Saudi Arabia
Centre for the
Fourth Industrial
Revolution

Quantum Economy Project
2nd Workshop Report

25 April 2024, 9:30 am -03:00pm (KSA time)

Contents

1 Executive Summary

Quantum Economy Blueprint (QEB) is a comprehensive plan for the future of quantum technology, bringing together researchers, businesses, and policymakers. In line with the QEB's vision, the Centre for fourth Industrial revaluation (C4IR KSA) Quantum Economy Project aims to elevate the Kingdom's position in the global quantum technology landscape.

The objective of the workshop is to gain a holistic understanding of the QEB's core values and building blocks, explore effective localization strategies, and identify the optimal governance model for complete, equitable adoption and transparent decision-making. To guide the implementation of the QEB's themes, we proposed to group these themes (and the building blocks within each theme) to four workstreams namely Foundation, Innovation and Ecosystem Growth, Responsible Use and Societal Benefits. This structure will help define clear objectives and deliverables, forming the foundation for a national quantum strategy. Furthermore, stakeholders mapping and collaborative structures are essential to be set to ensure that the proposed workstreams are functional.

In the second workshop, the round table discussion on adopting the Quantum Economy Blueprint nationally brought together key stakeholders to address various aspects necessary for the successful implementation of the blueprint. A number of key areas emerged perceived as being fundamental for the Kingdom as it moves forward in establishing a quantum ecosystem. First, establishing a national mandate and a dedicated quantum steering committee representing key stakeholders from government, the private sector, investors, and academia, is crucial. Second, resource allocation should focus on funding, talent, and infrastructure, leveraging government R&D funding, public-private partnerships, and international collaborations. Third, providing incentives for innovation and startups, attracting international expertise, fostering educational initiatives, and establishing a local specialized center, and infrastructure are key points for successful integration and growth. Fourth, there is a great need for widespread education and training programs to cultivate a skilled talent pool. International collaboration and resource leveraging are crucial for attracting expertise and capital. Finally, transparency and public engagement are key to the plan's success. Open access research, social media outreach, and educational initiatives such as podcasts and videos will help demystify quantum technology and its potential benefits.

2 Introduction

The World Economic Forum's Quantum Economy Blueprint (QEB) is an initiative designed to create a comprehensive roadmap for the quantum technology sector, encompassing academia, industry, and government. Drawing on best practices from leading nations, the blueprint aims to cultivate a robust quantum ecosystem equipped with the necessary tools for innovation and growth. The QEB's primary objective is to support regions and countries in developing and commercializing their quantum technology initiatives. It provides stakeholders with a clear framework to understand the essential components and strategies needed to build a quantum ecosystem, thereby accelerating the adoption of quantum technologies. This, in turn, is expected to create new jobs, enhance prosperity, and safeguard national security, business integrity, and citizens' privacy. Following the World Economic Forum's Quantum Computing Governance Principles, the QEB establishes foundational principles for the responsible design and adoption of quantum technologies, ensuring that advancements are beneficial and equitable for society as shown in Figure 1.

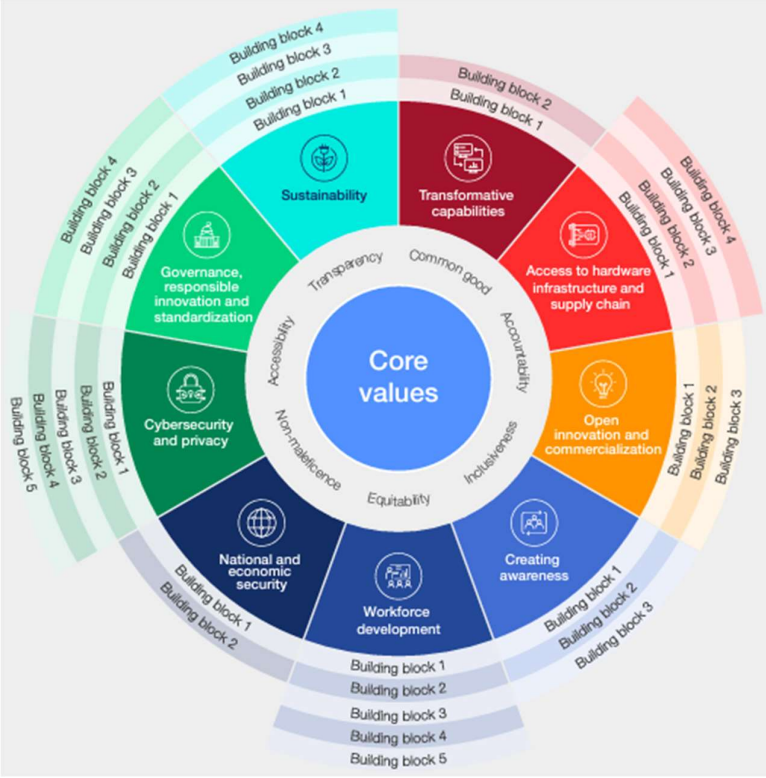

Figure 1: QEB core values and themes, Quantum Economy Blueprint, Insight report, Jan. 2024

Aligned with the QEB, the C4IR Saudi Arabia Quantum Economy Project aims to enhance the quantum technology landscape in the Kingdom of Saudi Arabia (KSA). The project's objectives are to:

- Develop a roadmap to serve as a foundational input for a national quantum strategy.
- Conduct a thorough analysis with project multi-stakeholders to identify national priorities and opportunities for quantum technology development and deployment.
- Build a multi-stakeholder project community to enhance knowledge sharing and accelerate strategic goals by establishing focused working groups.
- Co-develop and implement a campaign to raise awareness among the public and decision-makers about the potential and advantages of quantum technologies.

2.1 Summary of the First Workshop

The first Quantum Economy Workshop, held on February 6th, marked a pivotal step in exploring the transformative potential of quantum technologies for Saudi Arabia. This workshop brought together experts and stakeholders to discuss how these emerging technologies could impact various sectors and outline Saudi Arabia's strategic role in the global quantum landscape. The sessions focused on identifying opportunities, addressing challenges, and setting a course for national advancement in the quantum economy.

In the first workshop, the current state of quantum technology in KSA was thoroughly evaluated, identifying key opportunities, risks, driving forces, and primary stakeholders. This analysis highlighted the potential benefits and challenges of KSA in adopting a pilot role within the QEB network. A major focus was on the need to establish a community to effectively shape the localization and governance of quantum technologies. This involves aligning KSA's efforts with the QEB to foster a collaborative environment that supports the responsible design and adoption of these technologies. Clear decision-making processes, communication channels, and methods for monitoring and evaluation are essential to ensure the blueprint's successful implementation.

The analysis underscored the potential benefits and challenges of KSA adopting a pilot role within the Quantum Economy Blueprint network. This role is critical, as it shapes the strategic approach to enhancing KSA's quantum capabilities in alignment with global best practices.

3 The Second Workshop for Quantum Economy Project

The second workshop for the Quantum Economy Project built on the outcomes of the first workshop. This session aimed to further localize the Quantum Economy Blueprint by developing clear implementation plans, defining robust governance structures, and solidifying commitments from all stakeholders. The workshop enhanced the QEB's application through the identification of dedicated stakeholders, the formulation of detailed plans, and the assignment of specific responsibilities. A major focus was on refining the governance structure to provide a strong framework for managing the integration and growth of quantum technologies within national strategies. (Please refer to Appendix A for the Agenda of the workshop).

The main objectives of this workshop are:

- Gain a comprehensive understanding of the core values and building blocks of the QEB, informed by prior experiences and insights.
- Explore how to effectively localize the blueprint and determine the essential elements required for its successful implementation.
- Identify the most suitable governance model that ensures the complete and equitable adoption of the blueprint, fostering a transparent and effective decision-making process.

3.1 Proposed workstreams and mapping of stakeholders

To facilitate the governance and responsibilities of adopting each theme of QEB, the proposed workstreams are structured to group these themes (and hence building blocks in each theme) to build objectives and outputs to serve as a foundational input for a national quantum strategy. For the comprehensive list of building blocks, World Economic Forum's Quantum Economy Blueprint paper is referred to. The proposed groups are illustrated as follows:

Workstream [1]	Themes from the WEF QEB	Building Blocks (BB)
Workstream 1 Building Foundation *(This workstream focuses on identifying missing foundational elements necessary for a thriving quantum economy in quantum talent and essential infrastructure)*	• Workforce development • Access to hardware infrastructure and supply chain.	BB 2.1 BB 2.2 BB 2.3 BB 2.4 BB 5.1 BB 5.2 BB 5.3 BB 5.4

		BB 5.5
Workstream 2 Fostering Innovation and Ecosystem Growth *(This workstream focuses on technology transfer and facilitating the growth of a robust quantum ecosystem)*	• Open innovation and commercialization	BB 3.1 BB 3.2 BB 3.3 BB 3.4
Workstream 3 Ensuring Responsible Use *(This workstream focuses on addressing the responsible development of quantum technologies, ensuring ethical considerations and security)*	• Governance • Responsible innovation and standardization • Cyber security and privacy • National and economic security	BB 6.1 BB 6.2 BB 7.1 BB 7.2 BB 7.3 BB 7.4 BB 8.1 BB 8.2 BB 8.3 BB 8.4
Workstream 4 Unlocking Societal Benefits *(This workstream emphasizes on creating awareness and social benefits on the long-term)*	• Creating awareness • Sustainability	BB 4.1 BB 4.2 BB 4.3 BB 9.1 BB 9.2 BB 9.3 BB 9.4

[1] The selection of workstream member entities is ongoing. Official letters will be issued once appointments are finalized.

3.2 Roundtable Discussions

The first session was focused on “localizing" the quantum economy for Saudi Arabia, specifically, the national requirements, actions, and resource allocation. In addition, the discussion identified way of commitments to build a strong local quantum ecosystem and ensure the nation benefits from this transformative technology. In the second session, the discussion focused on the governing aspects of the localized quantum economy blueprint implementation. The specific implementation includes responsibility, authority, and how progress will be measured. Also, clear communication strategies for a successful quantum future were highlighted. The following sections identify the key highlights that emerged.

3.2.1 The requirements to adopt the Quantum Economy Blueprint nationally

- Establishment of a coordinated approach involving both formal and informal institutions.
- Adaptation of the blueprint to the local context and transformation into actionable projects with a robust governance model.
- Implementation of effective progress and resource monitoring, with clear objectives and direction for the national vision.
- Promotion of widespread educational efforts on quantum technologies to ensure impactful benefits for individuals and businesses.
- Fostering leadership by researchers collaborating with entrepreneurs to drive policy-driven entrepreneurship.

3.2.2 Stakeholders mapping

Workstream	Proposed Stakeholders
Workstream 1: Building Foundation	• Research Development and Innovation Authority (RDIA) and King Fahd University for Petroleum and Minerals (KFUPM) have a leading role in workforce development and infrastructure access. • Ministry of Communication and Information Technology (MCIT) and King Abdulaziz City for Science and Technology (KACST) and other academic institutions have integral roles in the development of quantum technology, infrastructure and applications.
Workstream 2: Fostering Innovation and Ecosystem Growth	• Aramco and KACST to lead roles in technology transfer and ecosystem growth. • PIF to target investments resilient to quantum technology disruptions or poised to benefit from its growth, including Helium and other key quantum technologies resources. • Saudi Telecom Company (stc), to integrate industrial and financial support to scale up quantum technology development.
Workstream 3: Ensuring Responsible Use	• MCIT plays a central role in governance, innovation, and standardization for quantum technologies. • National Cybersecurity Authority (NCA) to align the cybersecurity strategy with post-quantum threat.

	• Specific roles for Saudi Arabian Monetary Authority (SAMA) and stc in the financial and telecom sectors for cyber-risks, national priorities and regulations and standardization.
Workstream 4: Unlocking Societal Benefits	• The Centre for Fourth Industrial Revolution (C4IR Saudi Arabia) drives awareness through campaigns, society building and the uplink challenge for sustainability. • Academic and research institutes outreach programs are key for creating societal awareness and fostering sustainability. • Saudi Arabian Innovation Lab (SAIL) encourages startups to innovate and produce products that meet market needs, enhancing technology adoption and societal impact.

3.2.3 From blueprint goals to actionable steps

- Talent development through establishing dedicated training centres for quantum technologies to develop skilled talent capable of navigating this complex field.
- Addressing educational gaps by empowering universities, enhancing educational programs, and building an ecosystem that supports research and development.
- Promoting financial and international collaboration through the international exchange of talent and capital to support Saudi Arabia's ambitions in quantum technologies.
- Leveraging international partnerships and external capital, rather than relying solely on the local ecosystem.

3.2.4 Commitments for integration

- Establishment of a national mandate and a dedicated quantum steering committee representing key stakeholders from government entities, defense, private sector and academia.
- Creation of a collaborative ecosystem that unites efforts across sectors to drive quantum initiatives forward.
- Strategic, long-term investment in R&D, focusing on deepening specialization within existing academic programs and research groups.
- Integration of quantum technologies into Saudi Arabia’s broader strategic goals, including the National Digital Economy Strategy.
- Development of a conducive environment for quantum technologies through initiatives like local quantum clouds, a quantum center, and enhanced access to quantum computing resources.

- Enhancement of interaction among all stakeholders, including the defense and private sectors, to overcome traditional barriers and foster an innovative culture.
- Prioritization of depth over breadth in educational and research programs to build the necessary expertise and infrastructure for a sustainable quantum future in the Kingdom.

3.2.5 Optimizing resources

To achieve the goals of the blueprint, the resources of quantum technology (funding, talent, and infrastructure) have to be efficiently allocated and utilized as indicated below:

Funding Allocation:

- Leveraging government R&D funding and enhancing Public-Private Partnerships alongside private sector contributions.
- Promoting international collaborations and investments to expand impact.
- Implementing efficient resource use through clear priorities and proposals-based funding.
- Providing incentives, grants, and incubators to foster innovation and support startups.
- Focusing on sector prioritization, lighthouse projects, and a center of excellence to demonstrate and scale successful outcomes.

Talent Allocation:

- Attracting international talent to enhance local expertise and fostering partnerships with globally recognized education centers
- Focusing on educational programs targeting mid to high school levels and integrating quantum technology specializations at universities and research institutes.
- Promoting professional development through continuous education courses and multidisciplinary programs.

Infrastructure Allocation:

- Establishing foundational components such as a local quantum cloud and a specialized quantum center.
- Implementing a long-term strategy that aligns with short-term goals, ensuring broad access to quantum infrastructure for startups, businesses, and educational institutions.
- Engaging in international collaborations to build or enhance supply chain components (e.g., cryogens).
- Developing a hybrid supercomputing infrastructure with quantum capabilities.
- Enhancing national research infrastructure for micro and nanofabrication for quantum material and quantum devices.
- Prioritizing focus areas based on specific use cases to allocate resources effectively.
- Removing barriers to quantum cloud access and ensuring data privacy.
- Establishing national a center with specialized labs across universities.

3.2.6 Decision authority and key decision making

- Setting up a collaborative structure with focused groups of key stakeholders from government, academia, and the private sector. This will also foster international collaborations to enhance the national quantum ecosystem.
- The collaborative structure will be led by a central entity with specific, measurable goals to monitor progress and ensure coherence, direction, and effective and efficient resource allocation.
- Adoption of a bottom-up strategy where universities and a research center lead in research, development, and proof of concepts, integrating national security concerns from the outset.

3.2.7 Blueprint progress communication strategy

- Utilization of various communication channels, including social media, forums, meetings, and public outreach programs, to ensure transparency and engagement.
- Creation of engaging content such as podcasts, short videos, and expert interviews to demystify quantum technology and its applications.
- Implementation of networking and community-building efforts, such as round tables with leaders and forums, to provide an interactive platform for updates and collaboration.
- Launch of the Quantum Economy Network spaces by C4IR Saudi Arabia to foster communication and collaboration among stakeholders from different sectors.
- Enhancement of visibility and understanding of the blueprint's implementation through dedicated spaces for quantum discussions.

4 Open Q&A with the WEF

To seize the opportunity of hosting Arunima Sarkar, the Thematic Lead of Quantum Technologies representative from the WEF, an open Q&A session was held. Questions and responses are indicated below:

- **How is the World Economic Forum ensuring that the underlying technologies for quantum technologies remain open and freely accessible across countries, despite geopolitical influences?**

The World Economic Forum, through its Centre for the Fourth Industrial Revolution (C4IR), has been working on responsible governance and been a key theme in the Quantum Computing governance principles released by the Forum. Access to quantum hardware and infrastructure as well as access to the information on quantum technologies has been a key theme of the quantum economy blueprint. The blueprint recommends the ecosystem to ensure equitable access to the technology and its benefits. There are several Forum initiatives in foundational areas like digital inclusion and inclusive AI that have set the groundwork in this space. The WEF`s global C4IR Network, with Centres in various regions, helps advance the development and access to these 4IR technologies through various initiatives. There is global experience gained from initiatives such as the Edison Alliance for digital inclusion which helps informs the approach to ensuring that technologies are accessible and shared responsibly across countries.

- **How do you ensure countries are open to adopting your quantum policy framework, given the national security concerns and varying approaches of different countries?**

The WEF ensures countries are open to adopting its quantum policy framework by creating broad, flexible frameworks that can be adapted to various national and regional contexts. These frameworks are developed with global expert involvement and are tested through workshops and discussions when being implemented at national level. Quoting an example, as seen in the collaboration with India’s NITI Aayog in the co-design and development of India's National Responsible AI Strategy. The Forum brings in global expertise and facilitates informal government-to-government discussions and consultations, but the final decision-making lies with the respective national or regional authorities. This approach allows for customization while benefiting from global best practices.

- **How many countries have a common global sharing strategy for quantum programs to co-develop technologies, and how do they collaborate?**

Several countries with national quantum programs, such as United Kingdom , Denmark, Netherlands, Singapore, Australia work closely with the World Economic Forum's Quantum Economy Network. While these countries have their own national quantum initiatives, they share their experiences, learnings and best practices with the Forum and prioritize international collaboration within their programs. The Forum’s network of 20 affiliate C4IR centers collaborate closely across the C4IR technology thematic areas and provide a network for sharing, testing and scaling the adoption of 4IR technologies. In

Quantum technologies, bilateral relations and regional collaborations are emerging, and the Forum's Quantum Economy Network provides the first global platform for collaboration across nations and enabling it as integral component of national quantum strategies.

5 Moving forward

As we are shifting gears to the real implementation of QEB, four workstreams (found in 3.1 3.1) are proposed, where each workstream will have responsibility for localizing and implementing the associated themes. In each workstream, it is proposed that a main stream-leader/s that will be leading, together with the Centre, the associated activities. After identifying the remaining stakeholders of the workstreams with the leaders, a series of roundtable workshops will be undertaken to discuss the scope and implementation of the building blocks within each workstream in detail. It is important to note that considering the length of the quantum economy project and the maturity level of the quantum strategy, not all of the building blocks might be considered initially.

Therefore, the implementation framework will be structured as follows:

- A steering committee consisting of representatives from government, industry, and academia will be established to provide strategic oversight and guidance.
- Each workstream will be strategically formed under the direction of this steering committee to concentrate on specific themes from the QEB for targeted and effective implementation.
- Leaders will be appointed for each workstream to guide activities in close collaboration with the Centre.
- A series of roundtable workshops will be conducted to discuss and define the scope and detailed implementation of the building blocks after identifying the stakeholders for each workstream.
- Detailed research and analysis will commence based on the identified building blocks for each workstream to effectively adapt the strategy to national needs.

6 Appendices

Appendix A: 2nd workshop agenda

Agenda of the inaugural Quantum Economy Workshop		
09:30 – 10:00	Arrival and welcome coffee	
10:00 – 10:10	Summary of 1st Workshop and Quantum Economy Project Scoping	*Dr. Saad Alowayyed, Quantum Economy project lead*
10:10 – 10:30	Quantum Economy Blueprint	*Arunima Sarkar, Thematic Lead, Quantum Technologies, World Economic Forum*
10:30 – 10:45	Current Efforts in Saudi Arabia	*Aramco (Muhammad Al-Saiyari), MCIT (Hani AlHemsi), KFUPM (Dr. Muhamad Felemban), KACST (Dr. Saad Alowayyed)*
10:45 – 10:55	Coffee Break	
10:55 – 12:05	Session 1— Quantum Economy Blueprint Localization (Discussion)	*Moderator: Muhammad Al-Saiyari, Aramco*
12:05 – 13:00	Lunch & Prayer Break	
13:00 – 14:20	Session 2— Quantum Economy Blueprint Governance (Discussion)	*Moderator: Hani AlHemsi, MCIT*
14:20 – 14:30	Recap & Next Steps	*Dr. Saad Alowayyed, Quantum Economy project lead*
14:30 – 15:00	Networking and side discussions	

Appendix B: C4IR Saudi Arabia Team

- **Dr. Basma AlBuhairan,** *Managing Director*
- **Dr. Saad Alowayyed,** *Project Lead*
- **Layla AlQahtani,** *Project Fellow*
- **Dr. Adnan Alsaati,** *Advisor*
- **Mohammed Almohammadi,** *Part-Time Seconded Fellow*
- **Abdulmalik Alghonaim,** *Project Fellow*

Appendix C: Acknowledgments

MINISTRY OF COMMUNICATIONS AND INFORMATION TECHNOLOGY
وزارة الاقتصاد والتخطيط MINISTRY OF ECONOMY & PLANNING
National Industrial Development and Logistics Program
Saudi Central Bank
SDAIA
SIDF
SSA
aramco
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KACST
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Research Development and Innovation Authority
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