systems. (Camilleri, 2023, p. 1)

3.1. Some initiatives toward responsible AI

There are some important initiatives toward responsible AI at organizational, national, and supranational levels. rights.

3.1.1. The act of EU's artificial intelligence

The European Union (EU) set ahead its suggested AI management structure, which is based on 'The Act of Artificial Intelligence (AI Act),' in April 2021. It specifies that its objectives are to increase the safety and security of AI systems, as they have to respect relevant legislation on fundamental and should reflect EU values; facilitate (Camilleri, 2023, p. 3) investment in automated systems; reinforce responsible AI governance through regulations and principles; and create a trustworthy and safe ecosystem for the development of AI systems. (Camilleri, 2023, p. 4)

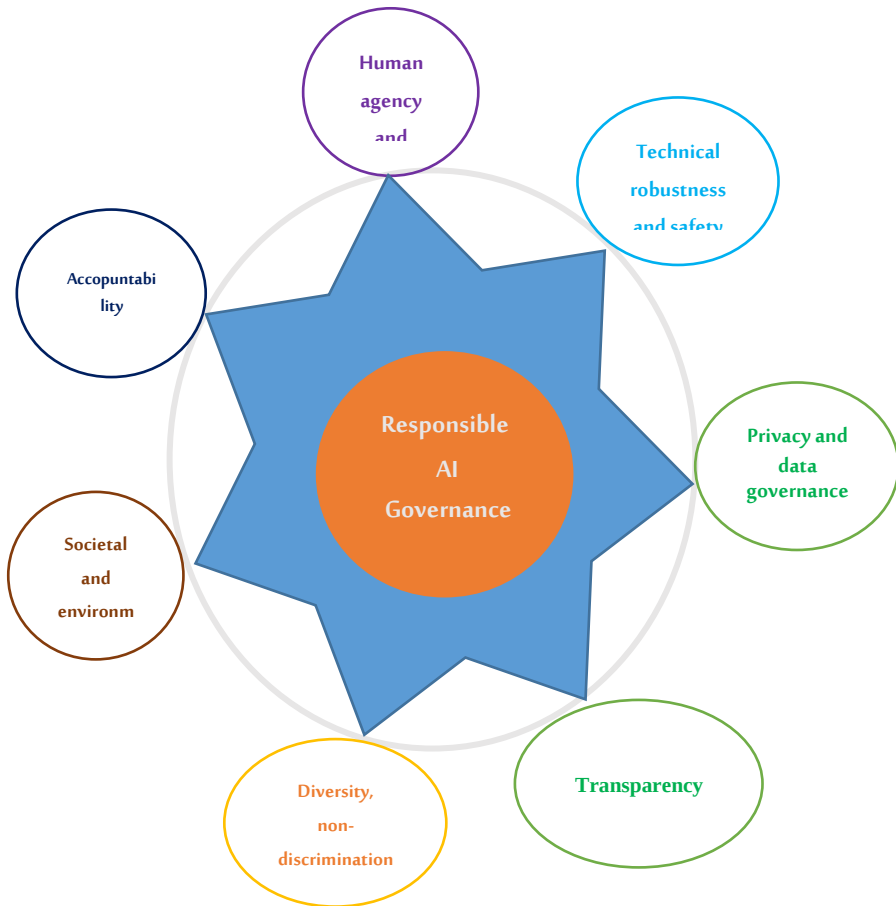
3.1.2. OECD's AI principles:

OECD's AI principles urge practitioners to respect human rights and democratic values. (Camilleri, 2023, p. 6)

3.2. Requirements of Trustworthy AI

The principles outlined previously must be translated into concrete requirements to achieve Trustworthy AI. (INDEPENDENT, 2019)

Fig 2. Responsible AI Governance (Interrelationship of the seven requirements of responsible AI)



Source: prepared by the researcher by depending on (INDEPENDENT, 2019) and (Camilleri, 2023)

Ethics Guidelines for Trustworthy AI' aimed at maximizing the benefits of AI while minimizing its risks, advocating that a human-centric approach to AI is needed to create 'Trustworthy AI. (Karatzogianni, 2021) As artificial intelligence transforms a wide range of sectors and drives innovation, it also introduces complex challenges concerning ethics, transparency, bias, and fairness. (Batool , Zowghi, & Bano, 2023)

3.3. Governance and measurement of Responsible AI for countries on GIRAI

While the rapid development of generative artificial intelligence (AI) has recently captured headlines and imaginations, the power of AI has been growing for more than 70 years. (Gillam & Jain, J U N E, 2 0 2 4) In fact, AI's ethical considerations extend across diverse societal domains, encapsulating issues related to privacy, equity, accountability, transparency, and the broader societal ramifications. (Shukla, 2024) Globally, a number of different sets of 'AI ethics principles' have been put forward by multilateral organizations, private sector entities, and various nation states. (Kumar, february 2021, p. 7)

3.3.1. The role of stakeholders in promoting responsible AI

A global consensus has started forming that RAI solutions must keep pace with innovation in AI. As AI's prevalence and potential impact increase globally, companies, investors, governments, and regulators will face a potential rise in the scale of risks and consequences. (Gillam & Jain, J U N E, 2 0 2 4, p. 8)

Table 1. Stakeholders’ role and incentive to accelerate the adoption of RAI.

Stakeholder Group	Stakeholders	Exemples	Role in RAI	Incentive to accelerate the adoption of RAI
Broader ecosystem	Governments, regulators	Governmental bodies (e.g., EU Commission, US Federal Trade Commission)	Define legal frameworks, enforce AI regulations, set “rules of the game”	Protect citizens, boost innovation, build trust
	Professional and research organizations	Independent organizations, not for-profits, research institutions	Evaluate AI impacts, advance RAI research,	Build trust, influence and community

		(e.g., Partnership on AI, The Alan Turing Institute), academia	advocate for policy	
Investors	Asset owners	Individuals/institutions owning financial assets (e.g., pension funds, insurance companies, sovereign wealth funds, foundations)	Set RAI expectations for asset managers (internal and external), contribute to standard setting	Manage risks, create value, act in best interests of their stakeholders (fiduciary duty)
	Asset managers	Individuals/institutions managing investments (e.g., private equity general partners, hedge fund investment managers, asset owner employees)	Integrate RAI into investment decisions and engagement with companies	Manage risks, create value, deliver on asset owner mandates
Companies	Boards	Governing bodies within companies (e.g., board of directors)	Oversee RAI strategy, manage AI risks	Protect reputation, comply with regulations, direct

				strategy, minimize harm to people and planet
	Management	Teams that execute company operations (e.g., suite executives, operations managers and other employees)	Create RAI governance, implement RAI strategy, ensure operational RAI alignment, minimize harm to people and the planet	Build a sustainable business, gain a competitive edge, advance best practices for product development

Source: (Gillam & Jain, J U N E, 2 0 2 4, p. 8)

The move to a wide concept of AI evaluation is the principal focal point of the attending job. (Scantamburlo, Cortés , & Schacht, 2020)

3.3.2. The Global Index on Responsible AI (GIRAI)

Is the initial mean to put universal pertinent comparison for responsible AI and evaluate them in countries all over the world. (Adams, et al.)

3.4. Measuring Responsible AI

Responsible AI measures 19 thematic areas of responsible AI, which are clustered into 3 dimensions: Human Rights and AI, Responsible AI Governance, and Responsible AI Capacities. Every subject area evaluates the execution of 3 distinct pillars of the responsible AI components: government frameworks, non-state actors’ initiatives, and government actions. (Adams, et al., p. 10)

3.5. Key Findings

The First Edition of the GIRAI revealed that global progress toward responsible AI is lagging far behind the development and adoption of AI. (Adams, et al., p. 12)

4. Arab countries case study

The Global Index on Responsible AI covers 138 countries, including 15 Arab countries.

Table 2. Arab Countries Ranking and Scores on GIRAI.

Country	Year	GIRAI rank	Index Score	PILLAR CORE			DIMENSION SCORE		
				Government frameworks	Government actions	Non-state actor	Human rights and AI	Responsible AI capacities	Responsible AI governance
U A E	2024	17	44,66	46,40	55,62	19,24	40,58	51,15	45,66
Qatar	2024	37	29,84	27,91	38,33	16,72	42,66	37,10	17,44
Jordan	2024	38	29,60	36,88	28,78	16,69	30,68	35,63	26,75
Saudi Arabia	2024	40	28,95	25,60	42,47	7,81	26,28	38,96	27,69
Palestine	2024	46	26,38	17,37	44,06	9,05	22,23	29,59	28,54
Morocco	2024	51	22,99	9,51	30,97	34,02	27,99	19,60	20,24
Kuwait	2024	57	19,11	0,00	35,79	23,99	23,39	18,92	15,85
Tunisia	2024	62	15,80	6,11	19,37	28,04	19,25	11,86	14,44
Egypt	2024	63	15,79	24,62	14,54	0,62	18,12	26,07	10,55
Oman	2024	67	14,80	23,54	13,03	0,86	13,85	16,06	15,12
Bahrain	2024	78	8,71	9,67	10,96	2,30	9,37	17,84	5,15
Libya	2024	94	4,53	0,00	6,61	9,44	5,17	9,68	2,32
Lebanon	2024	99	3,69	1,86	1,56	11,59	3,50	7,22	2,65
Algeria	2024	104	2,66	0,00	4,53	4,25	0,00	13,63	1,08
Somali	2024	126	0,97	0,00	2,44	0,00	1,32	3,08	0,00

Source: Prepared by the researcher, depending on the Global Index on Responsible AI 2024 Report (1st Edition)

From the above, it can be seen that the ranking of the Arab countries in responsible artificial intelligence in the global index of responsible artificial intelligence is related to their GIRAI index score during the study period, and the ranking of its components depends on the scores of each one. of them, that are government frameworks, government actions, non-state actors, human rights and AI, responsible AI capacities, and responsible AI governance.

While some Arab countries have a good world rank, like the Emirates (17), Qatar (37), Jordan (38), and Palestine (46), there are some countries with middle ranks, like Morocco (51), Kuwait (57), Tunisia (63), and Oman (67), although the other Arab world-ranked countries are lower, like Bahrain (78), Libya (94), Lebanon (99), Algeria (104), and Somalia (126).

4.1. Evolution of Arab countries score on the Global Responsible AI Index:

We have to add into analysis the GIRAI report scores classification.

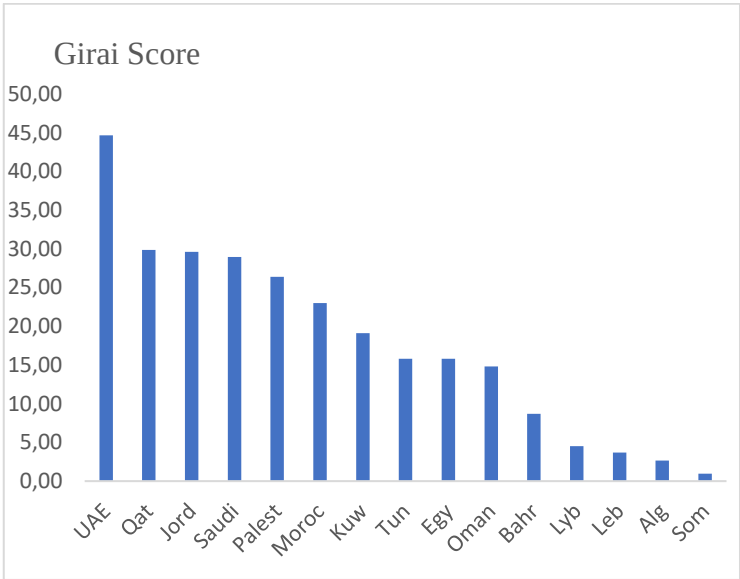
Table 3. The GIRAI report scores classification.

Countries GIRAI Score interval	Level Description
Score of countries above 75	Very high level
Score of countries above 50 and under 75	high level
Score of countries above 25 and under 50	Middle level
Score of countries between 0 and 25	Low level

Source: Prepared by the researcher, depending on the Global Index on Responsible AI 2024 Report (1st Edition).

The following figure shows the evolution of the score in terms of responsible AI.

Fig. 3. Arab Countries Scores on the Girai Index 2024.



Source: Prepared by the researcher, depending on Excel.

4.1.1. Analysis according to Arab countries level

We calculate the arithmetic mean of each of the points of the main GIRAI indices of the Arab countries, as shown in the table below:

Table 4. Statistical Mean of Arab Countries on Girai.

GIRAI main index	N	Minimum	Maximum	Mean	Std. Deviation
Score girai Arab	15	.97	44.66	17.8987	12.59089

Source: Prepared by the researcher, depending on SPSS.

By referring to table n° 03, we find that Arab countries general score on GIRAI could be divided into two levels:

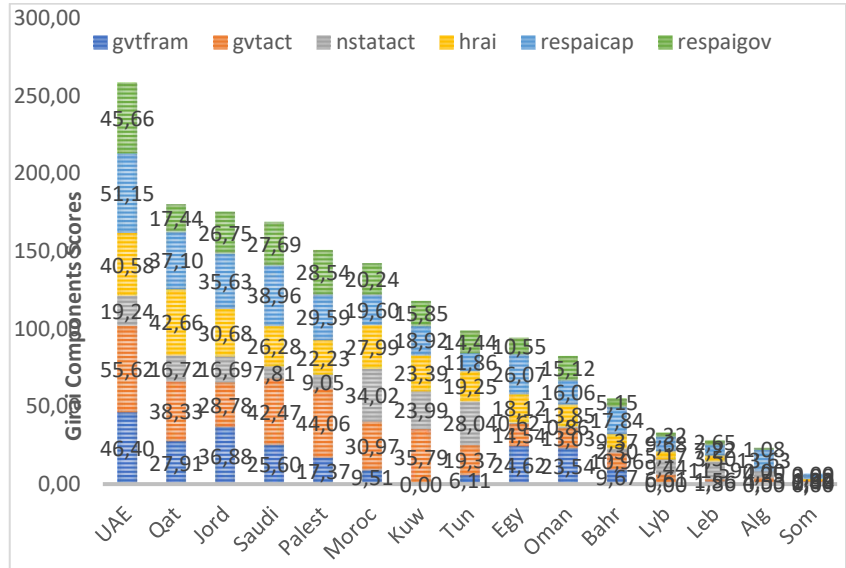
- **The middle scores level:** Countries scoring above 25 and up to 50 are 5 countries (UAE ranked 1 on the Arab level, and Qatar ranked 2 is the second-high score, 29.84 ranked 2, the 3rd rank is for Jordan with a score of 29.60, the 4th rank is for Saudi Arabia with a score of 28.95, and the 5th rank is for Palestine with a score of 26.38).

- **The low scores level:** Countries scoring between 0 and 25 are 10 countries (started with 5th rank for Morocco with score 22.99, and 6th rank is for Kuwait with score 19.11, 7th rank is for Tunisia with score 15.80, then 8th rank is for Egypt with score 15.79 while the 9th rank is for Oman with score 14.80, after that, the lower values are for the rest of the ranked countries with 10th rank for Bahrain with score 8.71, and 11th rank is for Libya with score 4.53, then 12th rank is for Lebanon with score 3.69, while 13th rank is for Algeria with score 2.66 and the minimum value on 14th rank is for Somalia with score 0.97).

4.2. Arab Countries scores in components of GIAI Index

The following figure shows the participation of each one of them in the Arab countries general score.

Fig. 4. Arab Countries Scores on the Girai Index Sub-Components 2024.



Source: Prepared by the researcher, depending on Excel.

We calculate the arithmetic mean of each of the Arab countries scores in the components of GIRAI and calculate the percentage of each one of them, as shown in the following table:

Table 5. Statistical Mean of Arab Countries on GIRAI sub-components.

GIRAI subcomponents	N	Min	Max	Mean	Std. Deviation
Government Framework Arab	15	.00	46.40	15.2980	14.93731
Government actions Arab	15	1.56	55.62	23.2707	17.32538
Non state action Arab	15	.00	34.02	12.3080	10.57601
human rights responsible AI Arab	15	.00	42.66	18.9593	13.49765
Responsible AI capacities Arab	15	3.08	51.15	22.4260	13.60544
Responsible AI governance Arab	15	.00	45.66	15.5653	12.82027

Source: Prepared by the researcher, depending on SPSS.

It is noted from the above that Arab countries scores of responsible AI components on the GIRAI Index could be summarized as follows:

4.2.1. Government frameworks (gvtfram)

By referring to table n° 03, we find that there are two levels:

- **The middle scores level:** Countries scoring above 25 and up to 50 are 4 countries (the maximum score is for United Arab Emirates with value 46.40, the 2nd high score refers to Jordan with value 36.88, the 3rd is for Qatar with value 27.91, and Saudi Arabia with 25.60).

- **The low scores level:** Countries scoring between 0 and 25 are 11 countries (Egypt with score 24.62, then Oman with score 23.54 and Palestine with 17.37. after that Bahrain 9.67 and Morocco with score 9.51, next there is Tunisia with 6.11 and Lebanon with 1.86, after that we find the rest of countries Libya, Algeria and Somalia with minimum score 0.00).

4.2.2. Government actions (gvtact)

By referring to table n° 03, we find that there are three levels:

- **The high scores level:** Countries scoring above 50 and up to 75 is 1 country (the maximum score is for United Arab Emirates with value 55.62).

- **The middle scores level:** Countries scoring above 25 and up to 50 are 6 countries (the 2nd high score refers to Palestine with score 44.06, and the 3rd Saudi Arabia with value 42.47, then there Qatar with value 38.33, and Kuwait with 35.79. After that, there are Morocco with score 30.97, then Jordan with score 28.78).

- **The low scores level:** Countries scoring between 0 and 25 are 8 countries (Tunisia with 19.37, Egypt 14.54, and Oman with a score of 13.03; next, there is Bahrain with 10.96, Libya with 6.61, and Lebanon with 1.56; after that, we find Algeria with 4.53 and Somalia with a minimum score of 2.44).

4.2.3. Non-state actors (nstatact)

By referring to the table n° 03, we find that there are two levels:

- **The middle scores level:** Countries scoring above 25 and up to 50 are 2 countries (the maximum score is for Morocco with value 34.02; the 2nd highest score refers to Tunisia with score 28.04).

- **The low scores level:** Countries scoring between 0 and 25 are 13 countries (the 3rd is Kuwait with a value of 23.39, then there is the United Arab Emirates with a score of 19.24, after that, there are Qatar with a score of 16.72 and Jordan with 16.69, then Lebanon with 11.59 and Libya with a score of 9.44, and Palestine with a score of 9.05. The low level started with Saudi Arabia at 7.81, Algeria at 4.25, and Bahrain at 2.30. Next, there is Oman at 0.86, and after that, we find Egypt at 0.62 and Somalia with a minimum score of 0.00).

4.2.4. Human rights and AI (hrai)

By referring to Table No. 03, we find that there are two levels:

- **The middle scores level:** Countries scoring above 25 and up to 50 are 5 countries (the maximum score is for Qatar with value 42.66, the 2nd high score refers to United Arab Emirates with score 40.58, and the 3rd Jordan with value 30.68, then Morocco with score 27.99 and Saudi Arabia with score 26.28).
- **The low scores level:** Countries scoring between 0 and 25 are 10 countries (there are Kuwait with score 23.39, and Palestine with 22.23, then Tunisia with score 19.25, Egypt with 18.12, and Oman with 13.85; after that, Bahrain 9.37 and Libya with score 5.17 and Lebanon with score 9.05 next, there are Somalia with 1.32 and Algeria with minimum score 0.00).

4.2.5. Responsible AI capacities (respcap)

By referring to the table n° 03 we find that there are three levels:

- **The high scores level:** Countries scoring above 50 and up to 75 is 1 country (the maximum score is for UAE with value 51.15).
- **The middle scores level:** Countries scoring above 25 and up to 50 are 5 countries (the 2nd high score refers to Saudi Arabia with score 38.96, and the 3rd Qatar with value 37.10, then there is Jordan with value 35.63, and Palestine with 29.59, and there is Egypt with score 26.07).
- **The low scores level:** Countries scoring between 0 and 25 are 9 countries (there are Morocco with 19.60, then Kuwait with score 18.92, Bahrain with 17.84 and Oman with 16.06, after that, Algeria 13.63 and Tunisia with score 11.86, next there are Libya with 9.86, Lebanon with 7.22, after that we find Somalia with minimum score 3.08).

4.2.6. Responsible AI governance (respaigov)

By referring to the table n° 03 we find that there are two levels:

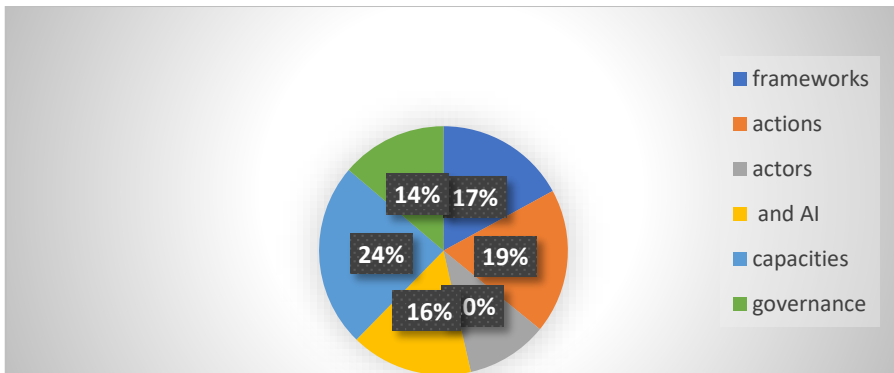
- **The middle scores level:** Countries scoring above 25 and up to 50 are 4 countries (the maximum score is for the United Arab Emirates with value 45.66, the 2nd high score refers to Palestine with score 28.54, and the 3rd is Saudi Arabia with value 27.69, then Jordan with 26.75).
- **The low scores level:** Countries scoring between 0 and 25 are 11 countries (there are Morocco with score 20.24 and Morocco with 20.24, then Qatar with 17.44, and Kuwait with 15.85, after that there is Oman with score 15.12 and Tunisia with 14.44, after that, Egypt 10.55 Bahrain with

score 5.15, next there are Lebanon with 2.65, Libya with 2.32, after that we find Algeria with 1.0 Somalia with minimum score 0.00).

4.2.7. Percentage of Algeria's score in components of sustainable competitiveness

The following figure shows the contribution of Arab countries scores in subcomponents of GIRAI.

Fig. 5. Percentage of Arab countries score in components of sustainable competitiveness.



Source: Prepared by the researcher, depending on Excel.

It is noted from above that of the responsible AI components of Arab countries, the highest percentage refers to responsible AI capacities (24%), the second is for government actions (19%), then the third refers to government actions (17%), after that there are human rights and AI (16%), next there is responsible AI governance (14%), and finally there are non-state actors (11%).

4.3. Test the hypotheses of the Study: The comparison between Arab and world interval values mentioned in the table n°03 could test every hypothesis of the study.

4.3.1. Test of the main hypothesis

Table 6. Test of the main hypothesis.

Index	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Score GIRAI Arab	5,506	14	,000	17.89867	10.9261	24.8713
Score Interval on GIRAI	Between 0 and 25					

Source: Prepared by the researcher, depending on SPSS.

Therefore, the main hypothesis is **acceptable with a low degree**.

4.3.2. Test of the first sub-hypothesis

Table 7. Test of the first sub-hypothesis.

Index	T	Df	Sig. (2- tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Government Framework	3,967	14	,001	15.29800	7.0260	23.5700
Score Interval on GIRAI	Between 0 and 25					

Source: Prepared by the researcher, depending on SPSS.

Therefore, the first sub-hypothesis is **acceptable with a low degree**.

4.3.3. Test of the second sub-hypothesis

Table 8. Test of the second sub-hypothesis.

Index	T	Df	Sig. (2- tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Government actions Arab	5,202	14	,000	23.27067	13.6762	32.8651
Score Interval on GIRAI	Between 0 and 25					

Source: Prepared by the researcher, depending on SPSS

Therefore, the second sub-hypothesis is **acceptable with a low degree**.

4.3.4. Test of the third sub-hypothesis

Table 9. Test of the third sub-hypothesis.

Index	T	Df	Sigg. (2- tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lowe	Duper
Non-state action Arab	4,507	14	,000	12.30800	6.4512	18.1648
Score Interval on GIRAI	Between 0 and 25					

Source: Prepared by the researcher, depending on SPSS.

Therefore, the third sub-hypothesis is **acceptable with a low degree**.

4.3.5. Test of the fourth sub-hypothesis:

Table 10. Test of the fourth sub-hypothesis.

Index	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
human rights and AI Arab	5,440	14	,000	18.95933	11.4846	26.4341
Score Interval on GIRAI	Between 0 and 25					

Source: Prepared by the researcher, depending on SPSS.

Therefore, the fourth sub-hypothesis is **acceptable with a low degree**.

4.3.6. Test of the fifth sub-hypothesis

Table 11. Test of the fifth sub-hypothesis.

Index	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Resp AI capacities Arab	6,384	14	,000	22.42600	14.8916	29.9604
Score Interval on GIRAI	Between 0 and 25					

Source: Prepared by the researcher, depending on SPSS.

Therefore, the fifth sub-hypothesis is **acceptable with a low degree**.

4.3.7. Test of the sixth sub-hypothesis

Table 12. Test of the sixth sub-hypothesis.

Index	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Responsible AI governance Arab	4,702	14	,000	15.56533	8.4657	22.6650
Score Interval on GIRAI	Between 0 and 25					

Source: Prepared by the researcher, depending on SPSS

Therefore, the sixth sub-hypothesis is **acceptable with a low degree**.

Conclusion

In this study, the Responsible AI governance and measurement, especially the Arab countries, by collecting the statistics of their ranks and scores during the study period on the GIRAI Index, and its sub-components of which are collected in two categories called pillars and dimensions.

Results

- The governance of responsible AI contributes effectively in the construction of sovereign AI.
- The governance of responsible AI is useful for Arab economies in terms of costs, efforts, time, and achieving SDGs.
- The governance of responsible AI protects adequately workers' rights, economic platforms users in Arab economies and companies.
- The ranking of Arab countries goes from 17th place for the United Arab Emirates to 126th place for Somalia in the GIRAI Index, and the other ranked Arab countries are spread across this range.
- The Arab countries arithmetic mean for the main index score of 17.89 is considered a low score. Arab countries arithmetic means for sub-index scores are considered low scores.
- There are 15 Arab countries ranked in the first in the GIRAI Index report, which could be considered an achievement, but there are 7 other Arab countries not be ranked which are: Comoros, Djibouti, Iraq, Mauritania, Sudan, Syria and Yemen.-Government frameworks contributed (17%) in the responsible AI scores of the Arab countries.
- Government frameworks contributed (17%) in the responsible AI scores of the Arab countries.
- Government actions contributed (19%) in the responsible AI scores of the Arab countries.
- Non-state actors contributed (11%) to the responsible AI scores of the Arab countries.
- Human rights and AI contributed (16%) to the responsible AI scores of the Arab countries.
- Responsible AI capacities contributed (24%) in the responsible AI scores of the Arab countries.
- Responsible AI governance contributed (14%) in the responsible AI scores of the Arab countries.

Suggestions and recommendations

- For Arab ranked countries scoring above 25 and up to 50:
 - Advanced section to address the implications of AI for children's rights.
 - Strengthen the role of civil society in the responsible AI ecosystem.
 - Supporting activities to protect and promote cultural and linguistic diversity in AI.

- Provides government frameworks to protect workers' rights in the context of AI.
- Adoption of technical standards to ensure the security of AI systems.

- For Arab ranked countries scoring between 0 and 25:

- Prioritize the adoption or updating of data protection and privacy laws.
- Ensure approval of AI and assessment of its impact.
- Develop programs to improve public sector capacity in responsible AI.
- Encourage the activities of non-state actors in responsible AI.
- Development of standards for responsible public procurement of the AI.

- For Arab not ranked countries on GIRAI:

- Include and encourage AI in its important sectors and in different fields.
- Adopt responsible AI at individual, organizational and national levels.
- Adopt responsible governance of AI, especially sub-components of GIRAI.

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