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Innovation Patterns – The UAE Case

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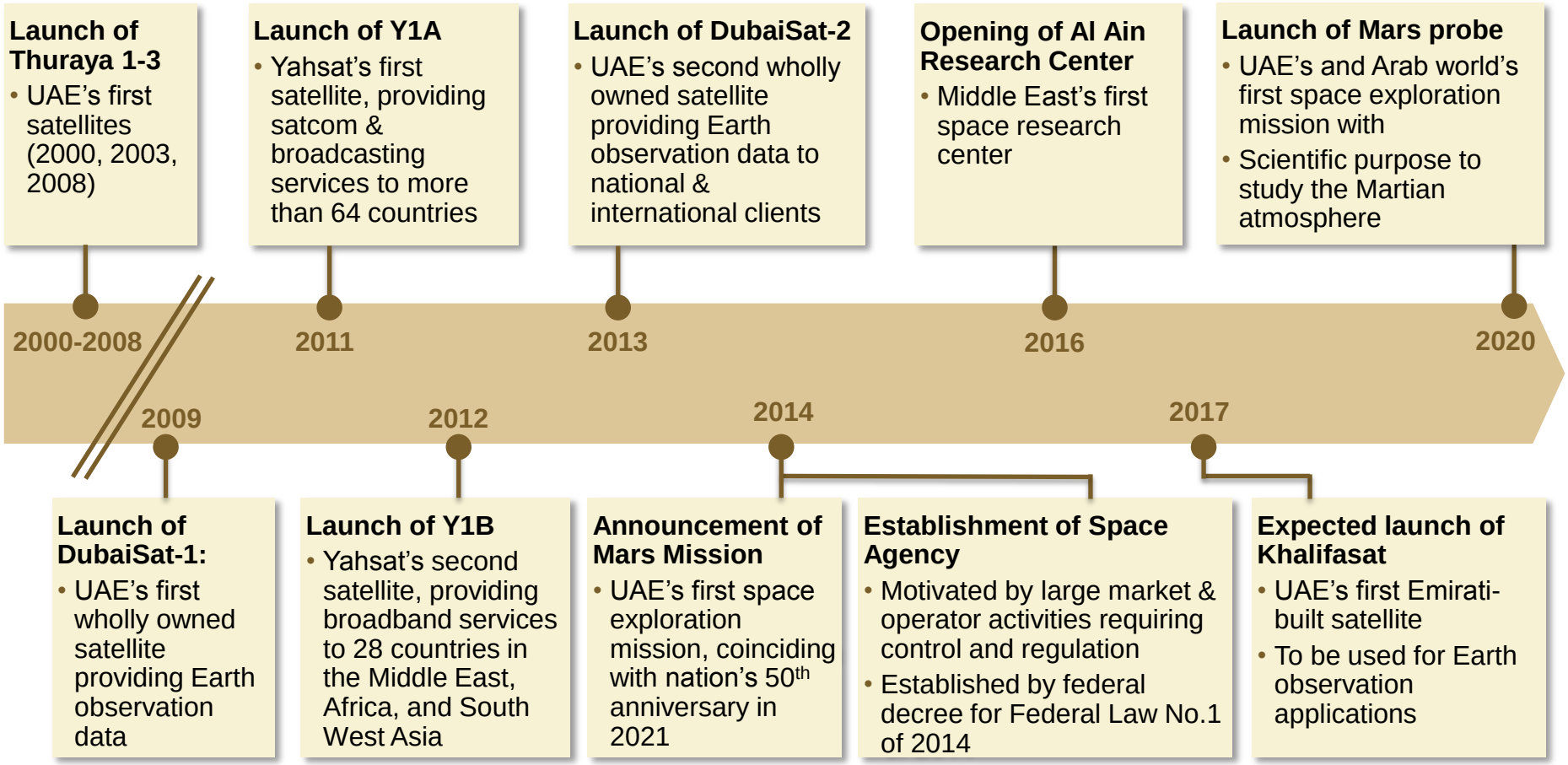
The UAE has carried out an extensive range of space activities since 2000 with ambitions set significantly higher for the future

History of UAE space activities



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The UAE Capabilities Baseline highlights multiple globally leading companies downstream and strengths in the enablers

Snapshot of selected UAE strengths

Value chain steps

UPSTREAM		DOWNSTREAM	
R&D	Manufacturing & AIT[1]	Ground Operations	Value Added Services
Establishment of new space center	Increasing Emirati involvement in spacecraft manufacturing	yahsat الياه سات **Global #7** in FSS THURAYA **Global #3** in MSS du Independent **teleport operator of the year[2]**	elseco **Global #1** in space insurance

Value chain enablers

Partnerships	Growing range of domestic and international partnerships
Human Capital	University STEM enrollment growing at 12%/year
Laws & Regulations	space(-related) activities likely to require approval from a relevant authority
Science, Technology & Innovation	increased amount of international patent applications in the last 3 years
Capital & Finance	Multiple space-relevant funding sources available
Facilities & Infrastructure	World Top 3 transport infrastructure

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UAE is currently carrying out four large scale initiatives that together span the entire value chain

Significant ongoing UAE space initiatives

UPSTREAM | **DOWNSTREAM**

R&D | **Manufacturing[1]** | **Ground Operations** | **Value Added Services**

Al Ain Space Centre

- Will act as first Space Research Centre in the Middle East
- Partnership between UAE Space Agency, UAE University and ICT Fund

Khalifasat

- First Emirati-developed satellite
- Satellite ground operations carried
- Will strengthen satellite imaging capabilities

Al-Yah 3

- Third Yahsat satellite
- To be launched in 2016
- Based on Orbital ATK's GEOStar-3 commercial communication satellite platform

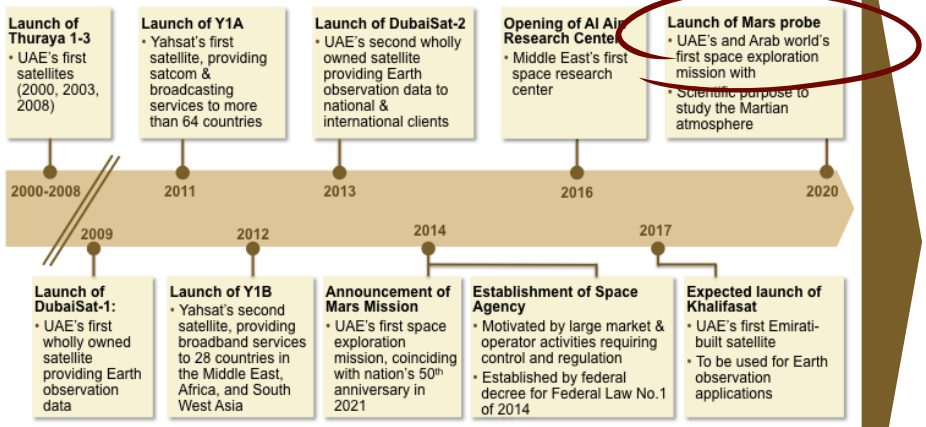
Emirates Mars Mission

- R&D in EO and planetary science data processing
- Manufacturing of probe
- Mission control
- Payload operations
- Scientific analysis of data

Not all nations having space related activities were able to upscale their space technological frontier ladder

What is the innovation pattern

.. Can not determine unless if we compare it with other countries and base on comparison criteria model.



.. Is the UAE making big jumps?

A technological frontier comparison ladder!

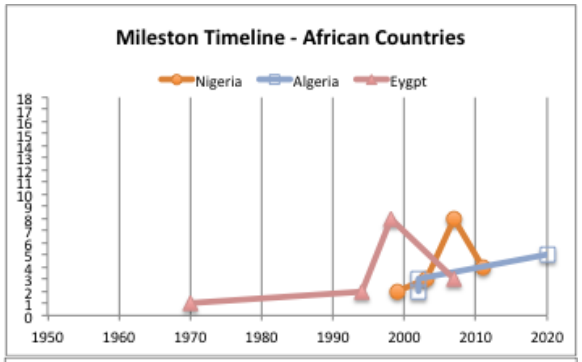
Complexity/Capabilities +

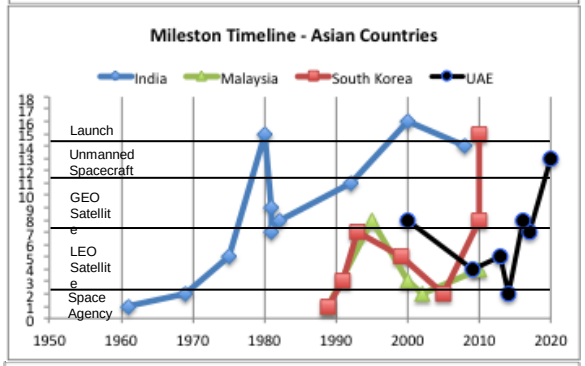
The Space Technology Ladder	
20	Crewed Exploration Spacecraft: Build Locally
19	Crewed Exploration Spacecraft: Build through Mutual International Collaboration
18	LEO/GEO Crewed Exploration Spacecraft: Build Locally
17	LEO/GEO Crewed Exploration Spacecraft: Build through Mutual International Collaboration
16	Launch Capability: Satellite to GEO
15	Launch Capability: Satellite to LEO
14	Uncrewed Exploration Spacecraft: Build Locally
13	Uncrewed Exploration Spacecraft: Build through Mutual International Collaboration
12	Uncrewed Exploration Spacecraft: Build Locally with Outside Assistance
11	GEO Satellite: Build Locally
10	GEO Satellite: Build through Mutual International Collaboration
9	GEO Satellite: Build Locally with Outside Assistance
8	GEO Satellite: Procure
7	LEO Satellite: Build Locally
6	LEO Satellite: Build through Mutual International Collaboration
5	LEO Satellite: Build Locally with Outside Assistance
4	LEO Satellite: Build with Support in Partner's Facility
3	LEO Satellite: Procure with Training Services
2	Space Agency: Establish Current Agency
1	Space Agency: Establish First National Space Office

Source: By K. Alhashmi modefied work of Wood and Weigel (2011)

Technological Innovation Patterns vs. accumulating capabilities

Space Technology Ladder





Technological Innovation patterns

- These countries followed unique approaches to gain and **accumulate capabilities**, innovate, produce new product, **'shifting'** national **technological frontier** and scale up along the STL
- None of these countries were able to make a '**big jump'** and built satellites locally without outside support to **transfer the know-how**.
- Although these countries attempted to accumulate capabilities through either building satellites with outside assistance or mutual international collaboration. India, South Korea, Brazil and UAE were succeeded and were able to build satellites locally.
- Interesting, South Korea within 15 years from its first achievement milestone, supported both UAE and Malaysia to transfer the know-how.
- The UAE was able to accumulate prerequisite capabilities to build satellite locally and other challenged with some issues.

The UAE Capabilities Baseline was developed using a structured approach for both the value chain capabilities and the enablers' status

Work process

UAE activities by value chain step

Identify relevant entities

- Regional and global company databases were filtered for UAE space sector activities
- Long-list was validated and adjusted based on desk research, and SME and Space Agency input

Identify activities and assets of each entity

- Information on activities, assets, financial data, and non-financial data was gathered using
  - Stakeholder survey
  - Stakeholder interviews
  - SME and Space Agency input
  - Desk research (company home pages, news media, industry organizations, etc.)

Consolidate, structure and analyze

- Data and findings on activities and assets were structured according to a pre-defined value chain
- Analysis of UAE strengths carried out on the combined activities and assets in the value chain steps

Status of enablers

Establish high-level status of each enabler

- Globally recognized indices measuring UAE performance on the enabler were used as a starting point (where available)
- Other relevant macro data was used where there was no relevant consolidated index available

Identify ongoing initiatives

- Information on ongoing initiatives was gathered, primarily using
  - SME and Space Agency input
  - Stakeholder surveys & interviews
  - Desk research (company home pages, news media, industry organizations, etc.)

Identify key strengths & challenges

- Gathered information was analyzed
- Analyses were reviewed and refined using SME and Space Agency input

UAE space R&D is government-driven and the level of government investments will set the scale of future activities

R&D: Executive summary

- Currently, MBRSC is the main space technology development center in the UAE and is aspiring to expand its R&D activities
- The UAE also has multiple academic entities conducting space R&D, with the most prominent being Masdar Institute, UAEU, and Khalifa University
- Space R&D activities in the UAE have a strong focus towards earth observation and remote sensing applications and areas directly related to the science data processing for the Mars mission
- Looking forward to launch space R&D activities in the newly established Al Ain Space Centre
- A space innovation working group is under establishment to bring in universities and space and related industry to cooperate and collaborate in development of space activities.

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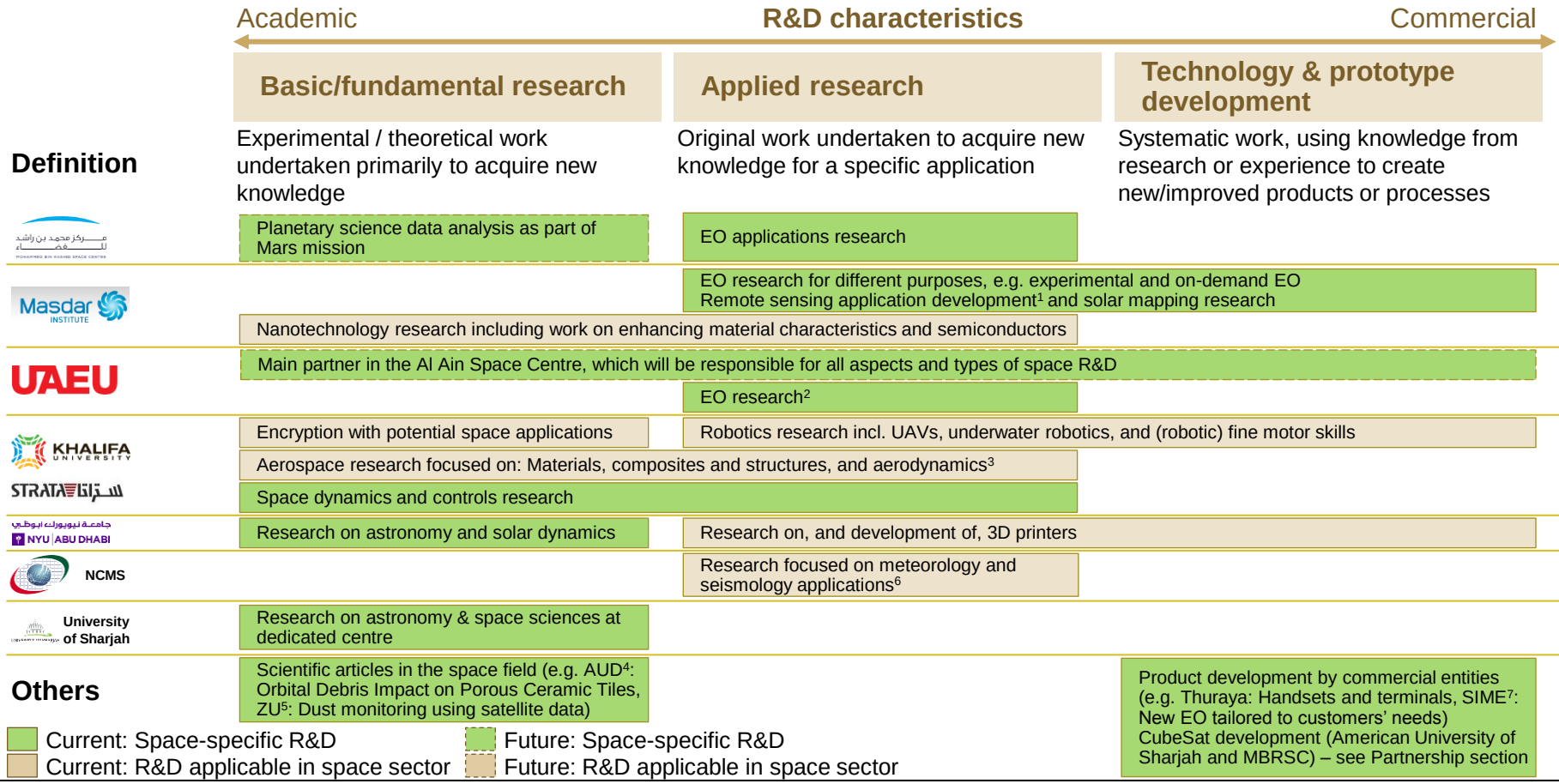
The wide range of space and space-related R&D activities drives innovations

R&D: Landscape



UAE space manufacturing & AIT is focused on two MBRSC initiatives and scale of future activities will depend on investments in follow-ups

Manufacturing & AIT: Executive summary

- UAE manufacturing and AIT[1] activities are focused on two government-funded flagship initiatives carried out by MBRSC:
  - Khalifasat, an earth observation satellite
  - Al Amal, the Mars mission probe
- In addition, several CubeSat manufacturing initiatives are carried out in public-private partnerships
- In the short term, the scale of future activities will depend on the government's potential plans for follow-up projects for Khalifasat and Al Amal

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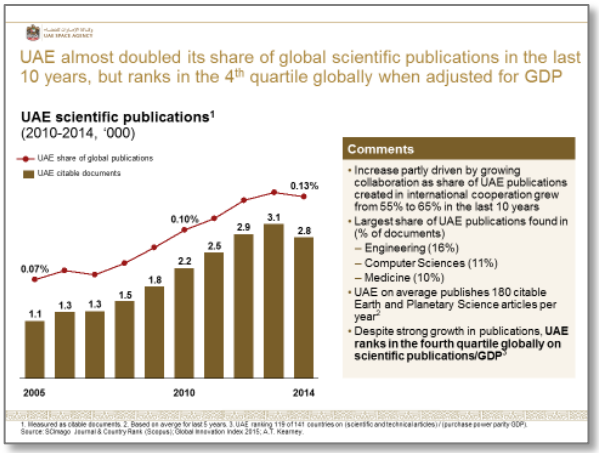
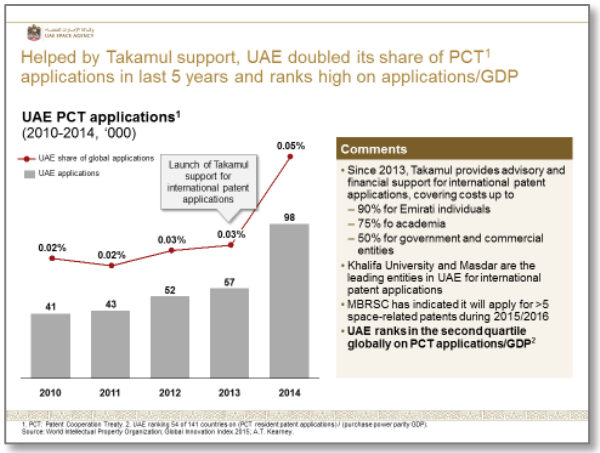
UAE is rapidly growing scientific publications and patent applications but fell in innovation ranking due to relatively weak innovation outputs

UAE Science, Technology, and Innovation: Status snapshot

1 Scientific publications



2 Patent applications



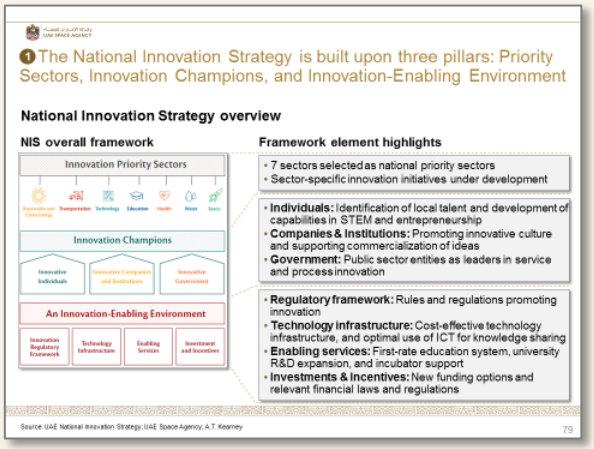
UAE **almost doubled** its share of global **scientific publications** in the last 10 years

UAE **doubled** its share of **patent applications** in last 5 years and ranks high on applications/GDP

UAE's NIS and Higher Policy for ST&I provide the framework and specifies the nation's large scale initiatives within ST&I

UAE Science, Technology, and Innovation: Main initiatives

① National Innovation Strategy

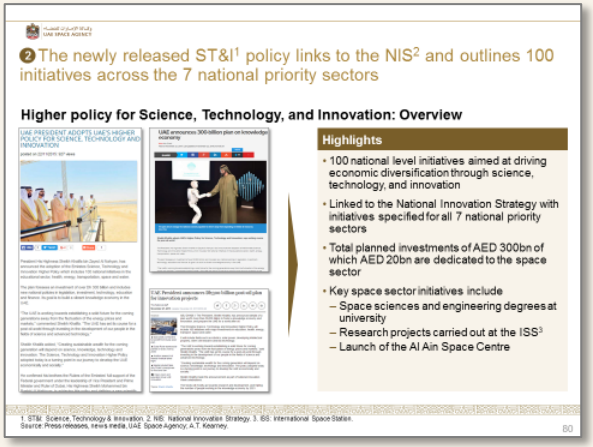


Holistic framework for UAE's innovation efforts that acts as a key tool to achieve Vision 2021

NIS is concretized by Higher Policy for ST&I

Higher Policy for ST&I is a tool to achieve NIS

② Higher Policy for ST&I



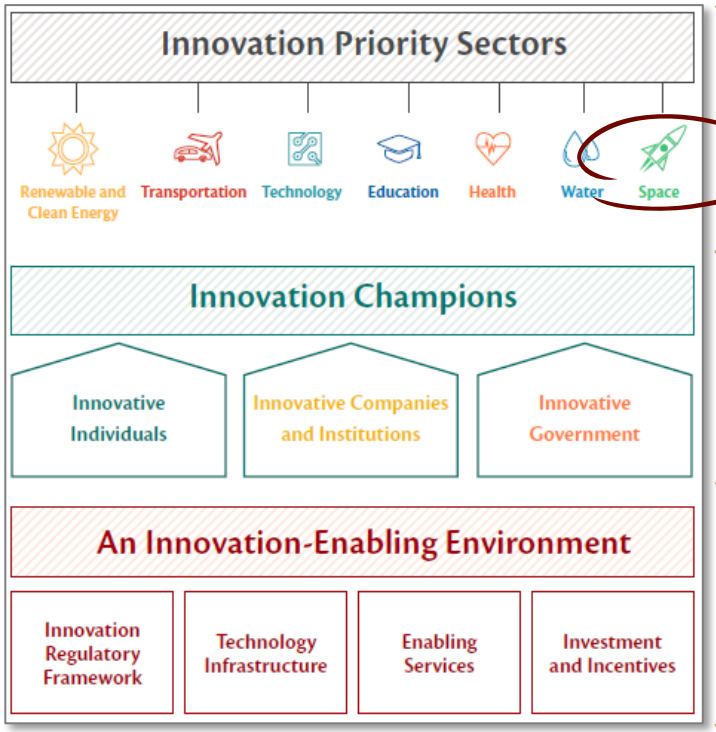
Set of initiatives with allocated investments spanning the priority sectors in the National Innovation Strategy

1. NIS: National Innovation Strategy. 2. ST&I: Science, Technology & Innovation.
Source: UAE National Innovation Strategy; news media; UAE Space Agency; A.T. Kearney

The National Innovation Strategy is built upon three pillars: Priority Sectors, Innovation Champions, and Innovation-Enabling Environment

National Innovation Strategy overview

NIS overall framework



Framework element highlights

- 7 sectors selected as national priority sectors
- Sector-specific innovation initiatives under development

- **Individuals:** Identification of local talent and development of capabilities in STEM and entrepreneurship
- **Companies & Institutions:** Promoting innovative culture and supporting commercialization of ideas
- **Government:** Public sector entities as leaders in service and process innovation

- **Regulatory framework:** Rules and regulations promoting innovation
- **Technology infrastructure:** Cost-effective technology infrastructure, and optimal use of ICT for knowledge sharing
- **Enabling services:** First-rate education system, university R&D expansion, and incubator support
- **Investments & Incentives:** New funding options and relevant financial laws and regulations

The newly released ST&I policy links to the NIS and outlines 100 initiatives across the 7 national priority sectors

Higher policy for Science, Technology, and Innovation: Overview

UAE PRESIDENT ADOPTS UAE'S HIGHER POLICY FOR SCIENCE, TECHNOLOGY AND INNOVATION

posted on 22/11/2015: 927 views

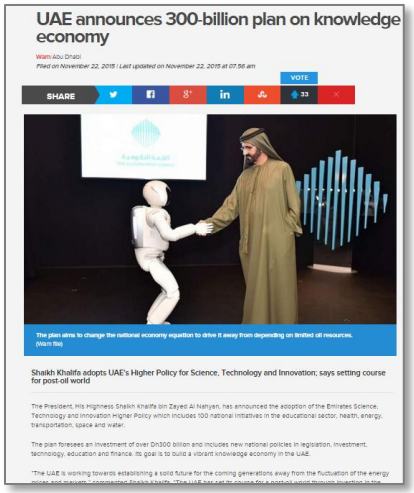
President His Highness Sheikh Khalifa bin Zayed Al Nahyan, has announced the adoption of the Emirates Science, Technology and Innovation Higher Policy which includes 100 national initiatives in the educational sector, health, energy, transportation, space and water.

The plan foresees an investment of over Dh 300 billion and includes new national policies in legislation, investment, technology, education and finance. Its goal is to build a vibrant knowledge economy in the UAE.

"The UAE is working towards establishing a solid future for the coming generations away from the fluctuation of the energy prices and markets," commented Sheikh Khalifa. "The UAE has set its course for a post oil world through investing in the development of our people in the fields of science and advanced technology."

Sheikh Khalifa added, "Creating sustainable wealth for the coming generation will depend on science, knowledge, technology and innovation. The Science, Technology and Innovation Higher Policy adopted today is a turning point in our journey to develop the UAE economically and socially."

He confirmed his brothers the Rulers of the Emirates' full support of the Federal government under the leadership of Vice President and Prime Minister and Ruler of Dubai, His Highness Sheikh Mohammed bin



UAE announces 300-billion plan on knowledge economy

Sheikh Khalifa adopts UAE's Higher Policy for Science, Technology and Innovation; says setting course for post-oil world

UAE President announces Dh300 billion post-oil plan for innovation projects

The National staff
November 21, 2015

ABU DHABI // The President, Sheikh Khalifa, has announced details of a plan worth more than Dh300 billion to foster a knowledge economy and innovation, and prepare the UAE for a world after oil.

The Emirates Science, Technology and Innovation Higher Policy will include 100 initiatives with major investments in education, health, energy, transport, space and water.

It will include fields such as robotics, solar power, developing intellectual property, stem cell research and bio-technology.

"The UAE is working towards establishing a solid future for coming generations away from the fluctuation of energy prices and markets," said Sheikh Khalifa. "The UAE has set its course for a post-oil world through investing in the development of our people in the fields of science and advanced technology.

"Creating sustainable wealth for the coming generation will depend on science, knowledge, technology and innovation. The policy adopted today is a turning point in our journey to develop the UAE economically and socially."

Sheikh Khalifa made the announcement as part of national Innovation Week celebrations.

The funds will mostly go towards research and development, and tripling the number of people working in the knowledge economy by 2021.

Highlights

- 100 national level initiatives aimed at driving economic diversification through science, technology, and innovation
- Linked to the National Innovation Strategy with initiatives specified for all 7 national priority sectors
- Total planned investments of AED 300bn
- Key space sector initiatives include
  - Space sciences and engineering degrees at university
  - Research projects carried out at the ISS
  - Launch of the Al Ain Space Centre

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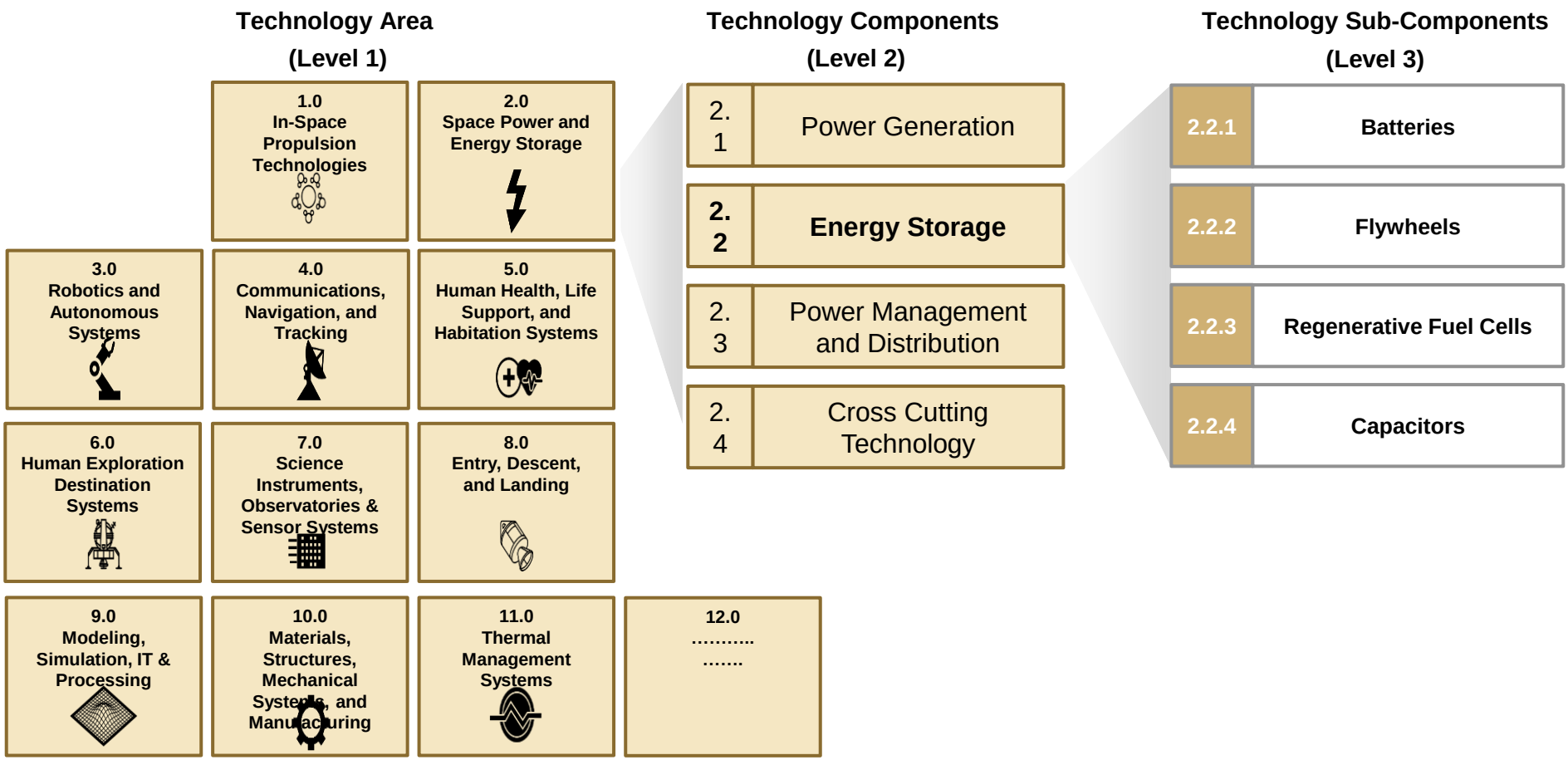
Way Forward: To develop the Space Technology Tree, key international agencies' trees have been analyzed and relevant technology areas, components and sub-components identified

FOR DISCUSSION
ILLUSTRATIVE

Space Technology Tree Example*



Thank you

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