AN INDEPENDENT REVIEW OF THE UAE SCIENCE 2030 STRATEGIC FRAMEWORK

ANALYTICAL METHODS:

CRITICAL REVIEW

ASSESSMENT

1.0 OVERVIEW

This report has been commissioned to support the Ministry of Advanced Sciences' Analysis and Strategy team on the UAE Science 2030 strategic framework by offering insights on:

- challenges which could impact the quality of analysis work,
- required evidence from data analysis activities,
- an analytic process structure, and
- two additional pieces of analysis.

2.0 CONTEXT AND PURPOSE

In 50 years, the United Arab Emirates (UAE) has evolved from a region of individual states engaged in marine trading activities to a federation that has achieved significant development through its oil-based economy [1]. While the UAE has largely benefited from oil revenues, more recently, there has been a growing concern to diversify its economy and advance national development. Through science, the UAE seeks a sustainable means to lasting prosperity and security for both its citizens and residents. Thus, the UAE Science 2030 programme has been set up to support the government's ambitions.

The Ministry of Advanced Sciences contributes to economic development through scientific research across areas including materials science, medical and life sciences, and engineering. This report therefore assumes the following:

- the UAE has a breadth of scientific research capabilities which are being and have been leveraged to grow multiple sectors of its economy,
- the quest to create new pathways for national development suggests a desire to reduce reliance on oil resources, and
- its willingness to explore more dynamic ways of working suggests the government could adopt forward-looking analytic methods in developing the UAE Science 2030 strategic framework.

The UAE Science 2030 strategic framework report thus purposes to outline the ways in which the UAE Science 2030 programme could use science policy to facilitate national development, by highlighting likely challenges and opportunities to be resolved and exploited respectively. This development is also targeted to occur within the next 10 years.

Tight project timelines suggest a need for proactive analytic tools to address possible barriers to the quality of analysis activities. The period between receiving the bibliometrics report from Elsevier (end of April) and completing all data analysis (15 June 2021) may impact the timely synthesis of all analysed data for inclusion in the final report due by 31 July 2021. Additionally, with the month-long Ramadan anticipated to end by mid-May 2021 [2], fewer working hours would be observed in the UAE [3] further contracting planned timelines. COVID-19 lockdown situations that may arise could also contribute to poor data quality by preventing some data collection activities from occurring. Accordingly, planning for analysis activities needs to incorporate these challenges.

3.0 EVIDENCE REQUIREMENTS

Given the stated context and purpose, the research questions articulating how science policy would enable the UAE to attain its goal of national development which would inform the team's data collection and analysis activities are:

- **Research Question 1 (RQ1):** What investments should the UAE undertake to bridge existing gaps in its science policy domain that would enable it to achieve sustainable national development by 2030?
  Evidence the team needs to produce to address RQ1 includes issues and needs obtained from experts comprising academia, the UAE scientific community and industry stakeholders. These inputs help further contextualise and set the direction for the UAE Science 2030 strategic framework.

- **Research Question 2 (RQ2):** Why has science policy been beneficial to industry sectors in the UAE?
- **Research Question 3 (RQ3):** Why is science policy beneficial to industry sectors in the UAE?
  These require evidence that shows the effects of science policy on industry sectors of the UAE. Suggested evidence types to understand these effects are trends which indicate specific sectors that have benefited from the use of science overtime, and external constraints which impose limits on the UAE's science policy system [4]. For example, tracking and measuring trends in the UAE's manufacturing industry which has recently experienced growth [5] would provide insights on specific sub-sectors that have the greatest development potential from increased use of scientific research. While external constraints would explain how regulatory requirements impede the incorporation of scientific knowledge in the UAE's industry sectors to spur development.

- **Research Question 4 (RQ4):** Compared to other regions – within the Gulf and beyond, how would the UAE's capabilities in advanced sciences research enable it to drive the use of science policy for national development?
  For RQ4, the team should generate evidence highlighting actions the UAE must take to address existing gaps in its science policy domain. Options are an evidence type which would enable the prioritization of investment plans. For instance, to improve its talent capacity, the UAE could consider pathways that include improving the knowledge and skills of its local scientists or adjusting its immigration policies to attract highly skilled researchers from other climes. The bibliometrics report expected from Elsevier is also useful for providing evidence in the form of trends, highlighting research within and beyond the UAE. Combining both evidence pieces would enable the UAE to determine specific areas requiring investments.

Collectively, the suggested evidence types provide a structure to set the desired future for the Science 2030 strategic framework, understand the current UAE scientific landscape and how to use this knowledge to steer the framework towards the set direction. Trends from the bibliometrics analysis alongside issues and needs from stakeholder groups, would help focus resources on the areas most relevant to the UAE's science policy domain. Similarly, external constraints and trends gleaned from the industry sectors could determine options

available to the UAE for possible selection and implementation to close gaps in its science policy domain.

4.0 STRUCTURE OF ANALYTIC PROCESS

In view of the time constraints explained in section 2.0, it is recommended that the team complete the outlined activities below by the suggested completion dates. Dates are based on five-day working weeks, each comprising seven hours, amounting to 35-hour working weeks. It is assumed that the team has finalised initial planning activities which include setup of office location, acquisition of collaboration tools to schedule virtual meetings considering COVID-19, and assignment of team roles and responsibilities.

Table 1: Activity schedule

ACTIVITY	DESCRIPTION	START DATE	COMPLETION DATE
Initiation meeting	Project initiation meeting between analyst and A&S team to confirm and agree scope and deliverables.	11 February 2021	11 February 2021
Plan data collection and analyses	Map data collection and analysis tasks required for the strategic framework: ▪ Identification of data sources and stakeholders ▪ Inclusion of the two additional analysis pieces ▪ Selection of analytic methods ▪ Developing coding scheme for reducing qualitative data ▪ Setup of data storage facility	14 February 2021	18 February 2021
Collect and prepare data[i]	▪ Collecting data from identified data sources (includes organising workshops with stakeholders, obtaining data from online sources etc). ▪ Cleansing data and reducing qualitative data into a more digestible format using the agreed coding scheme.	21 February 2021	20 May 2021
Analyse bibliometrics report findings[ii]	Extract and analyse findings from bibliometrics report.	2 May 2021	6 May 2021
Analyse collected data	Apply analytic methods to collected data to derive insights.	23 May 2021	17 June 2021

[i] This activity is planned for 10 weeks, however weekly work hours are reduced to 25 hours during Ramadan which is expected to begin on 12 April and end on 12 May, with a five-day national holiday. The dates have been adjusted accordingly to accommodate the reduced hours and national holiday, which is tentatively fixed for 11 – 15 May [6].

[ii] As the bibliometrics report is expected by the end of April, data collection and preparation would be paused to enable the team to analyse its contents. Data collection and preparation tasks would resume fully the week of 16 May (after the national holiday).

Table 1: Activity schedule

ACTIVITY	DESCRIPTION	START DATE	COMPLETION DATE
Conclude data analyses	▪ Finalise analyses work ▪ Harmonise results of the data analyses with bibliometrics findings	20 June 2021	24 June 2021
Initial documentation and review of report	Complete first draft of report for review and discussion within team.	27 June 2021	15 July 2021
Final documentation and review of report	Update report for final review before submission.	18 July 2021	28 July 2021
Communicate UAE Science 2030 strategic framework report	Present finalised report to Minister.	11 February 2021	29 July 2021

The following data sources are suggested to enable the team to address the research questions in section 3.0:

Table 2: Data sources

S/n	EVIDENCE TYPE	DATA SOURCE	RATIONALE
1	Set direction for UAE Science 2030	Human (focus groups **–** from academia, industry, and other ministries)	Provides input on a diverse range of issues experienced by stakeholder groups related to the use of science in industry.
2	Understand current and future behaviour	Digital (database scanning & web alerts subscriptions)	Provides intelligence useful for identifying science policy trends and their underlying drivers within and beyond the UAE.
		Human (focus groups **–** from academia, industry, and other ministries)	Provides input on external constraints experienced by stakeholder groups related to the use of science in industry.
		Text-based (existing policies and industry analysis reports)	Access to trends and external constraints experienced by stakeholder groups in the science community and industry.
3	Develop options	Outputs from 1 and 2 above	Feedback obtained from 1 and 2 include perspectives of the future, and internal and external factors that may impede or facilitate the UAE Science 2030 are all useful for generating options.

Considering its strategic importance, the team is further advised to consider the following mitigating measures against failure of the framework development project:

- Create a register for project risks and mitigating controls. The register should be constantly monitored and updated. A typical risk could be project overrun due to time lags imposed by the Ramadan period. The corresponding control would be to avoid using iterative analytic methods like Delphi surveys.
- Implement an escalation process for communicating challenges to designated senior ministry officials to facilitate their resolution and prevent project delays.
- Involve diverse stakeholders to ensure a wide range of perspectives is represented during data collection.
- Communicate the benefits of a shared future i.e. national development through science, early to stakeholders, to ensure richness of data collected.
- Define clear procedures and templates for requesting budgetary allocations prior to commencing the analytic process, to ensure expenses are traceable and auditable.
- Validate elicited data across data sources, to strengthen the quality of analysed data to produce credible findings.
- Given time constraints, automate data collection and analysis using analytic software where applicable, to ensure procedures and results are repeatable and reproducible.

The bibliometrics report gives a current state assessment of the UAE's scientific research capabilities by identifying its strengths, gaps, and opportunities. It provides details of scientific research trends and collaborations in and beyond the UAE [7]. Creating visual representations with visualisation software would also enable the team to quickly spot patterns and relationships in the data that offer insights to facilitate decision-making [8]. For instance, emerging trends observed in the bibliometrics combined with evidence from other data sources could guide the Minister of State in answering RQ4, i.e. the investments required to bridge the UAE's science policy gaps.

5.0 SUPPLEMENTARY ANALYSIS

5.1 IDENTIFICATION OF DISRUPTORS

Evidence indicating black swan events that could hinder the UAE Science 2030 framework from being achieved should be generated. Identifying disruptors is a means of preparing for uncertainties of the future which in turn enables the team to produce a range of options. It also suggests a forward-looking position in that the team would also be able to assess the framework's resilience by simulating different scenarios using these events. Patent maps are a useful data source as they contain patent information on scientific advances and technological innovations. Access to this information would aid the UAE in spotting potential competition and/or opportunities relevant to the strategic framework [9]. Alternatively, the team could use the bibliometrics analysis or leverage focus group sessions as a data source.

The drivers of change mapping and wildcards methods are recommended to analyse data obtained from patent mapping, bibliometrics or focus group activities. Drivers of change mapping is useful for surfacing and understanding underlying drivers that could lead to disruptive events. Identified trends and drivers are ranked by impact and uncertainty on a four-quadrant axes. Items that are both high impact and high uncertainty are selected for

further analysis. Wildcards could then be used to simulate 'what-if' analysis on scenarios that assume these selected trends and drivers.

There are however certain biases the team needs to be aware of in conducting these analyses. First, participatory workshops like focus groups are susceptible to the moderator inserting their own biases which may reinforce group think during deliberation and data collection. Second, patent mapping may be subject to inherent bias by the analyst in designing the data collection protocol, thus skewing the results to suit a narrow perspective [10]. In countering these biases and to ensure the quality of analysis is not compromised, data collected from these sources should be validated by triangulating them with the other available data sources cited in this report.

5.2 DISCOVERING PATHWAYS

The team should perform analysis that produces pathway evidence. With the assumption that the UAE would rely less on its oil revenues in the coming years, pathways present a way of exploring alternate means of advancing economic growth. Given the limited timeframe of the project, it is suggested that the team leverage data generated during focus group sessions, the bibliometrics analysis and intelligence gathered through the web alert subscriptions suggested in section 4.0. As an alternative data source however, news articles may provide some insights or signals relevant to developing pathways.

Recommended analytic methods are morphological analysis and the SWOT (strengths, weaknesses, opportunities and threats) technique. Morphological analysis helps in generating possible alternatives for a multi-dimensional, non-quantifiable problem such as the UAE Science 2030 programme [11]. It involves creating parameters based on the general context of the framework, then defining and assigning multiple options into each of the parameters. The parameters should range between five and eight, while as many options as are allowable within project timelines should be produced. Next, the team should identify compatible options across the set parameters, combine them and then select possible solutions from these for further scrutiny. The SWOT technique could be used to unearth insights into the characteristics of these options, which are in turn useful for understanding their viability as well as any required trade-offs.

The team should also be aware of biases while performing these analyses. As previously stated, focus groups can be influenced by the moderator's bias which may result in poor quality evidence being produced. Additionally, data analysed with the SWOT technique may be subject to biases embedded in its source (for example, news articles from popular publications) [12]. Likewise, using the SWOT technique may lead to analysts accumulating a laundry list of items that are neither prioritized nor ordered in any definitive manner [13]. To resolve these biases and preserve the quality of the analysis process, the team could consider using computer aided morphological analysis to ensure reproducibility of the analysis and more rigorous generation of options [14]. Finally, output from the SWOT analysis should be combined with other evidence types generated during the project to strengthen the pathways exploration process.

6.0 REFERENCES

1. Economy of the UAE: from a sandy desert into a global phenomenon [Internet]. [cited 2021 Mar 13]. Available from: https://capital.com/economy-of-the-uae

2. Ramadan 2021 begins in April with 14 hours of fasting in UAE [Internet]. [cited 2021 Mar 14]. Available from: https://gulfnews.com/uae/ramadan-2021-begins-in-april-with-14-hours-of-fasting-in-uae-1.1614675735852

3. Working hours - The Official Portal of the UAE Government [Internet]. [cited 2021 Mar 14]. Available from: https://u.ae/en/information-and-services/jobs/working-hours

4. Focus on Human Intellectual Capital. :28.

5. UAE economic outline - Santandertrade.com [Internet]. [cited 2021 Mar 20]. Available from: https://santandertrade.com/en/portal/analyse-markets/united-arab-emirates/economic-outline

6. UAE Public Holidays 2021 [Internet]. PublicHolidays.ae. [cited 2021 Mar 22]. Available from: https://publicholidays.ae/2021-dates/

7. chuihsia. Bibliometric analysis and its application to evidence mapping [Internet]. Campbell Collaboration. [cited 2021 Mar 21]. Available from: https://www.campbellcollaboration.org/blog/bibliometric-analysis-and-evidence-mapping.html

8. Waltman L, Noyons E. Bibliometrics for Research Management and Research Evaluation. :28.

9. Patent mapping [Internet]. [cited 2021 Mar 24]. Available from: http://sphhp.buffalo.edu/cat/kt4tt/best-practices/need-to-knowledge-ntk-model/ntk-commercial-devices/master-list-of-tools/business-tools/patent-mapping.html

10. Blanchard A. Understanding and customizing stopword lists for enhanced patent mapping. World Pat Inf. 2007 Dec 1;29(4):308–16.

11. General Morphological Analysis [Internet]. [cited 2021 Mar 25]. Available from: http://www.swemorph.com/ma.html

12. Murzinov A, Zhubreva T. Methodical Errors of the SWOT-Analysis in Applied Research. Nikulchev E, Bubnov G, editors. ITM Web Conf. 2017;10:03005.

13. Clardy A. Strengths vs. Strong Position: Rethinking the Nature of SWOT Analysis. 2013;1(1):23.

14. Morphological Analysis - Mycoted [Internet]. [cited 2021 Mar 26]. Available from: https://www.mycoted.com/Morphological_Analysis

Cover Page Image Credit

Hope Probe sends back first photo of Mars since entering orbit [Internet]. ArabianBusiness.com. [cited 2021 Mar 14]. Available from: https://www.arabianbusiness.com/technology/458714-hope-probe-sends-back-first-photo-of-mars-since-entering-orbit