

FLASHES

A MONTHLY MAGAZINE ON KNOWLEDGE AND DEVELOPMENT BY THE
MOHAMMED BIN RASHID AL MAKTOUM KNOWLEDGE FOUNDATION

JUNE 2017
ISSUE 30

#YearOfGiving



The Value of Cultural Tourism

A growing global market segment

SOFT POWER

HOW THE UAE IS HARNESSING IT

WATER FROM THE AIR

A NEW TECHNOLOGICAL BREAKTHROUGH

UNSUNG GENIUSES

WHY SOME GREAT MINDS ARE FORGOTTEN



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CONTENTS

JUNE/2017
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REGULARS

05: WELCOME

06: NEWS

Arab Hope Makers
honoured

12: THE ROLE OF SOFT POWER

The UAE is widely regarded
as a beacon of tolerance,
hope, prosperity and
stability, which testifies
to its successful use of
soft power

50: LIKE FATHER, LIKE SON

Abdulla and Abdul Aziz
Al Ghurair have taken
philanthropy to a new level
with a special focus on
education

54: THE BEAUTY OF LIGHT

The use of light plays a
central role in Islamic
architecture, especially in
terms of religious buildings

EXPLORE

STAMPING OUT ART FRAUD

Armed with new technologies, a
small but dedicated band of
experts are taking on the forgers /18

UNFRIENDING SOCIAL MEDIA

A new study has found that 60 per cent
of American teens have taken a break
from social media /22

UNSUNG GENIUSES

There are a number of great minds that
have disappeared into obscurity despite
their achievements /26

WORLD'S FIRST MALARIA VACCINE

It has taken billions of dollars and a
huge amount of research, but the first
malaria vaccine is finally available and
will be trialled in three African countries
next year /30

THE PENGUIN MYSTERY

Scientists are trying to answer the
baffling question why some penguin
species are doing better than others /32

THE DEMOCRATISATION OF THE INTERNET

There are plans to send thousands of
small satellites into low Earth orbit to
provide total internet coverage /38

THE VALUE OF CULTURAL TOURISM

The UAE, as well as other GCC states,
are investing heavily in the world's
growing cultural tourism market /42

WATER FROM THE AIR

Using a metal-organic framework,
a team of scientists has been able
to collect water directly from the
atmosphere /46

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FOREWORD

Dear readers,

Since its founding on 2 December 1971, the UAE has grown at an unprecedented pace thanks to its wise leadership. Today, the UAE is an economic powerhouse, but it is also a beacon of hope, tolerance, respect, cultural diversity and stability.

These factors are reflected in the way the rest of the world views this country. In this year's ASDA'A Burson-Marsteller Arab Youth Survey, the UAE retained its position as the top choice for young Arabs to live in for the sixth consecutive year. Moreover, more than a third (36 per cent) of young Arabs cited the UAE as their model country. Dubai also continued to have the highest rank for quality of living across Africa and the Middle East in Mercer's 19th annual Quality of Living survey.

His Highness Sheikh Mohammad Bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE and Ruler of Dubai referenced these factors, when he launched the UAE Soft Power Council.

The UAE has achieved its elevate position on the world stage by being true to the ideals of its founding fathers. This is particularly true on the humanitarian front. A report by the Organisation for Economic Co-operation and Development (OECD) found that the UAE spends more on aid to develop other countries than any other nation on Earth compared to its wealth.

This generosity is part of the UAE's heritage. With 2017 being declared the Year of Giving in the UAE, it is only fitting that we strive to share the principles and experiences that have allowed this country to succeed economically, socially and culturally.

The Mohammed Bin Rashid Al Maktoum Knowledge Foundation (MBRF) plays an important role in this regard. This year's fourth annual Knowledge Summit, which is titled "Knowledge and the 4th Industrial Revolution", is scheduled to take place on November 21-23, 2017. This event brings together decision makers, intellectuals, experts, scientists, and academics from all around the world to share experiences, insight, and best practices.

MBRF also recently launched the region's largest, most comprehensive audiobook platform, Masmooou.com, through its educational arm, Qindeel Educational. Such initiatives are all part of our remit to spread a culture of knowledge and education among all segments of society.

Jamal Bin Huwareb
CEO of Mohammed bin Rashid
Al Maktoum Knowledge Foundation



Arab Hope Makers Honoured

His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, honoured the winner of the Arab Hope Makers initiative at a ceremony on May 18th.

The Arab Hope Makers initiative highlights the inspirational stories of people who provide hope and spread it among communities throughout the Arab World, thereby contributing to social prosperity in different fields.

Nawal Al Soufi from Morocco was named the Arab Hope Makers winner after an audience vote and points given by a panel of judges. However, at the end of the ceremony, HH Sheikh Mohammed, a hope maker himself, announced that the grand prize of Dh51 million would be awarded to each of the five finalists for their volunteering that helped make a difference to thousands of lives.

Al Soufi helped save the lives of more than 200,000 refugees who became stranded at sea while attempting to seek a better life in Europe. The four other finalists were Maali Al Asousi from Kuwait who left her home 10 years ago and dedicated her life to volunteering in Yemen and led over 30 initiatives that helped 250,000 people; Majida Jobran from Egypt who spent 27 years of her life helping the poor in Cairo; Hesham Al Thahabi from Iraq who provided homes and shelter for hundreds of street children; and the White Helmets, a group of 3,100 volunteers, who

saved more than 94,000 people from under the rubble of collapsed buildings in Syria.

The Arab Hope Makers initiative, which was launched on 1st March, garnered 65,489 nominations in just one month. Volunteer-based initiatives were most common, with 29 per cent of nominations, followed by youth-focused initiatives at 19.6 per cent, education at 19.1 per cent, health-sector at 9.1 per cent, media initiatives at 7.3 per cent, and the remaining 15.9 per cent dispersed across a range of different sectors.

Twenty-two Arab countries nominated people in their communities with the highest number of nominations coming from Egypt with 22.3 per cent, followed by Saudi Arabia with 17 per cent, the UAE with 10.9 per cent, Jordan with 9 per cent, Morocco with 6.5 per cent, Palestine with 4.8 per cent, Iraq with 4.5 per cent, Syria with 4.4 per cent, Algeria with 4.2 per cent and Kuwait with 3.6 per cent.

Arab Hope Makers was launched under the umbrella of the Mohammed bin Rashid Global Initiatives, MBRGI, as part of the Year of Giving. The year 2017 was announced as The Year of Giving by President His Highness Sheikh Khalifa bin Zayed Al Nahyan, and is in line with His Highness Sheikh Mohammed bin Rashid's vision to create hope and optimism with the aim of instilling the values of goodness in the Arab World. ♪

days to 14.

The first group of Government Accelerators presented their accomplishments to Sheikh Mohammed. They included reducing mortality rates on dangerous roads by 21%; increasing the quality of air by 10%; providing 1,000 job opportunities for Emiratis in the financial sector within 75 days; and easing the process for patent registration and processing, apart from other significant accomplishments. 

The 'Area 2017' will act as an umbrella that brings together venture capital, R&D, innovators, entrepreneurs, industry disruptive start-ups, and SMEs. It will also house all UAE Government Accelerators and Dubai's Future Accelerators.†

Knowledge and the 4th Industrial Revolution:

Mohammed bin Rashid Al Maktoum Knowledge Foundation Announces Knowledge Summit 2017



The Mohammed Bin Rashid Al Maktoum Knowledge Foundation (MBRF) has revealed that the fourth annual Knowledge Summit, which is titled “Knowledge and the 4th Industrial Revolution”, is scheduled to take place on November 21-23, 2017.

Held under the patronage of His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, and by directives from MBRF Chairman HH Sheikh Ahmed bin Mohammed bin Rashid Al Maktoum, the Summit offers a comprehensive global knowledge platform to discuss the most pressing issues and challenges facing the knowledge industry and proposing solutions to address them. The event brings together decision makers, intellectuals, experts, scientists, and academics from all around the world to share experiences, insight, and best practices.

His Excellency Jamal bin Huwairib, CEO of MBRF, said: “The Knowledge Summit has established itself as a catalyst for the regional knowledge movement, working to modernise the production, dissemination, and localisation of knowledge. With the support of HH Sheikh Mohammed bin Rashid Al Maktoum and HH Sheikh Ahmed bin Mohammed bin Rashid Al Maktoum, the Summit has managed – since its very first edition – to create a dialogue among all stakeholders in the knowledge industry in order to promote ideas and introduce innovative programmes and initiatives.”

“The activities held during the Knowledge Summit add tremendous momentum to the event,” HE bin Huwairib continued, “especially as it hosts the awards ceremony of the Mohammed Bin Rashid Al Maktoum Knowledge Award, which honours those who play an effective role in the efforts to build a knowledge economy and preserve intellectual assets. The Summit also constitutes the official platform to reveal the results of the Arab Knowledge Index and the Arab Reading Index – both accurate scientific tools that track

the status of knowledge and reading in the Arab region.”

The Knowledge Summit 2017 will focus on the history of industrial revolutions and their role in transforming people’s lives for the better, on the one hand, and in supporting the development of knowledge societies, on the other. The Summit will go over the first, second, and third industrial revolutions in detail, before tackling the subject of the Fourth Industrial Revolution – a.k.a. “The Digital Revolution” – which began at the outset of the 21st Century.

The Summit is also set to explore the relationship between the Fourth Industrial Revolution and the “Knowledge Society”, shedding light on the transformative effects of the Fourth Industrial Revolution on vital sectors such as education, youth affairs, environment, healthcare, technology, and media, among others. Coinciding with the Year of Giving 2017 initiative, the fourth annual Knowledge Summit will connect the successive industrial revolutions to social initiatives that promote charity and knowledge.

The Knowledge Summit 2016 – bearing the theme: “Knowledge...Present and Future” – explored the concept of forecasting and planning for the future, as well as the means to achieve that. It highlighted Dubai’s successful track record in the future industry and the efforts and initiatives launched in this regard. The Summit discussed the future of sectors that are vital for the development of countries, including reading, medicine, technology, and education.

During the 2016 Summit, the Foundation revealed the results of the first-ever Arab Reading Index, which was developed in cooperation with the United Nations Development Program (UNDP). MBRF also revealed the findings of the Arab Knowledge Index 2016, honoured the winners of the Mohammed Bin Rashid Al Maktoum Knowledge Award for 2016, and organised a series of workshops on the side.†



MBRF Launches Region's Largest Audiobook Platform



The Mohammed Bin Rashid Al Maktoum Knowledge Foundation (MBRF) has launched the region's largest, most comprehensive audiobook platform, Masmooou.com, through its educational arm, Qindeel Educational.

The platform was developed following directives from the Foundation's Chairman His Highness Sheikh Ahmed bin Mohammed bin Rashid Al Maktoum, and offers a wide variety of e-books, audio content, and online material, covering various subjects and topics, all in a bid to spread knowledge across the region and the world.

The launch was announced at a press conference attended by His Excellency Jamal bin Huwairb, CEO of MBRF, and Saif Al Mansouri, General Manager of MBRF Holding, in addition to representatives from the platform's partners: Al Rawi Media, Kitab Sawti Co., Soundless Co., Qitaf Int. Co., Machina Communications Co., Rodian Co., and Booklava Ventures.

In its first phase, the flagship project will offer Arabic audiobooks, with content in foreign languages to be added at a later stage. The platform seeks to consolidate efforts that spread knowledge and keep up with publishing trends. It will also work to encourage production of audiobooks, bringing together all cultural efforts under one roof. It also aims to preserve and promote the Arabic language, its authenticity, and heritage.

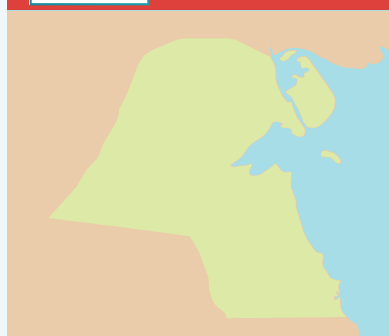
HE bin Huwairb said: "In line with the innovative vision of HH Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, MBRF has, since its inception, striven to launch state-of-the-art initiatives that work to push the boundaries of knowledge to new horizons. We work to spread a culture of knowledge and education among all segments of society."

Masmooou.com will constitute an added value for all

segments of society, enabling people with visual impairments to indulge in a world of knowledge that caters to their needs and requirements. The platform will bring together books of different topics and orientations, including family and children, and will constantly expand to further genres. It will closely cooperate with several publishing houses to expand its database, and will also encompass short versions of Qindeel's 'A Book in Minutes' series, along with various MBRF publications.

With a rich selection of Arabic and international books, the brand new platform will attract avid readers and knowledge seekers from across the world. At the same time, it will keep pace with the latest global technological advancements, offering online material that can be accessed 24/7 via smart applications. Among many other features, the state-of-the-art platform will incorporate an online payment portal, enabling hassle-free downloads via the website or the app. In addition, companies, enterprises, universities, and publishing houses can integrate their own audiobook libraries into Masmooou.com.





Reading Rank Overall: 13th
Total Reading Time Per Year: 32 hours
2016 Sample Size: 1,121
Number of Arab Countries Sampled: 22

The Arab Reading Index (ARI) was first released in 2016 and aims to provide an objective assessment of the state of reading in the Arab region

under the wider vision of the Arab Knowledge Index. As reading is the basic tool in knowledge acquisition, exchange, and dissemination this assessment is of primary importance. The Arab Reading Index focuses mainly on reading within the more general knowledge development concept, emphasising the role of reading as a tool for enlightenment and empowerment.



46%

EXTENT OF
READING



40%

ACCESS AND
AVAILABILITY

Reading matter
sourced from



36%
Family



56%
School



28%
Society



AVERAGE TOTAL
READING HOURS
(ANNUAL)

Made up of



17 hrs
Electronic
documents



13 hrs
Printed documents



13 hrs
Work related



17 hrs
Not work related



45%

PERSONAL
ATTRIBUTES



96%
Skills and abilities



47%
Motivation



52%
Attitudes



AVERAGE
NUMBER
OF BOOKS
READ

ابت
12

In Arabic

أ
6

In foreign languages



6
Work related



9
Not work related

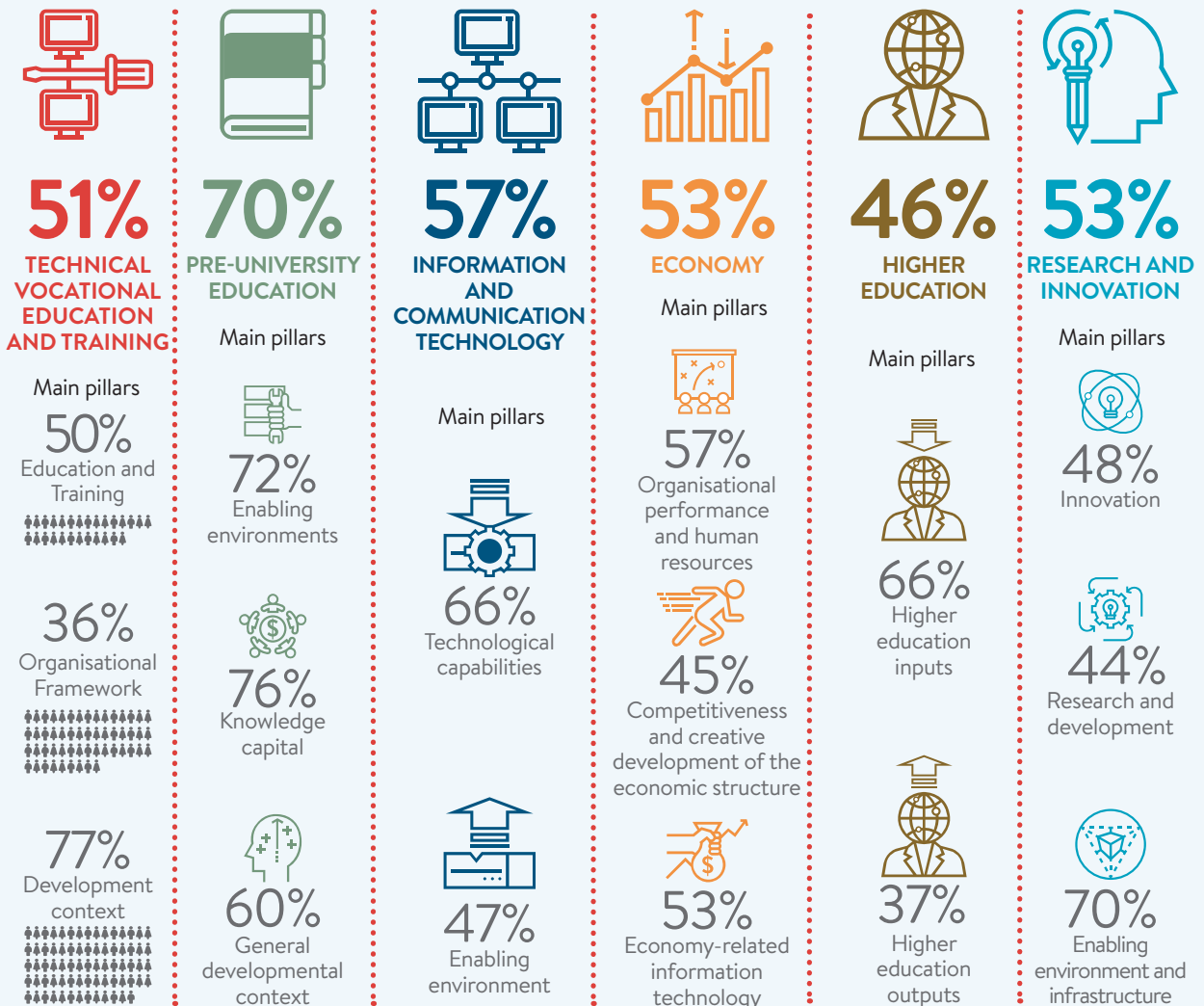
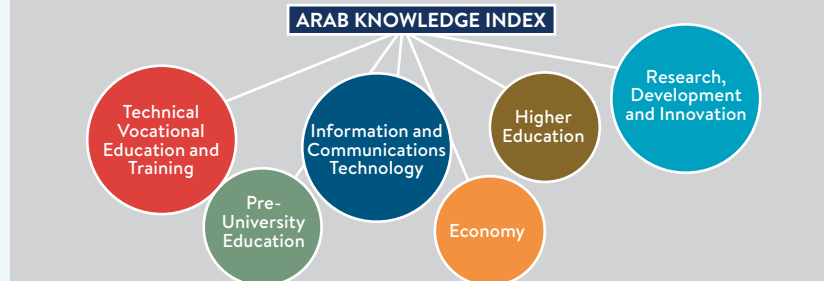
The Arab Reading Index is done in partnership by the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF) and the United Nations Development Programme (UNDP).

Source: www.knowledge4all.com

Number of Arab Countries
Sampled: 22

The Index, which was initially launched at 2015's Knowledge Summit, monitors the status of knowledge in 22 Arab countries to help decision makers, experts and researchers to implement development policies and identify knowledge gaps.

THE SIX MAIN SECTORAL INDICES OF THE ARAB KNOWLEDGE INDEX



The Arab Knowledge Index is a joint initiative between the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF) and the United Nations Development Programme (UNDP).

Source: www.knowledge4all.com

THE ROLE OF SOFT POWER



The UAE is widely regarded as a beacon of tolerance, hope, prosperity and stability, which testifies to its successful use of soft power.

In April, His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE and Ruler of Dubai, launched the UAE Soft Power Council. Its role is to define a comprehensive strategy to reinforce the country's position and consolidate its values of respect and appreciation with governments and citizens across the world.

A country's 'soft power' stands in direct contrast to 'hard power'. The latter term includes the use of both negative instruments (military force, threats of violence, economic sanctions) and positive inducements (development aid, the offer of an alliance) in order to get co-operation according to *Foreign Affairs* magazine. In the 1980s Harvard political scientist Joseph Nye,

in his groundbreaking book *Soft Power: The Means To Success In World Politics*, coined the term 'soft power'. Soft power differentiates itself from hard power by being non-coercive - it reflects the ability of a country to shape the preferences of others through appeal and attraction. The currency of soft power is culture, political values, and foreign policies.

It is clear that the UAE Soft Power Council's aims and duties fall well within this framework. In the announcement of the Council's creation, HH Sheikh Mohammed stressed that the UAE has military and economic power and will now develop its soft power in order to solidify its reputation, and serve the interests of its people in the long term by establishing relationships





Above: Emiratis take part in a National Parade to celebrate the UAE's founding.

across various sectors including the economic, tourism and investment sectors.

His Highness said: "The UAE holds a special place in the hearts of millions of people around the world; we want to build on that and elevate it. We have the economic, cultural and civilisational components to achieve this swiftly." Sheikh Mohammed concluded by saying: "We want to utilise new tools and methods in order to reach more people, and share our knowledge, culture and history with the world. The UAE Soft Power Council is a stepping stone to achieving this vision, and promoting our country through successful public diplomacy to many people from various backgrounds."

Regionally, the UAE's soft power is already well established as shown by the ninth annual ASDA'A Burson-Marsteller Arab Youth Survey this year. In it, the UAE retained its position as the top choice for young Arabs to live in for the sixth consecutive year. When asked 'Which country in the world, if any, would you like to live in?' more than one in three young Arabs (35 per cent) cited the UAE as their choice, an increase of 13 percentage points over last year, when just under a quarter (22 per cent) put the UAE in the top spot. Moreover, more than a third (36 per cent) of young Arabs said the UAE is their model country, compared to one in four (23 per cent) last year.

The UAE's cities also have an enviable reputation. Dubai continued to have the highest rank for quality of living across Africa and the Middle East, rising

one position in this year's chart, followed closely by Abu Dhabi in Mercer's 19th annual Quality of Living survey. The survey takes into account factors such as a city's political and social environment, medical care and health considerations, public services, recreation facilities and natural environment, amongst others. Dubai also ranked highest for infrastructure in the region.

This overwhelmingly positive view is indicative of the soft power that the UAE wields. Since its founding in 1971, the UAE has become an important player on the world stage and it serves on numerous United Nations boards. The UAE was founded on the principles of peace, tolerance, gender equality, freedom of faith and ensuring the happiness of its people. As a result it is a regional beacon of hope, prosperity and stability, while being a bastion against extremism.

On the humanitarian front the UAE is a leading light. According to a report released by the Ministry of Foreign Affairs and International Cooperation in late 2015 – the last year for which comprehensive figures have been released – the UAE's government, NGO and charity institutions had spent Dhs174 billion in aid that went to 178 countries around the globe between 1971 and 2014, with assistance ranging from disaster relief and infrastructure projects to polio eradication efforts and help for refugees. Earlier this year an Organisation for Economic Co-operation and Development (OECD) report found that the UAE spends more on aid to develop other countries than any other nation



on Earth compared to its wealth (the UAE spent Dhs15.23 billion worth of development assistance in 2016). Dubai is home to the International Humanitarian City (IHC), which hosts nine UN humanitarian agencies, and over 50 international NPOs (non-profit organisations), intergovernmental organisations and commercial companies.

On the economic and cultural fronts, the UAE is emerging as a powerful link between the West and the East. The UAE's well-diversified economy attracted \$13 billion of foreign direct investment in 2015, a 25 per cent increase over 2014. The UAE also ranked 26th out of 190 countries in the 2017 Doing Business ranking published by the World Bank. Dubai was the first in the region to set up free zones that offered 100 per cent foreign ownership, which include the Dubai International Financial Centre, Dubai Media City, Jebel Ali Free Zone Authority and Dubai International Academic City to name just a few. According to government data around 25 per cent of Dubai's GDP passes through its free zones. The emirate has continued to invest heavily in real estate and transport projects before it hosts



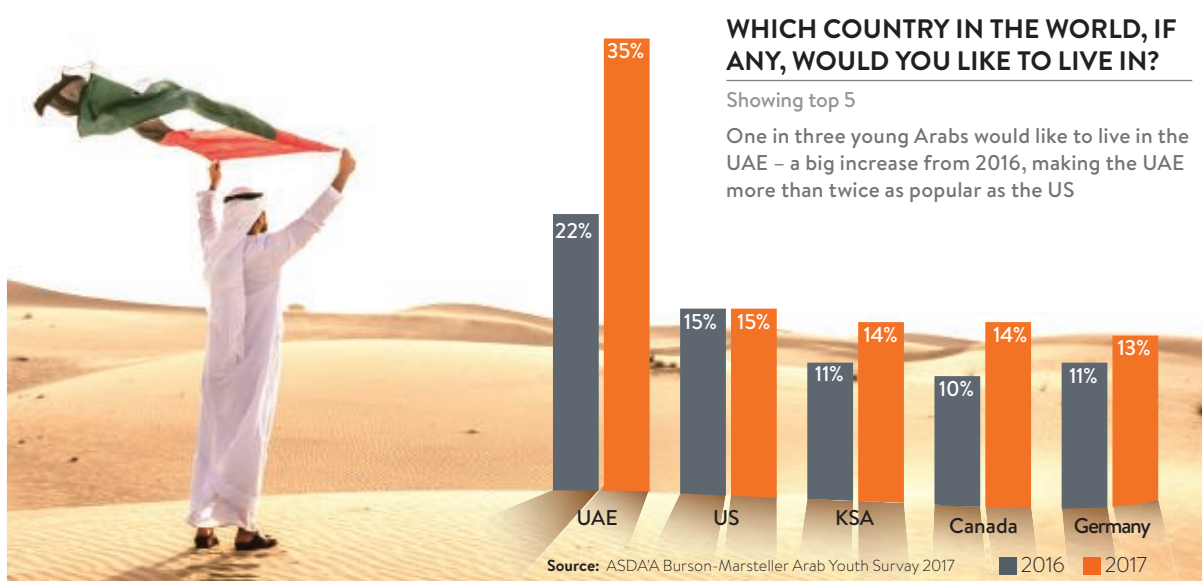
the World Expo in 2020. It recently announced a state budget that envisages total spending rising to Dhs47.3 billion (\$12.9 billion) this year from Dhs46.1 billion dirhams planned for 2016, including a 27 per cent jump in infrastructure spending.

The revival of art and architecture has helped reshape the national identity. A number of new hotspots such as Dubai Opera, numerous galleries and the Museum of the Future are adding to the country's cross-cultural image, aided by museums like the Louvre and Guggenheim in Abu Dhabi that are close to completion. Dubai's Burj Khalifa, the world's tallest building, has become an international landmark that defines the UAE's ambition and futuristic thinking. This perception has been aided by Dubai's ultra modern skyline appearing in Hollywood blockbusters such as *Mission Impossible: Ghost Protocol* and *Star Trek Beyond*, as well as several Bollywood movies. Such exposure provides invaluable international marketing for the emirate and the UAE to a wide target audience.

Dubai's international standing is further enhanced by numerous sporting events. The \$10 million Dubai World Cup celebrates the UAE's equine heritage in the world's richest horserace. This glitzy event, which attracts international celebrities and hosts numerous fashion events, is syndicated to 23 broadcasters across

Above: *Mission Impossible: Ghost Protocol*, which starred Tom Cruise, brought Dubai's skyline to an international movie audience.

Above left: Free zones, such as Dubai International Financial Centre, are responsible for around 25 per cent of Dubai's GDP.



Above: A performance by Plácido Domingo inaugurated Dubai's new Opera house.

134 countries, penetrating 300 million-plus households last year. Other high-profile events such as the Omega Dubai Desert Classic, DP World Tour Championship (TV coverage in excess of 455 million households), Dubai Duty Free Tennis Championship (global TV audience of some 400 million) and Dubai Tour attract the world's best golfers, tennis players and cyclists.

These events all play an important part in marketing Dubai internationally and regionally, and play an

invaluable role in promoting tourism. According to figures published by the Department of Tourism and Commerce Marketing (DTCM), the number of overnight visitors flocking to Dubai in 2016 rose to 14.9 million from 14.2 million a year earlier, an increase of five per cent year on year. This figure places Dubai firmly as the world's fourth most visited city behind Bangkok, London and Paris. These visitors experience the UAE's unique culture and hospitality first hand and serve as word-of-mouth ambassadors for the country. Tourism contributed \$64 billion to the UAE's economy in 2016 and this figure is set to almost double over the next 10 years, according to the latest research by the World Travel & Tourism Council (WTTC).

Visitor numbers are further driven by the numerous Meetings, Incentives, Conferencing and Exhibition (MICE) events held in the UAE. Among the key events are the Arabian Travel Market that saw 2,600 exhibitors, and visitor numbers smash through the 28,000 mark. The Emirates Airline Festival of Literature drew 40,000 visitors this year and has firmly established itself as a key event on the international literary calendar. However, it also plays an important role in marketing authors from the UAE and the Arab world to a wider audience.

Another sector where the UAE exercises its soft power is education. The total number of students in schools and universities in the UAE is projected to grow by 4.1 per cent annually until 2020, making the UAE's education sector one of the fastest growing in the region according to a report by Alpen Capital. Expected to grow faster than the GCC average, the total number of students in the UAE is predicted to increase from an estimated 1.1 million students in 2015 to 1.4 million in 2020. The faster growth is due to the expansion of primary and tertiary education, facilitated by the growth



of private schools and the government's focus on higher education. The country allocates around 25 per cent of its federal spending on education, with the intention to promote the UAE's standard of life and groom the nation for a competing world.

This focus on education reaches beyond the UAE's borders. For example, the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF) releases the annual Arab Reading Index that assesses the state of reading in the Arab region under the wider vision of the Arab Knowledge Index. The latter, in turn, is an index that creates credible data and research that can feed the decision making process in the areas of knowledge and development. It speaks volumes that the UAE ranked high in the Arab Knowledge index. In the same vein, the UAE declared 2016 as the Year of Reading, which successfully promoted a love of reading across the region and a consequent enhancement of knowledge. Under its auspices the Arab Reading Challenge project saw the



participation of more than 3.5 million students from different schools in the Arab world who read more than 150 million books.

From the above it becomes clear that the UAE and Dubai already successfully exercise soft power in a number of important fields. The UAE Soft Power Council will now create a more coherent framework through an integrated national strategy that consolidates the roles of both the public and private sectors in achieving soft power and conveying the nation's history in a new way. The Council will also develop a soft power strategy for the state, including the science, culture, technology, humanitarian and economic sectors, in order to establish relationships at the grassroots level with partners both in the Arab region and globally. †

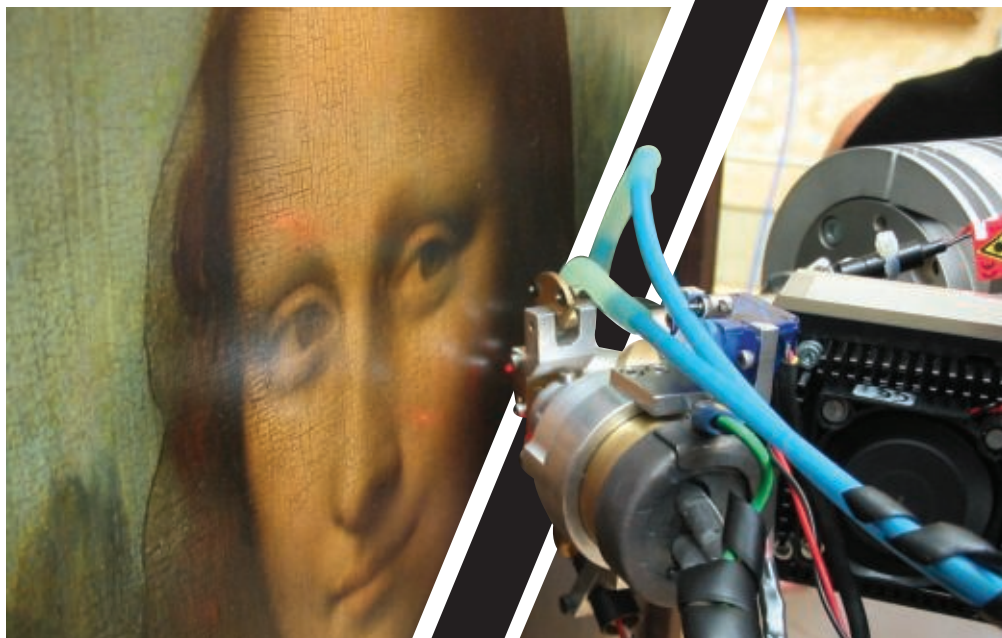
Above: Dubai is the fourth most visited city in the world.

Left top: Events such as the Dubai Desert Classic enhance Dubai's international standing.

Left bottom: The Dubai World Cup is broadcast to 134 countries.

STAMPING OUT ART FRAUD

Up to a staggering 40 per cent of the \$60 billion to \$1 trillion worth of artworks that change hands annually are estimated to be fakes. Armed with new technologies, a small but dedicated band of experts are taking on the forgers.



Fakes and fraudulent art is nothing new. For as long as art has held commercial value, someone, somewhere, has been concocting a way to cash in on forging it. Eric Spoutz is one of a long line of art crooks who amassed a small fortune selling fake paintings. In February this year the art dealer from Michigan, USA, was sentenced to three years and five months in prison for selling works he claimed were by American Modern artists such as Willem De Kooning, Joan Mitchell and Franz Kline.

Whilst this was undoubtedly a victory for the art world, Spoutz is but a minnow in a heavily polluted lake. A more significant fish was landed in 2011 with the closing of one of the oldest commercial art galleries in the US, M. Knoedler & Co. Founded in 1846, the Knoedler gallery remains at the centre of ongoing lawsuits for art fraud on a grand scale. On April 11 this year, the American casino tycoon Frank Fertitta settled one of ten lawsuits involving the Knoedler gallery. Fertitta purchased a forged Mark Rothko from Knoedler in 2008 for \$7.2 million. This was just one piece out of 30 forged paintings that the gallery sold for almost \$70 million.

Between 1994 and 2011, art dealer Glafira Rosales sold the Knoedler faked paintings by Rothko, Jackson Pollock and many more celebrated artists. Rosales bought the forgeries from painter Pei-Shen Quian, who worked in his garage in Queens, New York. Rosales reportedly paid Quian \$9,000 for each painting and then sold them to the Knoedler for millions.

The scourge of faked paintings exists all around the globe and not all forgers charge such reasonable fees. Between November 2012 and 2014, two galleries in Seoul, South Korea, paid a painter \$240,600 to forge paintings which they attributed to the artist Lee Ufan, which subsequently sold for \$2.3 million.

In Germany, there is the infamous case of the self-professed master forger, Wolfgang Beltracchi, who in 2011 was sentenced to six years in prison for forgery and corruption relating to 14 works that sold for \$45 million. Freed in May 2015, Beltracchi now paints under his own name, but his forgeries hung in the world's most prestigious galleries until Dr. Nicholas Eas- taugh, a British expert in the scientific analysis of paintings, unmasked a painting by Dutch artist Heinrich Campendonk from 1915 as a Beltracchi. The forger slipped up by using a modern 'titanium white' paint that was non-existent in the early 20th century.

These high-profile convictions don't deter the chancers though and in August 2015 Dutch police arrested an unidentified man who was planning to sell a forgery of a preparatory work for Van Gogh's *The Harvest*, complimented by faked documents of authentication from the Van Gogh Museum. The art dealer and television presenter of the BBC's *Fake or Fortune?* TV programme, Phillip Mould, says that in recent years the number of forged artworks on the global market has increased, "Compared with four years ago, when we began, the pestilence is growing."

However, with the development of a range of new technologies, now more than ever, the crooks can be thwarted. Mould adds, "There is hope in the emergence of individuals who have decided to devote themselves to artistic counter-espionage, with the result that fake-busting looks as if it is becoming as ingenious as some of the fraudulent works that these individuals are seeking to root out and prevent."

So, whilst the forgers can deploy the latest technologies in researching and meticulously recreating the materials of an era, the fake-busters can turn to science to shine a bright forensic



Top: Self-confessed forger Wolfgang Beltracchi forged 14 works that sold for \$45 million.

Above: Glafira Rosales sold fake paintings through one of the US's most respected art galleries.

light on anything deemed suspect. One such method is X-ray fluorescence (XRF). Almost inconceivably, XRF delivers light a million times brighter than the sun onto paintings without damaging them in any way, and the materials can be scrutinised at micron levels. This method is not only useful in revealing fakes but also in solving art world mysteries, such as the case of Edgar Degas's painting *Portrait of a Woman*, which was painted over the top of a previous portrait. Using XRF the original portrait was identified as Emma Dobigny, who Degas painted several times in his lifetime.

Another method is scanning electron microscopy but this is being gradually sidelined as it unavoidably

defaces part of the work it tests. MALDI spectrometry is another technology which analyses minute particles taken from the edges of paintings but the best known non-destructive investigative method is optical coherence tomography – a medical imaging system that uses near-infrared light and is used by ophthalmologists to get three-dimensional, highly detailed images of the retina. This method takes time and incurs significant costs but it provides crucial information about the composition and layering of paint. Not only can these various techniques help detect the fakes, they can also be used in the field of fine art restoration.

At the vanguard of the fight against the forgers is Colette Loll, an art-expert and the Founder and Director of Art Fraud Insights, LLC – a consultancy dedicated to art fraud-related projects that include prevention initiatives, exhibitions and specialised investigation of artworks. Commenting about the necessary progress needed in the art sector, Loll says, “In essence, the structures, attitudes and approaches that have shaped art, its authentication and its market for nearly two centuries are no longer able to address the incredibly high stakes and complexity of the contemporary scenario. It has become an untenable situation. What will protect everyone who is acting in good faith begins with the artwork itself.”

Art has become more than a luxury that is bought for passion and personal enjoyment, now it is a financial asset-class in its own right. Globalised investment opportunities supercede genuine interest in art for





art's sake. Inevitably, as with all financial affairs, art is susceptible to illegal activities ranging from money laundering through to fraud. Tackling the inherent risk in this largely unregulated international market is the Global Center of Innovation, established at the State University of New York at Albany.

Founded in collaboration by ARIS Title Insurance Corporation and NRS Associates, the Global Center of Innovation is swiftly becoming a formidable warrior in the fight against international art fraud. Working with leading bioscientists, materials engineers, art conservators, and cultural heritage experts, the Center has compiled sets of authentication marking technologies that will adhere to a set of enduring standards of current and future application named i2M. The technology effectively consists in labels applied to artworks that function as DNA and identify them in perpetuity as being authentic.

Martin Tenniswood – the molecular biologist who came up with the methodology for the labels,



explained, “These are short sequences of synthetic DNA; it has nothing to do with the artist’s DNA. We’ve come up with a microfluidic system: A sticker with tiny wells containing DNA samples is adhered to the back of the artwork. We know what the DNA sequences are – no one else does. We can then go in and, using tiny volumes of fluid, extract the DNA from one of the wells and confirm that those are the sequences we originally put in that well. It’s like hiding four specific grains of sand on a huge flat surface covered in sand. You’re hiding the tag in plain sight, but unless you know exactly what you’re looking for, you won’t find it.”

The i2M technology will function as a global, multi-stakeholder-involved framework that will help to fend off prospective forgery attempts. The initiative is the first of its kind to establish industry standards by which all art will be invisibly and permanently marked at the point of manufacture or discovery for primary market objects and at a defined point in time and intervention for secondary market objects, allowing all objects to be recognisable as indisputably authentic.

The Global Center of Innovation says, “i2M is much more than a product or service launch – i2M represents the start of a process and of a global collaboration that will break the cycle of criminal activity and misidentification with a set of standards and standards-based solutions that solve an asset integrity challenge for an entire ecosystem of industry stakeholders – from artists to dealers and investors to law enforcement agencies.”

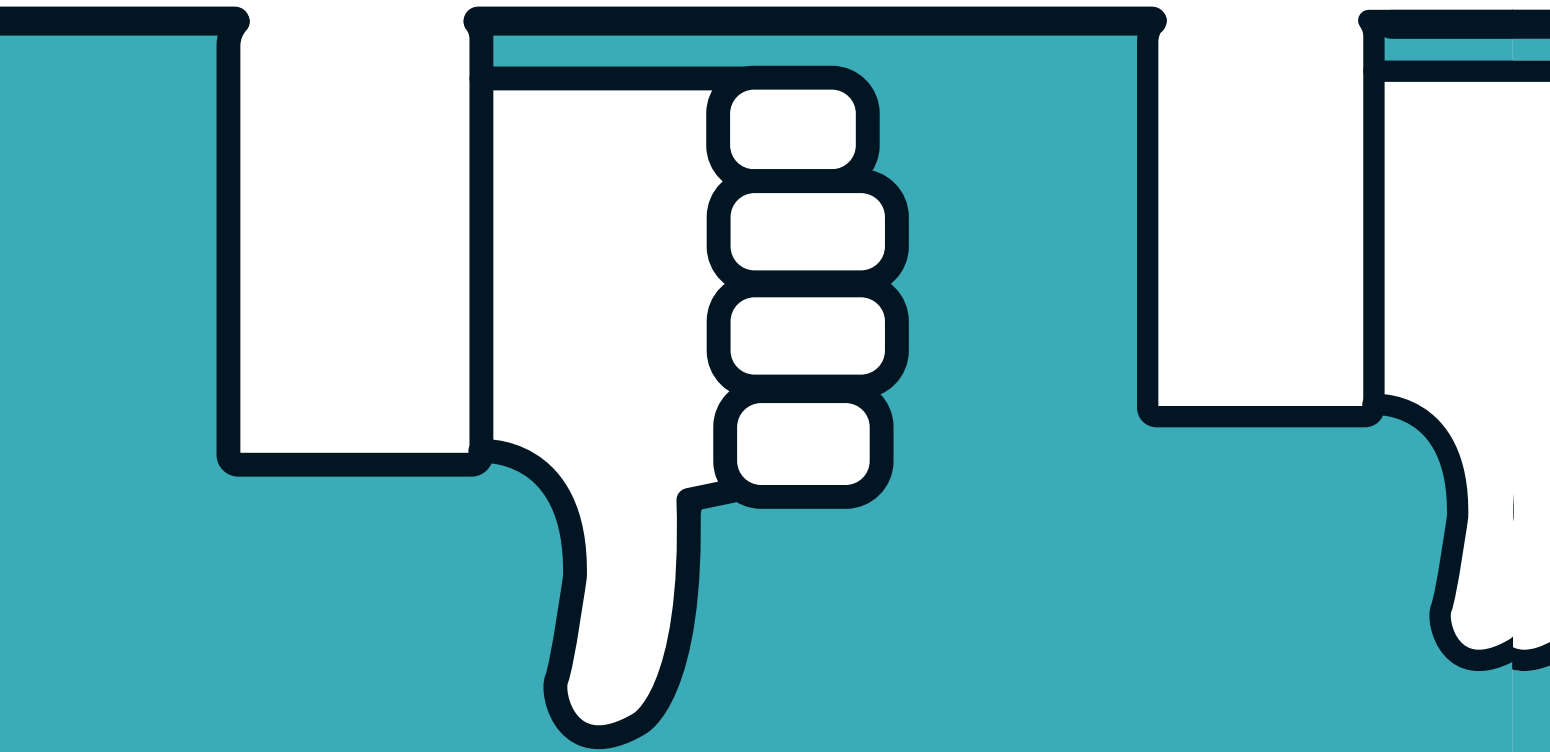
Whilst courts all over the world will continue to contest multi-million-dollar law suits for some time to come, the hope that i2M technology offers is that as more art works are marked, authenticity disputes will eventually become as uncommon as the unearthing of a lost Van Gogh. †

Above: Pei Shen Quian created forgeries for \$9,000 each.

Left: High-tech methods such as X-ray fluorescence are revolutionising art conservation and authentication.

UNFRIENDING SOCIAL MEDIA

A new study has found that 60 per cent of American teens have taken a break from social media, challenging the stereotype that teenagers are glued to their phones.



Two-thirds of the teens in the United States of America confessed that social media does get in the way of work or school and the “conflict and drama” on it are tiring – prompting them to steer away from it. A poll by The Associated Press-NORC Centre for Public Affairs Research, which surveyed teens aged 13 to 17 in December 2016, revealed that 60 per cent of American teens took a break from social media last year – and most of them did so voluntarily.

The breaks usually lasted for a week with boys more likely to take longer breaks than girls. Thirty-eight per cent of the surveyed group cited disruption in work or school as the reason for the break. Twenty per cent said they were tired of having to keep up with what’s going on and nearly a quarter said they quit because they were fed-up of the emotional drama and conflict on social media. The poll also showed that teens from lower income families were more likely to give up on social media than their affluent classmates.

Teenagers taking a break from social media typically quit across the board – checking out of Facebook, Snapchat, Instagram and Twitter all at once. Although they felt relief and happiness for the duration of their sabbatical,

most teens went back to how they were before once they logged back in. However, most of the teens associated social media with positive emotions such as the feeling of being connected with family and friends rather than negative emotions such as being overwhelmed or the need to always show their best selves.

The remaining group of students said they were forced to take a break when their parents took away their phones or computers, or they had misplaced or damaged their gadgets and devices. According to Amanda Lenhart, the lead researcher and an expert on young people and technology use, the involuntary break is a challenge in itself. “They feel that they are missing out, detached from important social relationships (as well as) news and information,” she said.

Thirty-five per cent of the survey group said they did not take any breaks as they feared missing out or being disconnected from friends. Taking a break from social media was akin to taking a break from family and friends and they did not want to do that. For some, social media was important for their school and extracurricular activities.



Middle East Social Media Use

136_m

Across the region Facebook has 136 million monthly users. Ninety-three per cent access Facebook on mobile. The number of active monthly users has tripled since 2012.

91%

WhatsApp – which along with Instagram is also owned by Facebook – remains the most popular direct messaging service in the region, according to data from Northwestern University in Qatar. 93 per cent of WhatsApp users, in the six nations studied, are daily users of the app.

62%

Across the 16 countries covered by the annual Arab Youth Survey, 62 per cent of young Arabs (those aged 18-24) use WhatsApp on a daily basis (ahead of Facebook at 55 per cent).

60%

Instagram usage has grown from 38 per cent of internet users across the UAE in 2014 to 60 per cent in 2016. Usage in Saudi Arabia has jumped from 57 per cent in 2014 to 82 per cent in 2016. The global average is 42 per cent (2016) up from 24 per cent two years ago, according to the Connected Life study published by the research agency Kantar TNS.

74%

The same study found in Saudi Arabia and UAE usage of Snapchat has tripled in two years among internet users. Usage in Saudi Arabia grew from 24 to 74 per cent during 2014-16. In UAE, it increased from 15 to 53 per cent. The global average was an increase from 12 per cent to 23 per cent.

24%

Instagram has overtaken Twitter, according to a survey of internet users (nationals only) in Egypt, Lebanon, Saudi Arabia, Tunisia and UAE. Data from Northwestern University in Qatar shows that use of Instagram in these markets increased by 24 per cent between 2013 and 2016. The number of Twitter users fell by 17 per cent in this time, including a 12 per cent drop in the past year.

52%

More than half (52 per cent) of Arab youth share stories with their friends on Facebook, up 11 per cent in the past year. Only 17 per cent of young Arabs aged 18-24 use newspapers as a source for news. In 2011, nearly two-thirds of Arab youth (62 per cent) claimed to use newspapers as part of their news habits.

71%

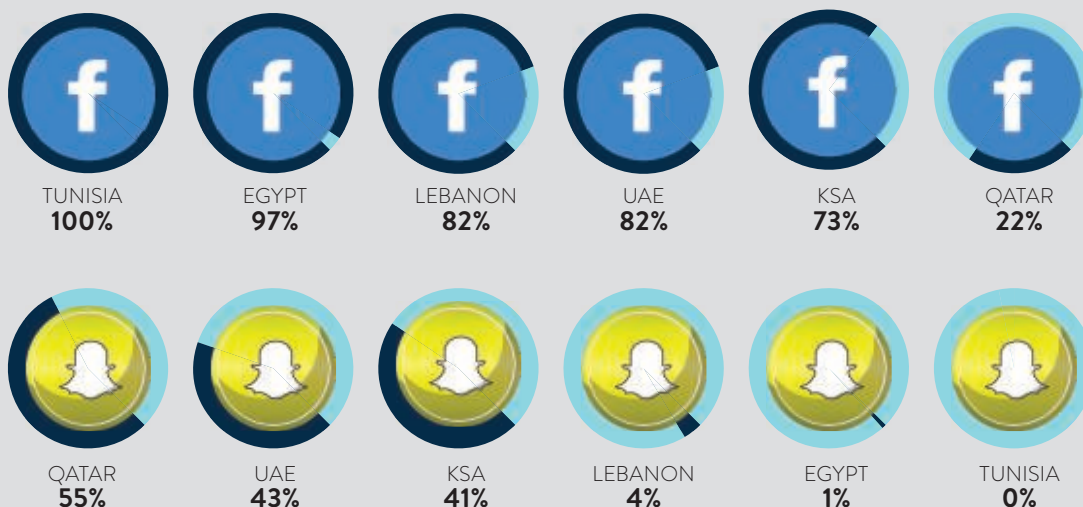
71 per cent of UAE residents will take advice from Social Media Influencers before buying a product. Facebook is the most popular channel to follow influencers in food, fashion and beauty.

7_{in}10

Research from Northwestern University in Qatar found: "Nearly seven in 10 national internet users say they changed how they use social media due to privacy concerns, with proportions ranging from 89 per cent of Saudis and 75 per cent of Egyptians to 46 per cent of Qataris".

Source: Social Media in the Middle East:
The Story of 2016 Top Trends and Data from the Past 12 Months

PER CENT OF INTERNET USERS WHO USE FACE BOOK AND SNAPCHAT



TAKING OVER THE WORLD

Fuelled by a rapid increase in mobile technology ranging from netbooks and tablets to smart phones and smart watches, social media has taken the world by storm. Each second, twelve new people go active on mobile social networks.

A 2016 report shows there are nearly 2.3 billion active social media users worldwide. That's almost 28 per cent of the whole world. And this number is only set to rise with each passing year. In 2015, the number of social media users went up by 176 million with users having an average of 5.54 social media accounts. Facebook alone adds 500,000 new users every day – that is six new profiles every second.

So huge a number automatically sets the tone for a huge number of new and unique problems. One of the most pressing issues is “addiction” to social media. Social networking accounts for 28 per cent of all media time spent online with users aged between 15 and 19 spending at least three hours per day on average using platforms such as Facebook, Twitter and Instagram. Eighteen per cent of social media users reported that they cannot go a few hours without checking Facebook, while 28 per cent of iPhone users said they check their Twitter feed before getting out of bed in the morning. Perhaps the most worrying statistic is that 70 per cent of internet use by people at their work places has nothing to do with their job.

ADDICTED TO SOCIAL MEDIA

According to a study published in *Psychological Reports: Disability and Trauma* last year, Facebook affects the brain much like cocaine addiction does.



Twenty undergraduate students were asked to fill in a questionnaire that assessed ‘addiction-like’ symptoms relating to Facebook, such as anxiety, withdrawal and conflict relating to the website. They were then shown a series of images and asked to press, or not press, a button.

Students who pushed the button in response to Facebook-related images such as the Facebook logo also scored highly in the addiction-like symptoms test. Brain imaging used during the experiment revealed that images relating to Facebook activated the amygdala and striatum – the brain regions involved in compulsive behaviour. These brain patterns were similar to those in people addicted to cocaine. The researchers concluded that, “technology-related ‘addictions’ share some neural features with substance and gambling addictions”.

Above: Facebook has 136 million monthly users across the Middle East.



UNSUNG GENIUSES

There are a number of great minds that have disappeared into obscurity despite their achievements.

The world's history is full of geniuses. However, there are also many famous minds that have disappeared into obscurity for a variety of reasons. Social and cultural biases can play a role as countless exceptional minds have been downplayed or ignored due to their race, class, or gender.

In 1859, Charles Darwin published *On the Origin of Species* that laid out his theory of evolution. Yet approximately 1,000 years before the British naturalist published his theory of evolution, a scientist working in Baghdad was thinking along similar lines.

In the *Book of Animals*, Abu Uthman al-Jahith (781-869), an intellectual of East African descent, was the first to speculate on the influence of the environment on species. He wrote: "Animals engage in a struggle for existence; for resources, to avoid being eaten and to breed. Environmental factors influence organisms to develop new characteristics to ensure survival, thus transforming into new species. Animals that survive to breed can pass on their successful

characteristics to offspring." There is little doubt that it qualifies as a theory of natural selection – even though the *Book of Animals* appears to have been based to a large extent on folklore rather than on zoological fact.

Another Arab scientist who has been largely forgotten is Ibn al-Nafis, a Syrian from the late 13th century. He is credited with giving the first correct description of blood circulation in the body, 400 years before the work of William Harvey. In 1628, aged 50, Harvey published his masterpiece – usually referred to as *De Moto Cordis – the Motion of the Heart*. Its full title in English is: *Anatomical Studies on the Motion of the Heart and Blood in Animals*. Remarkably, western medical beliefs – and theories about blood and circulation – had advanced little since Galen wrote his medical textbooks in Rome 1,400 years earlier.

Ibn al-Haytham, who lived in the 10th century was a scientist, philosopher, mathematician and astronomer who is widely considered the father of optics. He spent most of his life close to the court of



Above: Ibn al-Haytham invented the scientific method.

Opposite page: Pierre Louis Moreau de Maupertuis was known as one of the greatest minds of his time.



Above: Esther Lederberg was a pioneer in microbiology, but her husband got the plaudits.

Above right: Frances Bacon is falsely credited with discovering the scientific method.

the Fatimid Caliphate in Cairo and earned his living authoring various treatises and tutoring members of the nobilities. Ibn al-Haytham is widely considered to be one of the first theoretical physicists, and an early proponent of the concept that a hypothesis must be proved by experiments based on confirmable procedures or mathematical evidence - hence understanding the scientific method 200 years before Renaissance scientists. Yet it is Francis Bacon and René Descartes who are widely credited with establishing the scientific method in the 17th century.

It is unclear why these Arab scientists have been largely forgotten or not credited for their astute observations and theoretical breakthroughs. One line of thinking is that the collapse of the Islamic empires relegated their work to obscurity, or that Christian scientists were biased against crediting Islamic scholars.

Today, we widely regard Polish astronomer Nicolaus Copernicus as proving that the sun is the centre of our universe and that all planets revolve around it. In fact, it was Aristarchus of Samos, an ancient Greek astronomer and mathematician, who identified the "central fire" with the Sun, and put the other planets in their correct order of distance around the Sun. However, it has to be said that Copernicus himself credited the heliocentric theory to Aristarchus. However, he was less forthcoming about the fact that many of his calculations had seemingly been lifted



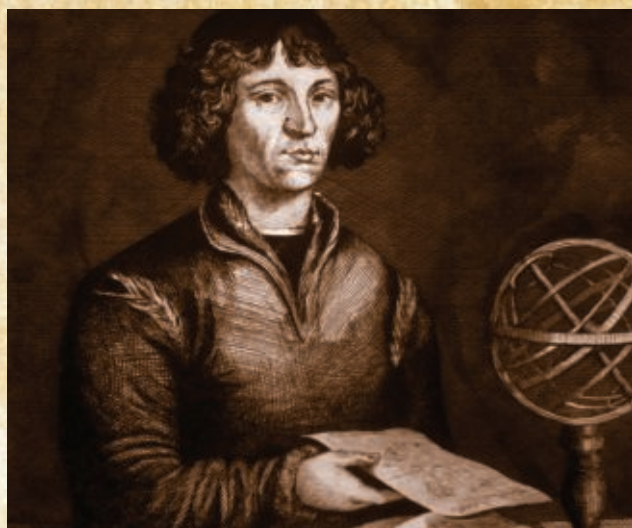
directly from the work of the Arab astronomer Ibn al-Shatir 100 years earlier.

History may have a patchy memory, but sometimes it is the genius' own fault that they are uncredited. A fine example is John Michell, one of the great unsung geniuses of 18th century science. Born in 1724, he studied at Cambridge University and later went on to teach there, instructing students in everything from Hebrew and Greek to math and geology. He was elected to the Royal Society in 1761, but in 1767 he left for northern England to take up the post of rector of St. Michael's Church in the city of Leeds, where he spent the rest of his days.

Some titans of science made the trip up to Leeds to visit him, including the great chemist Joseph Priestley, hydrogen discoverer Henry Cavendish, and even Benjamin Franklin.

Michell's speculations on earthquakes proved remarkably prescient, writing that earthquakes act like waves of energy beneath the Earth and that they are caused by discontinuities between different strata, essentially predicting the existence of fault lines. All this work earned him the later title of the father of seismology, and he also developed a method to very accurately measure the mass of Earth.

But Michell's most impressive scientific feat was coming up with the idea of black holes 150 years before any other scientists would start seriously considering the idea, and 200 years before they finally became a part of mainstream science. The reason why Michell's name isn't better known today is that he didn't bother to try to prove any of his theories or publish any work. He was quite happy with other people taking the credit.



Sometimes, geniuses are forgotten because they have a powerful enemy or a bad attitude. Pierre Louis Moreau de Maupertuis, among the most formidable minds of his generation, had both.

The 18th-century French polymath helped to determine the shape of the Earth and even set the stage for the theory of evolution. But Maupertuis clashed numerous times with his on-again, off-again best friend Voltaire until in 1751 their difficult relationship burst into full-fledged hostility when Voltaire sided with Maupertuis' critics. The witty author pilloried Maupertuis' principle of least action - now considered a pillar of physics - in the papers. Maupertuis was devastated, and today his name is relatively unknown, probably thanks to the verbal skills of his more influential friend.

Maupertuis had largely himself to blame, but Benjamin Bradley was a victim of society. He was born a slave in 1830, and quickly proved he had a knack for building things. Others were so impressed with Bradley's mechanical skills that he was given a job as an assistant in the science department at the United States Naval Academy in Annapolis, Maryland. Bradley was fully paid, but his master pocketed most of the money. Subsequently he invented the first steam engine powerful enough to run a naval ship, but being a slave he was unable to patent his invention as the law considered slaves to be chattel - all of their physical and intellectual labour legally belonged to their owners. However, Bradley was able to save enough money to buy his freedom later.

In 1857, a slave owner named Oscar Stewart applied for a patent on a cotton-processing machine that was invented by one of his slaves. He was granted the patent and the credit, while the only thing we know about the real inventor was that his name was 'Ned'.

Patents also played a role in the case of Jagadish



Chandra Bose. In the 1890s, he discovered that galena crystals could pick up radio signals. However, Bose objected to using science for profit. Though he let a friend persuade him to file a patent for a "detector for electrical disturbances," he ultimately let it lapse.

While Bose may not have cared about patents, radio innovator Guglielmo Marconi did. He is thought to have used a Bose-designed device to receive the first transatlantic wireless signal in 1901, an accomplishment that made his name famous worldwide. Bose continued to make advances in radio - and steadfastly refused to cash in. "If you had seen the greed and hankering after money in [the United States]," he lamented to a friend in 1913. "Money, money - what a terrible all-pervasive greed!"

Slaves were at the bottom of the rung, but women did not fare much better. A case in point is Esther Lederberg who might have been known as the mother of microbiology - if it wasn't for her husband, Joshua. Esther's accomplishments were just as impressive as Joshua's - among other things, she discovered the lambda phage, a type of virus that is still used to study how genes recombine. She also discovered a revolutionary way to duplicate cell colonies on Petri dishes, and she helped her husband figure out how bacteria swap genes.

Unfortunately, women scientists often worked as uncredited members of their husband's teams. Joshua rarely acknowledged his wife's contributions in public, and for years her pioneering research was all but secret to those who didn't know to look for the brilliant female scientist behind the charismatic man. †

Above: Bose made many advances in radio but eschewed patents.

Above left: Copernicus is widely regarded as being the first to place the sun at the centre of the universe.

THE WORLD'S FIRST MALARIA VACCINE

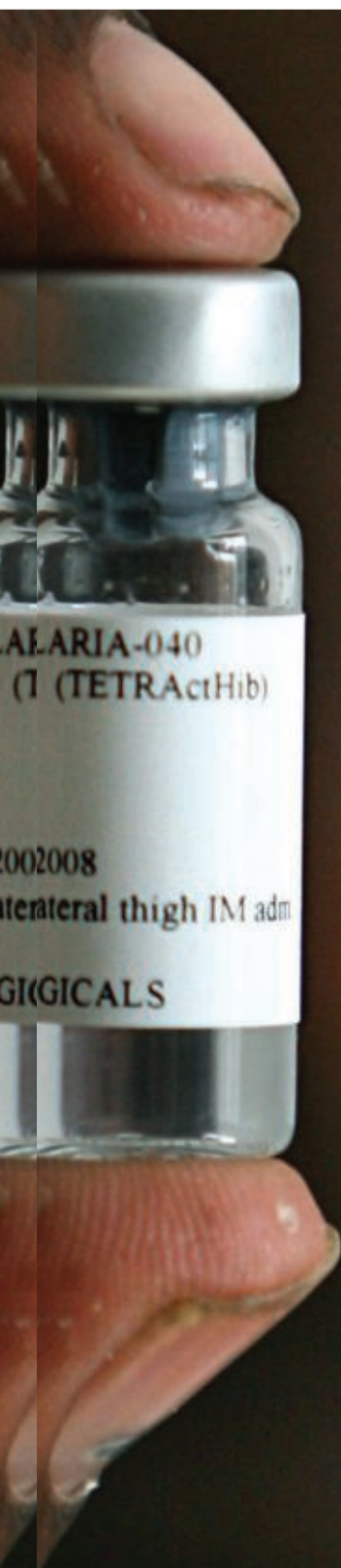
It has taken billions of dollars and a huge amount of research, but the first malaria vaccine is finally available and will be trialled in three African countries next year.

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The World Health Organisation (WHO) reported 212 million new cases of malaria worldwide in 2015. According to the UN body between 429,000 to 639,000 people lost their lives to the fatal disease. While most of the African, South-East Asia and Eastern Mediterranean region are plagued by malaria, it is the African region that bears the brunt of the disease. With a child dying every two minutes, nearly 80 per cent of the deaths on the continent are due to malaria.

Given the grim statistics, Ghana, Kenya and Malawi are keenly awaiting the world's first malaria vaccine. These African countries will be the world's first to avail of the malaria vaccine that will be available next year.

The RTS,S injectable vaccine will be received by over 750,000 children between the ages of five and 17 months. Up till now, it has been trialled only in tightly controlled laboratory environments and has been successful in controlling malaria. In Phase 3 trials, the vaccine decreased mortality rates in 11,000 children in Sub-Sahara Africa by 50 per cent, according to WHO data.

But its actual efficacy can only be proved after a trial in the real world. The vaccine demands a rigorous treatment programme – one injection every month for three months and the fourth dose after 18 months. It is necessary for a patient to receive all four injections otherwise the effectiveness reduces significantly. While doctors are enthusiastic about the launch of the vaccine, its method of administration is a cause of doubt.

“The prospect of a malaria vaccine is great news,” explains Dr Matshidiso Moeti, WHO regional director for Africa. “Information gathered in the pilot will help us make decisions on the wider use of this vaccine.”

Lab tests show that the vaccine can prevent up to four in ten cases of malaria and reduce the most severe cases of the disease by a third. The success rate is less than 50 per cent but for a region like Africa, it translates into tens of thousands of lives saved. Its real power will come through when combined with other existing vector control methods such as the use of mosquito nets and insecticides. Thanks to worldwide educational



efforts, in conjunction with advances and improvements in mosquito control and preventative medicine, the rate of deaths from malaria worldwide decreased by 60 per cent from 2000-2015.

RTS,S has been developed by pharmaceutical company GlaxoSmithKline (GSK) and is the first malaria vaccine to have successfully completed a Phase III clinical trial. The trial ran from 2009 to 2014 with the Bill and Melinda Gates Foundation and the PATH Malaria Vaccine Initiative partnering with GSK. A network of African research sites in seven African countries were also involved. RTS,S is the first malaria vaccine to have obtained the approval of the European Medicines Agency and two independent WHO advisory groups which recommended pilot implementation of RTS,S in sub-Saharan Africa.

Ghana, Kenya and Malawi were chosen for the launch of the vaccine as these countries already have extensive preventative programme in place as well as a high incidence of malaria.

The vaccines will be introduced in the areas most affected by malaria and information gathered will be used to determine the feasibility of introducing the vaccine for large scale use.

Above: The Bill & Melinda Gates Foundation supported the development and testing of the RTS,S malaria vaccine.

THE COMPLEXITY OF MALARIA

A study published this year has shown the potentially deadly malaria parasite has greater genetic diversity than scientists previously understood. A study involving more than 600 children from a single village in the West African nation of Gabon found that each had malaria caused by a different strain of the Plasmodium parasite – or a different composite of as many as 60 genes. The results suggest that scientists need to rethink their approach to malaria vaccines, since full immunity against all strains is needed to halt the disease.



THE PENGUIN MYSTERY

Some Antarctic penguins, such as the Gentoo, have increased their numbers by 40 per cent. Yet other species, such as Adélie, the most ubiquitous on the continent, have posted significant declines in some regions. After years of studies, researchers are now able to tell us why this is happening.

Adélie penguins have survived in Antarctica for nearly 45,000 years, adapting to glacial expansions and sea ice fluctuations driven by millennia of natural climatic changes. The Adélie penguin is one of two true Antarctic penguins – the other being the Emperor penguin. Unlike Emperor penguins, which breed on ice, Adélie penguins live all along the Antarctic Western Peninsula, and breed on rocky patches of ground during the austral (southern) summer, and migrate during the winter to the edge of the sea ice, where they are able to feed at sea.

However, over the past few years, Adélie and chinstrap penguins have shown a steady decline in numbers while another species, the Gentoo, continue to thrive. While this may seem a simple case of survival of the fittest, latest research from the icy continent is now revealing how the similar-looking fuzzy sea birds differ in their ability to win or lose against an ever-changing biosphere.

Research conducted by the University of Delaware suggests that unique 21st-century climate changes may pose an existential threat to many of the penguin colonies on the Antarctic continent.

The study, led by oceanographer Megan Cimino, found that up to 60 per cent of the current Adélie penguin habitat in Antarctica could be unfit to host colonies by the end of the century.

All living species need two basic things to survive: a place to breed and food to eat. Although weather conditions in the polar desert seem to be suitable for the penguins to breed, they have affected other factors the species is dependent upon for survival. The period of warming at the end of the last Ice Age melted the ice providing the penguins with bigger and better breeding spaces. But at the same time it depleted krill, the main food source of the Adélie and chinstrap penguins.

Food supplies have been further reduced by commercial fishing of krill and an increase in the humpback whale population, which also relies on krill. The Gentoo have been more flexible with their diet by including fish in their food, which means they have been able to adapt better to the shortage of krill. The Gentoo's larger built also allows them to dive deeper into the water, giving them access to more kinds of fish.





Above: Adélie penguin numbers have shown a serious decline in Antarctica's Western Peninsula.

Cimino explained the threat to the Adélie food supply: "Changes in [sea] ice and temperature can cause changes in the food, krill and fish." In some areas, she continued, "the fish populations have gone down a ton, so their major diet in those areas is krill. In other areas, these penguins eat more fish, which are a more nutritious food source."

Warmer temperatures also lead to rainfall and premature ice melt during the breeding season. According to Cimino, this could be bad news. "For penguins who lay their eggs on the ground ... rain and puddles are bad because eggs can't survive when they're lying in a pool of water. Chicks that don't have waterproof feathers can become wet and die from hypothermia."

Using a combination of field survey data and high-resolution satellite imagery, the researchers from the University of Delaware were able to stitch together 30 years of colony data, from 1981 to 2010, at sites ringing Antarctica. Looking at the year-to-year data, the researchers were able to identify population trends at each colony site for the full 30-year period.

The scientists found diverging trends at different sites. Some colonies, like the closely monitored population near Palmer Station, a United States research hub in northern Antarctica that has been there since the 1960s, saw declines of over 80 per cent.





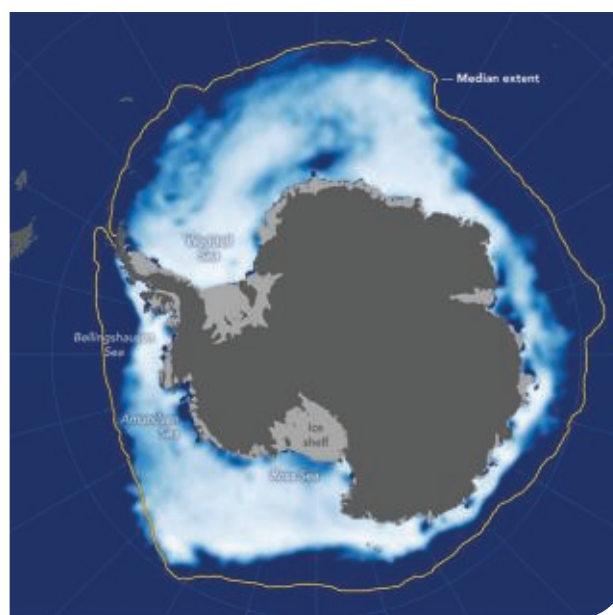
Palmer Station has been keeping accurate records for 45 years, and according to its lead researcher Shawn Farry: “The Adélie numbers on this island at their peak were almost 9,000, and this year it was about 1,200.”

Yet other sites were stable, and some even had growing colonies. Tellingly, the sites that experienced population declines over the study period were often sites that experienced novel climates, or conditions outside the range of historical observations.

The overall conclusion of the University of Delaware research was sobering. By 2060, about 30 per cent of the colonies may have lower populations, while 60 per cent of colonies will be in decline by the turn of this century. Overall, about half of the penguins could vanish by 2099.

A FRAGILE ECOSYSTEM

The five million square mile Antarctica ice sheet has always been particularly vulnerable to the effects of climate change and vice versa. Nicknamed ‘the canary in the coalmine’, the polar region shows the effects of climate change before they can be seen elsewhere in the world. Apart from playing an important role in influencing weather patterns, the polar desert provides valuable information about climate



THE ANTARCTIC TREATY

Given the importance and high sensitivity of the Antarctic region, a number of treaties and protocols have been put in place to protect it. The most important of these is The Antarctic Treaty of 1959, which was initiated by 12 countries. The treaty now has 52 signatories which affirm the protection of the Antarctic and that it will only be used for peaceful scientific research purposes. Today, the Antarctic Treaty System is recognised as one of the most successful sets of international agreements, setting an example of peaceful cooperation for the rest of the world. It is hoped that further agreements on fishing in the region may result in an increase in fish and krill numbers.

change patterns. Scientists believe that understanding climate change impacts on Antarctica is critical to understanding climate change around the world.

Both the Arctic and Antarctic regions are especially sensitive to even the slightest rises in the annual average temperature. The West Antarctic Peninsula, where the biggest declines in Adélie penguins was found, is one of the fastest warming areas on Earth, with only some areas of the Arctic Circle experiencing faster rising temperatures. In the past five decades, temperatures in this region have increased by nearly 3°C – that is 50 times faster than the average in the rest of the world. The resulting changes in sea ice concentration (SIC), or the relative area of water covered by sea ice, affect not only penguins, but also the entire Antarctic food web, down to the smallest of species.

Similarly to penguins, some species of seals and whales are considered to be ice-dependent for food and reproduction, while others do better in ice-free conditions. Crabeater, Weddell, Ross and Leopard

Above: In 2016, Antarctica's sea ice coverage was well below the norm that is indicated by the yellow line.

Above centre: Adélie penguins nest on rocky ground.





seals are ice-dependent species, reliant on sea ice for reproduction and foraging. Southern Elephant and Fur seals, however, are not as dependent on the ice for feeding, wintering and breeding. The changing climate has had a visible effect on seals, with large increases in the ice-avoiding Fur and Southern Elephant seals, and declines in ice-dependent Crabeater and Weddell seals. However, there are many factors that influence population dynamics and it would be a mistake to attribute these increases or decreases solely to any one factor.

Still, it is undisputable that sea ice serves as the basis for Antarctic ecosystems and most organisms' life cycles in this region are attuned to ice seasonality, according to a 2013 research paper. The large phytoplankton blooms that occur in the spring and summer attract species from around the globe to feed on the krill that these blooms support. In Antarctica, a wide array of species is dependent on krill, including penguins, seabirds, seals and whales.

Krill are tiny shrimp-like crustaceans that act as a keystone species in Antarctica, meaning that they are critical to ecosystem functioning, but a 2010 study found that the density of krill populations has declined 80 per cent since the 1970s. This is due to a variety of factors, including over-harvesting, sea ice loss, and ocean warming and acidification.

Antarctica's East and West parts are two geologically distinct regions separated by the great Trans-Antarctic Mountains but joined together by the all-encompassing ice sheet. This ice sheet serves as a powerful heat sink strongly affecting the climate of the whole Earth. The annual sea ice cover around Antarctica is also responsible for modulating

exchanges of heat, moisture, and gases between the atmosphere and ocean. World sea levels would rise by more than 60 metres if the Antarctic ice sheet melted completely. In the past few decades, large changes have occurred in the ice cover of the Western Peninsula. Many glaciers and ice shelves that formerly fringed the Antarctic have either retreated or have collapsed completely.

The most dramatic and immediate impact of climate change has not only affected the Adélie penguin and krill populations. The Emperor penguin also faces significant threat if the temperature rises by even a further 2°C. According to some projections, 20 per cent of Emperor penguin colonies will be nearly extinct by 2100. The Antarctic Toothfish is also highly vulnerable.

While the projections look grim for the penguins at northerly latitudes, the study did identify several refugia where the penguins could continue to thrive. Climate refugia are locations where animals could survive periods of adverse climate, safe havens that could support them in an otherwise uninhabitable world.

In the face of a warming climate, the Adélie penguins may find refuge in the Ross and Amundsen Seas. These areas are thought to have been glacial refuges in the past, and climate projections suggest they may provide refuge again in the future.

Even though Antarctica is remote and can seem far removed, the changes that are underway will not only affect the species that live there but, because many of the continent's species are migratory, may have ripple effects for marine biodiversity in oceans around the globe.†

Above: Declining krill numbers are having a negative effect on the Antarctic food chain.

Left: According to estimates nearly 20 per cent of Emperor penguin colonies will be extinct by 2100.

A large solar-powered aircraft, resembling a glider with a long, thin wing and multiple small solar panels, is shown in flight against a clear blue sky. The aircraft is positioned in the upper right quadrant of the frame. Below it, a vast, rugged mountain range stretches across the horizon, with peaks and valleys covered in dense green vegetation. The overall scene conveys a sense of exploration and environmental technology.

THE DEMOCRATISATION OF THE INTERNET

There are plans to send thousands of small satellites into low Earth orbit to provide internet to the 49 per cent of the population that have little or no connection. However, not everybody is happy with this idea.

In February 2017, India's space agency launched a record 104 satellites from a single rocket. It first released its main cargo, ISRO's 714-kilogram Cartosat-2 series satellite, which is being used for Earth observation. It then released two smaller ISRO satellites, followed by the remaining 101 nanosatellites, 96 from the US and one each from other countries like Kazakhstan, Netherlands, Switzerland and the United Arab Emirates.

If everything goes according to plan, the launch of smallsats, nanosats and CubeSats could become a common occurrence.

The main driving force behind these small satellites is internet access. Most of us take internet access for granted as mobile phone companies throw unlimited gigabytes at us. 4G (and 5G) are making mobile web access ever faster, and it's increasingly accessible from everywhere you go. However, that's not the whole truth.

More than 3.8 billion people around the world used the internet in April 2017, up by 38 million from January 2017. This one per cent increase takes global internet penetration to 51 per cent, which means 49 per cent of the global population is still not connected or only has access to intermittent or very slow service.

The simple truth is that the internet is still under construction. It looks increasingly likely that the next step – after undersea cables and fibre-optic networks for cities – could be satellite. Satellites currently carry barely one per cent of global web traffic, but there's a space race on to increase that up to 10 per cent.

However, satellites have generally been regarded as a last resort for internet access and they are mainly used by very remote island communities. There are two main reasons for this.

Firstly, a standard satellite is prohibitively expensive. The more than 2,000 satellites that are currently in our planet's orbit mainly handle TV, imaging, weather, Earth observations and GPS at a cost of around \$65 million per launch.

However, they host precious little two-way traffic, which brings us to the second reason: latency. Satellite internet has been around

for years, but extreme latency – the half second gap in time between the satellite receiving a request and responding to it – is a problem, making it impractical for real-time or near real-time applications such as online games or teleconferencing tools such as Skype.

The answer to overcoming latency is to bring the satellites closer to Earth. By placing them in a low Earth orbit, which ranges from roughly 100 to 1,250 miles above the planet, latency would be cut from 500 milliseconds to 20 milliseconds, which is the average of a fibre optic home internet connection in the US.

Low Earth orbit creates its own problem however. The catch is the signal from those satellites won't be able to cover as much of the planet's surface as satellites in geosynchronous orbit some 22,000 miles up. That means the companies looking at this approach will have to launch far more satellites to make up for the difference.

That is a factor that entrepreneurs are well aware of. Greg Wyler, founder and chairman of OneWeb, set up the company in 2012 with the mission of enabling internet access for everyone by 2027. In order to achieve this, OneWeb plans to build a network of around 700 CubeSats to blanket the Earth. These will be launched mostly on the back of Virgin Galactic's (one of its investors) LauncherOne rocket, which takes off from under the wing of a Boeing 747. OneWeb's investors include the Virgin Group itself as well as Qualcomm, Airbus, Coca-Cola, Intelsat and Hughes Network Systems. Its satellites are being built by Airbus, and should start launching in 2018 to sit about 500-750 miles above Earth. At 6Gbps apiece, 700 satellites would equal to a total capacity of about 4.2Tbps.

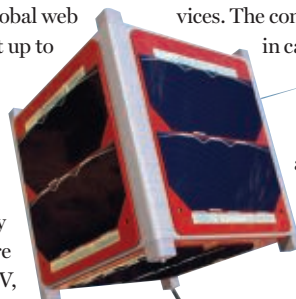
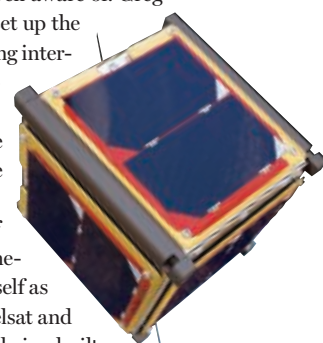
Elon Musk, the PayPal founder and owner of SpaceX, is planning a network of around 4,000 CubeSats to beam a Wi-Fi signal to the most remote regions, thereby turning his company into a global communications provider. Korean tech giant Samsung is also planning a network of 4,000 satellites, while US aerospace company Boeing is looking at 2,900.

A new player is Kepler Communications, a small satellite startup, which is designing a constellation of CubeSats for the Internet of Things (IoT) and inter-satellite communications services. The company recently announced it had raised \$5 million

in capital through an oversubscribed seed round, along with plans to potentially deploy an initial service in the second half of 2017.

Facebook and Google also want to get in on the action, albeit with a different approach. Facebook's Connectivity Lab wants to fly solar battery-powered Wi-Fi drones called Aquila at 22,000 metres – above regulated airspace and in a layer of the atmosphere that is largely free from strong winds and bad weather – to broadcast a powerful signal to towns and cities below for several months at a time.

Google's Project Loon – which is currently being tested – will see Wi-Fi balloons at an altitude of between



AQUILA

To help bring internet connectivity to more people, Facebook is designing solar-powered airplanes that will beam internet signal to people in remote, underserved regions within a 60-mile diameter. Each aircraft is designed to be in the air for up to 90 days at a time.

FLIGHT ALTITUDE

Aquila is designed to fly at altitudes between 60,000 and 90,000 feet.

GO-MILE COMMUNICATION DIAMETER

WINGSPAN

Aquila has a wingspan bigger than a Boeing 737 airplane.



WEIGHT

Aquila weighs a third as much as an electric car. About half the mass of the airplane is devoted to batteries.



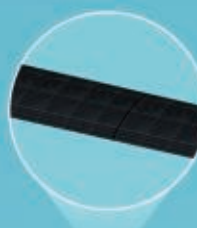
POWER USAGE

At 60,000 feet, Aquila can fly using just 5,000 W of power — about as much as three hair dryers.



WHY SOLAR

Solar airplanes are a less expensive way to deliver internet than fiber or microwave links. They require less maintenance, and don't need to land as often as traditional aircraft.



SPEED

Because it's very large, Aquila is very slow. It flies at less than 80 miles per hour. That's the best endurance speed, allowing Aquila to stay aloft for months at a time.

10km and 60km up use software algorithms to determine where its balloons need to go to fill gaps in global web connectivity, moving between layers of wind in the stratosphere to create a huge mobile Wi-Fi network.

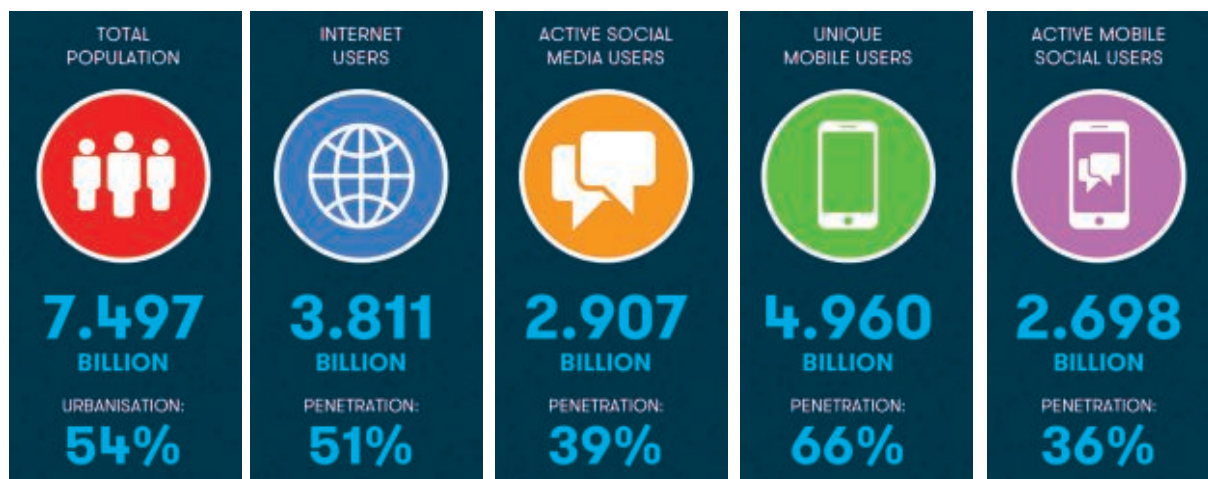
The idea of creating a network of satellites in low Earth orbit is not a new one. Several companies launched with that mission in the 1990s, the most famous of which was Teledesic, funded by Bill Gates, early cellular service entrepreneur Craig McCaw, and Saudi prince Alwaleed bin Talal. The much-hyped company planned an 840-satellite constellation but was plagued with setbacks until it suspended operations in 2002 and relinquished its wireless spectrum rights to the FCC in 2003.

The failure of Teledesic and its contemporaries has left many observers cynical about the prospects of the latest crop of would-be satellite providers.

"These large constellations are very inefficient," says Roger Rusch, a satellite communications industry analyst.

However, the tech is changing. The size and cost of satellites is drastically decreasing, with so-called CubeSats, nanosats and smallsats — some as little as 10 x 10 x 10cm — costing about \$57,000 to make and as little as \$122,000 to launch. These smallsats are designed to fly in constellations in a very low-Earth, Sun-synchronous orbit, as low as 350 miles up.

THE LATEST NUMBERS FOR INTERNET, SOCIAL MEDIA AND MOBILE USAGE AROUND THE WORLD



Rusch, the satellite communications industry analyst, acknowledges that the small satellites SpaceX and OneWeb hope to use are less expensive today than they were in the 1990s, but says they're still too costly. "They're cheaper, but you need 4,000 of them, so they need to be 1,000 times cheaper," he says.

Although the idea of bringing the internet to everyone is a noble one, the launching of so many smallsats is also a potential hazard as there's nothing to stop these sprawling "megaconstellations", which would include thousands of spacecraft, from colliding with other satellites and unleashing hazardous space debris in low Earth orbit.

Hugh Lewis at the University of Southampton in the UK has sounded the alarm about the risk of small satellite collision cascades before. That was in 2014, when 100 or so CubeSats were being launched per year.

Lewis and his colleagues used a supercomputer to simulate 200 years of possible orbits for 300 different megaconstellation scenarios. The supercomputer revealed that megaconstellations boost the risks of a catastrophic collision – in which a satellite is completely destroyed – by 50 per cent. Their results, which were revealed at a European Space Agency conference on space debris in Germany, suggested a raft of new rules need hammering out to reduce debris risks.

Numbers are just one problem: the small, mass produced CubeSats generally lack any motors or other ability to avoid collisions. One big fear is that debris fragments will collide with other spacecraft, causing a chain reaction known as Kessler syndrome, named after former NASA scientist Donald Kessler, who worked out the theory in 1978.

"Megaconstellations represent a unique problem, especially when comprised of CubeSats," Kessler says. "Any benefit from the small CubeSat size is more than offset by their numbers. But also because of their small size they are more vulnerable to small debris – debris

that is smaller than can be tracked by any network."

Lewis and his colleagues have called for space agencies, which regulate launches and debris mitigation measures, to bring dead satellites down sooner. Current rules order that satellites must de-orbit and burn up within 25 years after their mission ends, but that's too long for megaconstellations, Lewis says.

The team also suggests mandating onboard propulsion systems for small satellites so they can avoid collisions and steer themselves into Earth's atmosphere to de-orbit at the end of their lives. Making satellites smaller and lighter – to reduce collision energies – would also help.

It may already be too late. According to the Nanosatellite Database as of March 2017, 685 nanosats had been launched along with 613 CubeSats. There are also currently 405 nanosatellites in orbit of which 321 are operational. It remains to be seen what happens when thousands more join them in low Earth orbit. ↑



Above: Greg Wyler, founder of OneWeb, wants to enable global internet access by 2027.

WHAT ARE CUBESATS?

According to Nasa, CubeSats are a class of nanosatellites that use a standard size and form factor. The standard CubeSat size uses a "one unit" or "1U" measuring 10x10x10 centimetres and is extendable to larger sizes; 1.5, 2, 3, 6, and even 12U. They were originally developed in 1999 by California Polytechnic State University at San Luis Obispo (Cal Poly) and Stanford University to provide a platform for education and space exploration. The development of CubeSats has advanced into its own industry with government, industry and academia collaborating to increasing their capabilities. CubeSats now provide a cost effective platform for science investigations, new technology demonstrations and advanced mission concepts using constellations, swarms and disaggregated systems. NASA Ames launched its first CubeSat, GeneSat, in December 2006. Since then Ames has launched 16 CubeSat spacecraft varying in size from 1U to 3U with an additional 12 CubeSats in development or awaiting launch.

THE VALUE OF CULTURAL TOURISM

The UAE, as well as other GCC states, are investing heavily in the world's growing cultural tourism market.



Cultural tourism is one of the largest and fastest-growing global tourism markets, according to the OECD. Figures from the World Travel Organisation indicate that culture and heritage tourism accounts for 37 per cent of all global travel and is worth more than \$1 trillion annually.

Culture and creative industries are increasingly being used to promote destinations and enhance their competitiveness, uniqueness and attractiveness. As a result, many locations are now actively developing their tangible and intangible cultural assets as a means of developing comparative advantages in an increasingly competitive tourism marketplace, and to create local distinctiveness in the face of globalisation.

There is no denying the fact that culture and heritage tourism tends to attract high-yield tourists. While global figures can be hard to obtain, all available statistics on tourism in various individual markets such as the UK, New Zealand, Australia and India reveal a consistent pattern. Culture and heritage tourists often stay longer and spend a lot more money in general than other tourists do. In fact, one study showed that a culture and heritage tourist spent as much as 38 per cent higher per day and they stayed 22 per cent longer overall compared to other kinds of travellers.

Tourism is a growth business. From 2010 to 2015 the Travel & Tourism sector outpaced the global economy. In

2015 tourism grew at 2.8 per cent while the global economy only managed 2.3 per cent. In total, Travel & Tourism generated \$7.2 trillion in 2015 (9.8 per cent of global GDP) and supported 284 million jobs, equivalent to 1 in 11 jobs in the global economy.

Against this background it is not surprising that GCC countries are targeting cultural tourism as part of their overall strategy to grow their tourism sectors to help diversify their economies.

The UAE has been on a steady upwards tangent when it comes to developing its cultural attractions. Dubai is currently spending millions of dirhams to revive its Historical District and attract the 12 million tourists out of the estimated 20 million expected to visit the emirate when it hosts the World Expo 2020, to the old parts of the city. Bastakiya has received an investment of AED 150 million to redevelop its historic district along Dubai Creek. The emirate has also resubmitted its bid to get the historic quarter listed as a UNESCO World Heritage Site. This initiative is expected to transform the area into the leading culture and heritage centre of the region with Shindagha, Bur Dubai, Al Fahidi and Deira districts getting a new look to revive the old charm of the historical sites.





Top: Dubai's historic Bastakiya district reflects the emirate's diverse cultural heritage.

Above: Dubai Opera, which cost \$330 million, is building cultural bridges between East and West.

Dubai Opera, an investment of \$330 million, has also helped put Dubai on the cultural map, further aided by the opening of the Etihad Museum in January, which tells the story of the birth of the UAE. According to a report by Colliers International, Dubai's 35 festivals and two film festivals in 2015 attracted more than 50,000 guests.

Dubai has also seen an increase of 127 per cent in the number of visitors to its most popular museums and galleries, taking the total number of visitors to just five of the emirate's museums to 1.75 million in 2015. Last

year the Saruq Al-Hadid Archeology Museum opened, featuring artefacts unearthed from the recently discovered Iron Age archeological site of Saruq Al-Hadid. More discoveries are being at the site daily, which is why the museum's display is changed every three months. These numbers will receive a further boost over the coming 24 months with the opening of the Museum of The Future in 2017 and the 66,000 square metre Mohammed bin Rashid Library in 2018.

In May, the Dubai Culture and Arts Authority, Dubai Culture, established the Dubai Museums Company to support Dubai's vision of becoming a regional and global focal point for diverse cultural exchange.

The new company will manage all Dubai Culture's museums and be responsible for concluding agreements between public and private bodies locally and internationally in all areas related to museum operations and development. It will also develop and organise cultural exhibitions, events, workshops, programmes, conferences, seminars and training courses related to the museum sector, as well as managing all commercial activities in these museums.

Abu Dhabi, the UAE's capital, is also working on its cultural credentials. One of Abu Dhabi's most-visited cultural attractions is Sheikh Zayed Grand Mosque, which was named by Tripadvisor as the world's second most popular landmark for 2017, while Saadiyat Island will be home to the Louvre, Guggenheim and Zayed National Museum by 2020. It was also announced this

SOCIAL BENEFITS OF CULTURAL AND HERITAGE TOURISM

- Helps build social capital
- Promotes preservation of local traditions, customs and culture. UNESCO now recognises intangible cultural heritage as being as important as buildings. A market for experiences and traditional projects provides the economic support for keeping these skills and traditions alive
- Promotes positive behaviour
- Helps improve the community's image and pride
- Promotes community beautification
- Builds opportunities for healthy and useful community relationships and partnerships
- Provides research, education and work-placement opportunities for students
- Creates enjoyable opportunities for both local residents and visitors attracted to the cultural arts, history and preservation
- Boosts local investment in heritage resources and amenities that support tourism services

year that Qasr Al Hosn, the symbolic birthplace of Abu Dhabi and longtime home of the ruling Al Nahyan family, will undergo a year-long renovation.

However, other GCC countries are also focused on getting their share of cultural tourism.

According to the research compiled by Colliers, Saudi Arabia is ready to invest up to \$2 billion – one of the highest commitments of any government to cultural tourism in the region – with a number of projects and targets set out under Saudi Vision 2030.

As part of this plan by 2030, Saudi Arabia will increase the number of public and private museums from 155 to 241, increase the number of UNESCO World Heritage Sites from four to 10 and develop the number of archaeological sites suitable for visits from 75 to 155.

In addition, the kingdom will increase the number of archaeological heritage sites from 10 to 28 and increase the number of activities and cultural events from 190 currently to 400 annually.

In 2015, Oman pledged investments of \$2.5 billion for the Omani Project – a mixed-use development set on 245 acres of prime beachfront facing the Gulf of Oman, which is an integration of cultural, heritage, educational, entertainment and residential elements.

Its completion will add to Oman's growing cultural tourism sector, which includes 18 museums, four UNESCO World Heritage Sites, the Royal Opera House Muscat and Sultan Qaboos Grand Mosque, among others.

It is clear that cultural tourism is being targeted across the region. However, the UAE has the first mover advantage and its growing portfolio of heritage and modern attractions is resounding with the travelling public. The fact that Dubai hosted 4.57 million tourists in the first three months of the year compared to 4.1 million a year earlier is a positive indicator for the future. ↑

DUBAI MUSEUM TIMELINE

1971

Dubai Museum

1986

Sheikh Saeed Al Maktoum House, Dubai

1987

Dubai Police Museum

1997

Heritage Village Dubai

2006

Dubai Municipality Museum

2012

Women's Museum, Dubai

2013

UAE Currency Museum

2014

Dubai Coffee Museum

2016

Saruq Al Hadid Museum

2017

Etihad Museum



Traditional abras are part of the Dubai Creek experience.

WATER FROM THE AIR

Using a metal-organic framework, a team of scientists has been able to collect water directly from the atmosphere using only the sun's power.





Even in the desert, there is plenty of water around. According to scientists, atmospheric water is a resource equivalent to 10 per cent of all the fresh water in lakes on Earth. However, a process to capture water efficiently and cheaply from the air, especially at low humidity levels (down to 20 per cent) has not yet been developed. As fate would have it, 20 per cent is a humidity level that characterises many of the world's arid regions.

Technologies do exist for extracting water from very moist air, such as "fog harvesting" systems that have been deployed in a number of coastal locations. And there are very expensive ways of removing moisture from drier air.

Fog harvesting, which is being used in many countries including Chile and Morocco, requires very moist air, with a relative humidity of 100 per cent. Another method of obtaining water in dry regions is called dew harvesting, in which a surface is chilled so that water will condense on it, as it does on the outside of a cold glass on a hot summer day, but it is extremely energy intensive to keep the surface cool, and the method may not work at a relative humidity lower than about 50 per cent.

It is for this reason that a paper recently published in the journal *Science* has made waves. The new technology, developed by scientists at MIT and the University of California at Berkeley, could provide a novel way of obtaining clean, fresh water almost anywhere on Earth, by drawing water directly from moisture in the air even in the driest of locations.

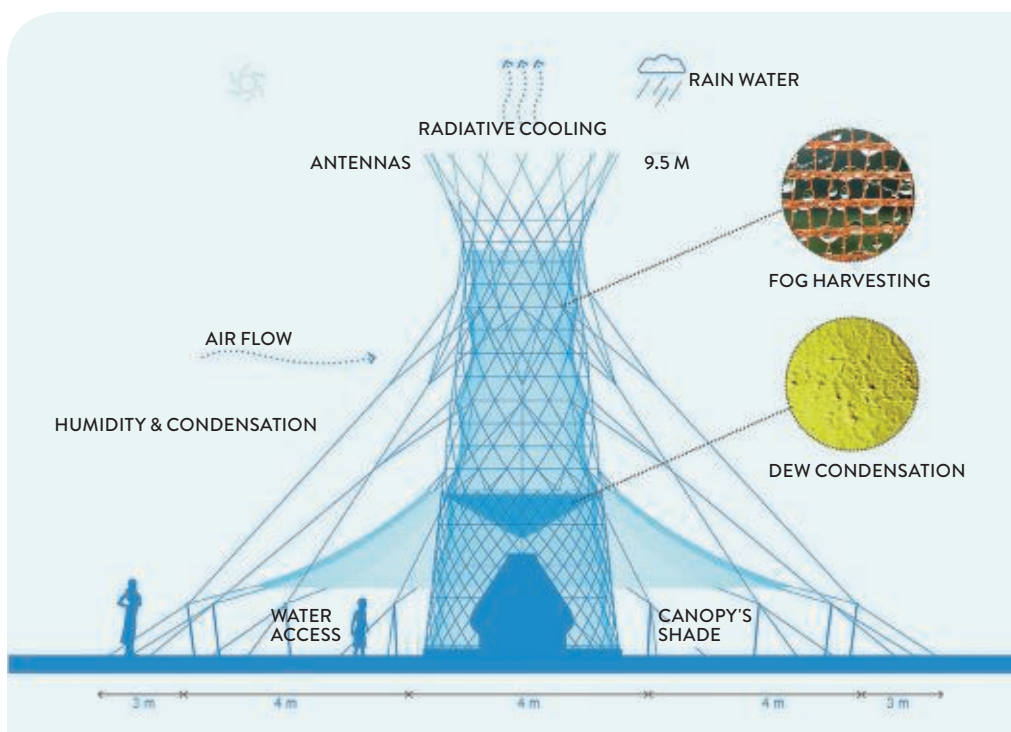
The new approach makes use of a substance called MOF, a metal-organic framework. As the name suggests, these are materials made of metals mixed with organic compounds. Powders made from MOFs are very porous, so researchers have proposed using them to store hydrogen or methane fuels or to capture carbon dioxide. In this case, however, MIT's Evelyn Wang and her Berkeley colleague Omar Yaghi decided to try using MOFs to capture water. MOF powders not only suck up liquid water, they can also absorb water vapour.





Above: Omar Yaghi is the creator of metal-organic frameworks.

Right: The Warka Water Tower collects water through fog harvesting and condensation.



Yaghi is the scientist who created the new classes of compounds known as metal-organic frameworks (MOFs), zeolitic imidazolate frameworks (ZIFs), and covalent organic frameworks (COFs). MOFs are noted for their extremely high surface areas (5,640 m²/g for MOF-177) and very low crystalline densities.

The MOFs that Yaghi invented two decades ago have a sponge-like configuration with large internal surface areas. By tuning the exact chemical composition of the MOF these surfaces can be made hydrophilic, or water-attracting. The MOF used in this experiment was a tangled lattice of zirconium and fumarate, an organic compound. Such frameworks are composed of a dense knot of threads perfect for holding on to molecules. By altering the composition of the framework, MOFs can be optimised to grab different kinds of compounds – anything from hydrogen and methane to petrochemicals.

The team found that when the lattice of zirconium and fumarate is placed between a top surface that is painted black to absorb solar heat, and a lower surface that is kept at the same temperature as the outside air, water is released from the pores as vapour and is naturally driven by the temperature and concentration difference to drip down as liquid and collect on the cooler lower surface.

The researchers tested their small prototype water collector on the roof of their laboratory building. The thin layer of MOF powder absorbed water vapour until it was saturated.

“Once you achieve that maximum amount,” Wang says, “you apply some type of heat to the system to release that water.” In this case sunlight did the trick, – but any source of heat, even a wood fire, would work.

There are other compounds that can suck water from the air, zeolites for example, but Wang says it takes a significant amount of energy to get these materials to release the water. Not so with a MOF device. “The amount of energy required is very low,” she says. In the prototype, the heat needed to drive the water out of the MOF comes from ambient sunlight – no external power supply is needed. The prototype needed 1kW per square metre to function and was capable of harvesting 2.8 litres of water per kilogram of MOF daily at humidity levels as low as 20 per cent. That is enough to supply drinking water for one person.

The system is so simple that it would only require attention a few times a day to collect the water, open the device to let in fresh air, and begin the next cycle. What’s more, MOFs can be made by combining many different metals with any of hundreds of organic compounds, yielding a virtually limitless variety of different compositions, which can be “tuned” to meet a particular need. So far more than 20,000 varieties of MOFs have been made.

“By carefully designing this material, we can have surface properties that can absorb water very efficiently at 50 per cent humidity, but with a different design, it can work at 30 per cent,” says graduate student Hyunho Kim, who worked on the study. “By

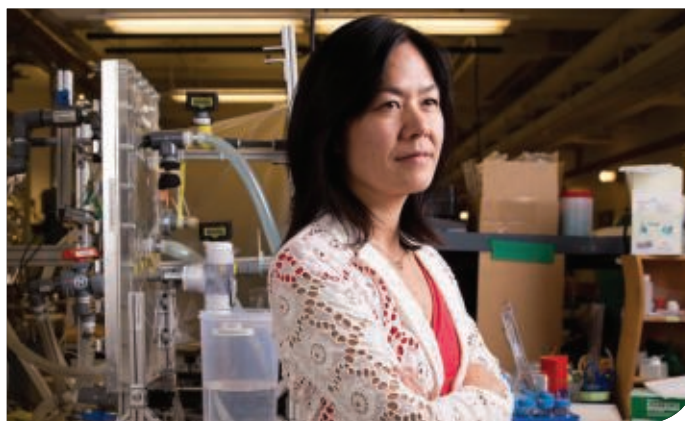


selecting the right materials, we can make it suitable for different conditions. Eventually we can harvest water from the entire spectrum of water concentrations.”

Wang expects scaling up the prototype won't be all that expensive. Although MOFs are a relatively new material, “there are companies that already make various MOFs at very large bulk scales,” she says. The present version can collect water up to about 25 per cent of its own weight, but with further tuning the research team thinks that proportion could be at least doubled.

Yaghi, who is the founding director of the Berkeley Global Science Institute, says “One vision for the future is to have water off-grid, where you have a device at home running on ambient solar for delivering water that satisfies the needs of a household. ... To me, that will be made possible because of this experiment. I call it personalised water.”

While these initial experiments have proved that the concept can work, the team says there is more work to be done in refining the design and searching for even more effective varieties of MOFs. To keep water flowing constantly, the researchers say that the system could soak up water overnight to disperse during the daytime, or it could be designed to force more air through, increasing the rate of water collection. The key advantage of their material is the lack of any artificial power source. After all, we pull moisture out of the air with dehumidifiers, but they also suck up a good deal of electricity. Powering the device with sunlight bypasses that requirement, especially important in developing nations lacking infrastructure.



There are many steps before a mass-produced MOF-based water collector becomes a reality. It hasn't been shown, for example, that the water released by the MOF powder is free of contaminants.

Other devices that rely on a similar concept have been proposed, such as the Warka Water Tower. Using designs borrowed from desert plants, the tower exploits temperature swings between day and night to capture water and funnel it to a tank. The MOF material operates in a similar way, but the porous mesh allows for more water to be held in a smaller area.

Whichever way, it is highly likely that one day you might be in the UAE's Empty Quarter and you'll be able to have a drink with a device based on Wang and Yaghi's concept. ↑

Top: In countries such as Chile fog harvesting is used.

Above: Evelyn Wang worked with Yaghi on the prototype water collector.

LIKE FATHER, LIKE SON

Abdulla and Abdul Aziz Al Ghurair have taken philanthropy to a new level with a special focus on education.

The popular Arabic proverb, “If you are charitable, you are rich”, applies in every sense to the Dubai-born billionaire and educational benefactor, Abdulla Al Ghurair. A scion of one of the UAE’s most respected and wealthy families, Abdulla was born into wealth and has spent a lifetime building his family’s business interests and giving back to his nation through various humanitarian and philanthropic initiatives.

Born into privilege, Abdulla did not take such gifts for granted and was aware as a young man that one of the world’s greatest challenges is a lack of education. More than 50 years ago Abdulla opened the first of the many schools he has established. Founded in 1964, the Masafi School was located in the emirate of Fujairah and was the UAE’s first boarding school. It attracted students from all over the UAE and it has produced some impressive alumni – people who today are captains of industry and cabinet ministers.

More schools followed, some of which remain the best in the country, and together they are the predecessors of the largest privately-funded philanthropic education initiative in the world

– the Abdulla Al Ghurair Foundation for Education (AGFE).

The AGFE is the culmination of a lifetime’s charitable work in the field of education, and as a non-profit, philanthropic organisation it will provide scholarships for 15,000 Middle Eastern students over the next 10 years. Initially the AGFE will focus on UAE nationals and Arab citizens living in the country before expanding to include Arab youth from all over the Arab World.

Founded on July 7, 2015, with the donation of AED 4.2 billion/\$1.14 billion – approximately one third of the Al Ghurair company’s assets, the Arab world’s largest education fund will provide grants for underprivileged and underserved youth from all across the region. Commenting on the founding of the AGFE and the continuation of his legacy, Abdulla says, “Seeking an education is not only about personal achievement, it is our civic and religious responsibility as Arabs and Muslims. I hope this foundation will help deserving young Arabs fulfil their education quest and that they in turn will help others.”







Above: CEO Maysa Jalbout, Chairman HE Abdul Aziz Al Ghurair and Professor Eric Grimson, Chancellor for Academic Advancement, MIT at the launch of the Abdulla Al Ghurair Open Learning Scholars Program.

Another proverb of marked relevance here is the ancient, “Like Father, Like Son”, frequently used to assert the continuity of family traits. Abdul Aziz Al Ghurair has taken after his father in both his formidable business acumen and his desire to give back to the community through philanthropy. While his father founded Mashreq bank – the largest private lender and oldest commercial bank in the UAE – with \$1.6 million worth of investment capital 40 years ago, Abdul Aziz has always had a firm grip of the reins and helped to drive the family business affairs – in sectors ranging from real estate and food produce through to construction materials, publishing and petrochemicals – from strength to strength.

Abdul Aziz is the CEO of Mashreq bank, a former Speaker of the House of the UAE’s Federal National Council, and Chair of the AGFE’s board of trustees. Much like his father, Abdul Aziz has for decades engaged in charitable and philanthropic ventures, but usually in a discreet manner. The creation of the AGFE posed a challenge in that the usual anonymous giving would not be as effective nor achieve the goal of widespread education for those otherwise unable to access it, without some fanfare and promotion.

The father and son team are creating a roadmap for significant change in the region – a paradigm shift that will ensure the future diversification and prosperity of the region and support generations of Emirati and Arab youth by providing the skills they need to become future

leaders. Abdul Aziz must ensure that his father’s vision becomes reality and reflecting on the required approach in an AGFE film, he says, “In the UAE and in the Arab world in general there are plenty of philanthropists. Usually their philosophy is that your left-hand should know nothing about what your right hand gives. But today the economy has grown, and so has giving. So, philanthropy had to become an institutional endeavour. This led to discussions with my father, as he was of the view that we shouldn’t announce the work of the foundation and continue to work discreetly away from the spotlight.

“This might have been possible in the old days, but today the population has increased. How can I get 15,000 students in 10 years without announcing and promoting the initiative? Hence, we managed to convince my father that it should be institutionalised work and continue on that basis. Accordingly, we now have a foundation that is run by a CEO just like any of our other enterprises”.

The CEO in question is Maysa Jalbout, former director of research and strategy at the office of Her Majesty Queen Rania Al Abdullah and former CEO of the Queen Rania Foundation and vice-chair of the Jordan River Foundation. With a background in creating and leading multi-country programmes and implementing innovative policies in foundations and NGOs in the Middle East, the USA and in the developing world, she is ready to drive the success of the AGFE.



In her keynote address entitled, Our Youth; Our Future: Continued Nation-Building and a Sustainable Future for our Emirati Youth, at the Sharjah Chamber of Commerce and Industry on March 6, 2017, Jalbout said, "The Foundation was born out of what Abdulla Al Ghurair and his family learned over five decades – that education and economic prosperity are deeply interdependent. The economic growth of the UAE must be matched by its education progress."

Considering the challenge ahead Jalbout added, "The pace and magnitude of the changes that Emirati youth will need to adapt to requires bold and innovative education approaches and a relentless focus on results. Together we hope to chart a new path for collaboration between private philanthropy, government, employers and the education community in the UAE and beyond."

To this end the AGFE will partner with some of the world's most lauded education institutions and it will focus on the academic subjects that address the needs of the local and global economy and the priorities of nation building – primarily science, technology, engineering, and mathematics (STEM). Abdul Aziz says, "We provide scholarships in the specialisations that we need in the United Arab Emirates and the Arab world. Thus, our scholarships focus on science, mathematics, engineering, applied sciences. Basically, everything that is new and drives the economy forward towards the prosperity of Emirati and Arab citizens. This was our target... We had to choose the topics that were most relevant for the progress of our nation".

The donation of one third of the Al Ghurair Group company's wealth is not intended to be a one-time gift. Rather the intention is to give for decades and beyond. As long as the economy and the family's broad portfolio of businesses permits, a one-third donation of assets will continue for decades to come and beyond.

In fitting conclusion Abdulla Al Ghurair says, "Education is the cornerstone of prosperous, progressive and inclusive societies, and it is essential for the sustainable development of our nation and the empowerment of our future leaders".

Abdulla Al Ghurair's contribution to philanthropy in the Arab world was recognised in 2016 when the Arab League Educational, Cultural and Science Organisation appointed him as the first goodwill ambassador for education in the Arab World.

Above: The Abdulla Al Ghurair foundation for Education will provide scholarships for 15,000 Middle Eastern students over the next 10 years.





THE BEAUTY OF LIGHT

The use of light plays a central role in Islamic architecture, especially in terms of religious buildings.

British artist, author and architect Ian Richie wrote in 2002. “The history of architecture can be described as the story of the way day and sunlight enters into buildings and reveals through shadow the spatial composition and forms within. Sunlight allows space and form of architecture to change. Through light and shadow architecture acquires shape and meaning. Light reveals a building’s contours and shadow, its depth.”

Nowhere more so, perhaps, than in the architecture of Islam. Within mosques, palaces, and even within individual homes, light enhances and illuminates. It is channelled, reflected, filtered. The great architects of the Islamic world played with light using windows, skylights and oculi; mosaics, glass, mirrors and tiles; and the nuanced use of colour and contrast.

In a paper written for the first International Conference on Islamic Heritage, Architecture and Art held in Valencia last year, Majdi Faleh wrote that light is timeless, dynamic and transformative, accentuating the beauty of interiors and exploring the duality between light and pattern.



Below: Extensive use was made of gold in Islamic architecture for its ability to radiate light.

“Light plays an important role in religious architecture as it contributes to creating spaces that transcend our everyday experience,” says Kevin Mitchell, vice provost for undergraduate affairs and instruction at the American University of Sharjah and a professor at the university’s College of Architecture, Art and Design. “For example, light can serve to focus attention on a particular element in a building or result in a shimmering effect on a reflective surface like polished stone or water. As the revelation and rise of Islam took place in a region that is characterised by intense sunlight, the builders of early mosques mastered techniques to control and manipulate light in ways that enhanced the interplay between material such as stone and wood and the particular qualities of light.

“Just as private dwellings in the region historically turned inward to maintain privacy and mediate the impact of climate, religious buildings created interior spaces that often stood in stark contrast to the surrounding environment. Whereas uncontrolled sunlight can be harsh and may result in physical discomfort, builders and architects of religious buildings throughout the Islamic world developed means to control and manipulate light to create interior-oriented worlds for worship, study and contemplation.”

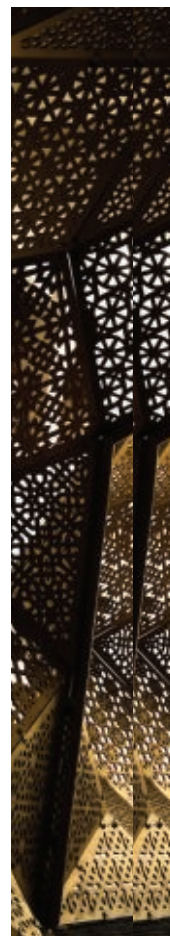
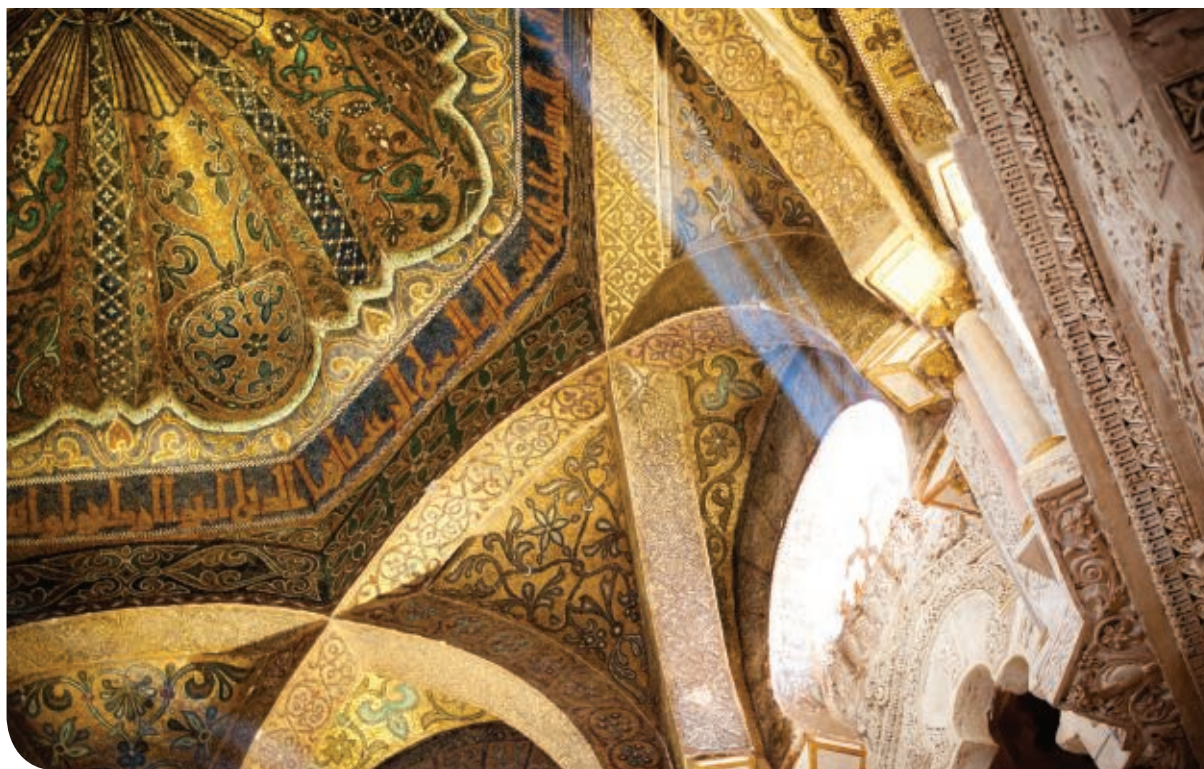
“Light certainly is one of the most important design elements in Islamic architecture,” adds Julia

Gonnella, curator at the Museum of Islamic Art in Doha. “It enhances ornament and structure, relying on the play of light and shadow. Key examples are the mashrabiyas or jalis that mediate the amount of light that enters the space.”

Traditionally made of small pieces of turned wood assembled into intricate geometric patterns, jalis (lattice screens) are synonymous with Islamic architecture. They also have multiple functions, not only casting beautiful patterns of light and shadow, but providing privacy and helping to maintain cooler interiors in hotter climates. Similarly, a mashrabiya – a type of projecting window used on second floors and above – was enclosed with carved wood latticework and often lined with stained glass.

Indeed, the methods used to allow light to illuminate and enhance a building were numerous, as Mitchell explains. Islamic architects “heightened the interplay of light and shadow by creating changes in the depth of a building façade, placing water in direct sunlight to create a reflective surface, using glazed tiles to create a shimmering effect, using a mashrabiya, carved [jali] screens or coloured glass to filter light, and employing muqarnas to refract light”, he says.

“In the design of architecture for the Islamic world, geometric or vegetal patterns are often used to make what are heavy elements appear light or to dematerialise surfaces,” adds Mitchell. “Light often





plays an important role in this respect. In the Hall of Two Sisters in the Nasrid Palaces at the Alhambra, the glistening gilded tiles forming the base of the room, the intricately patterned plaster covering the walls, and the muqarnas that facilitate the transition to the octagonal dome create the appearance of space formed by light rather than by material.”

Muqarnas play with light. They produce a honeycomb effect within domes, creating stunning visual effects as light plays over deeply sculpted but regularly composed surfaces. The use of ceramic tiles and even mirrors within muqarnas only acted to accentuate their singular beauty.

It is within Islam itself, however, that the architecture of the Muslim world finds its greatest inspiration. According to the Quran, light (nur) represents the sanctity of God.

“Light has a very special meaning in Islamic art as it has a very special meaning in Islamic religion,” says Gonnella. “The particular connotation comes from the Quran itself where God has likened himself to light. The most important chapter for this is al-Nur: God declares that he is the light of the heavens and the earth (24:35). This verse from al-Nur is one of the most often quoted Quranic verses in Islamic art, of course especially on lamps, such as mosque lamps.”

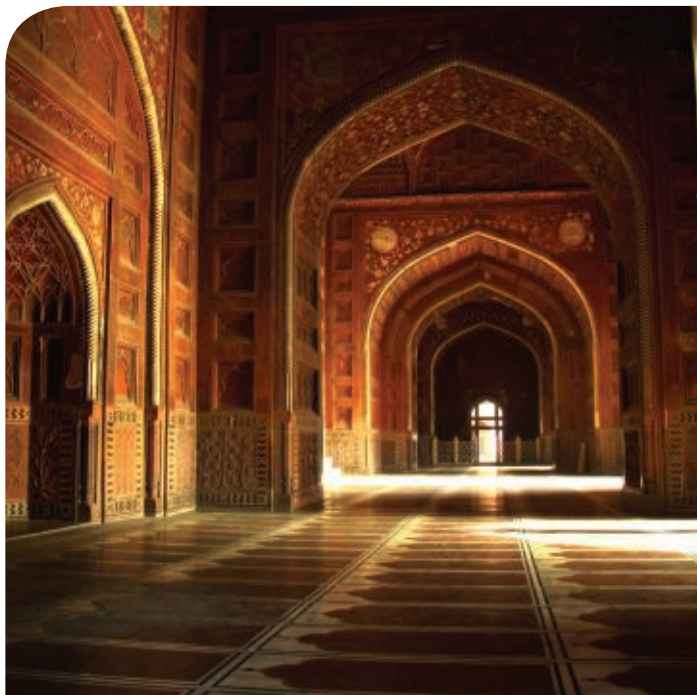
For Muslims, light represents the divinity of God, so natural light is an integral design element in Islamic architecture. It also represents perseverance on the path of righteousness, divine revelation, simplicity, sincerity, transparency and honesty. ‘Nur’ is used to express physical, moral and spiritual vision.

Left: The magnificent Court of the Lions in the Alhambra Palace is regarded as a pinnacle of Islamic architecture.

Below: Islamic architecture manipulates light to create inward-oriented worlds for worship, study and reflection.

Below left: Lattice structures are used to create light patterns, keep buildings cool and ensure privacy.





Above: The beautifully lit interior of the Taj Mahal mosque.

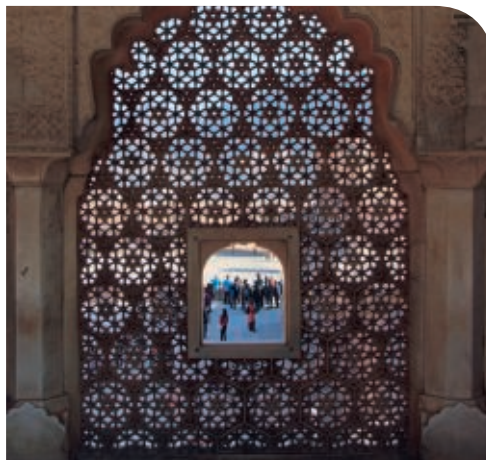
Above right: Jalis (lattice screens) provide privacy while casting beautiful patterns of light and shadow.

Therefore certain colours or materials were favoured for their capacity to absorb and radiate light. Ivory, alabaster, gold and white marble were used, either as cladding or at selected locations within a building.

Titus Burckhardt, a German/Swiss author and expert on Islamic art, architecture and civilisation who died in 1984, argued that “there is no more perfect symbol of the divine unity than light”.

“For this reason, the Muslim artist seeks to transform the very stuff he is fashioning into a vibration of light,” he wrote in *Art of Islam: Language and Meaning*. “It is to this end that he covers the interior surfaces of a mosque or palace – and occasionally the outer ones – with mosaics in ceramic tiles. This lining is often confined to the lower part of the walls, as if to dispel their heaviness. It is for the same purpose that the artist transforms other surfaces into perforated reliefs to filter the light. Muqarnas also serve to trap light and diffuse it with the most subtle gradations. Colours reveal the interior richness of light. Light viewed directly is blinding; it is through the harmony of colours that we divine its true nature, which bears every visual phenomenon within itself.”

Nowhere is the use of light more beautifully revealed than at the Alhambra Palace in Grenada, believes Burckhardt. “The Court of Lions in particular sets the example of stone transformed into a vibration of light; the lambrequins of the arcades, the friezes in muqarnas, the delicacy of the columns which seem to defy gravity, the scintillation



of the roofs in green tile-work, and even the waterjets of the fountain, all contribute to this impression,” wrote Burckhardt.

Burckhardt referred to the ‘alchemy of light’. Where light itself is indivisible, its nature unaltered by its refraction into colours nor diminished by its gradation into clarity and darkness. If alchemy is viewed as the desire to turn lead into gold, then Muslim architecture transforms stone into light.

“Some writers have focused on the symbolism associated with light in Islam, while others have considered the ways in which the particular qualities of light contribute to contemplation,” says Mitchell. “All of these views have merit, but I would maintain that light – and shadow – truly becomes significant when treated in a manner that focuses our attention away from the everyday concerns.”

For Mitchell, the most beautiful examples of the use of light in Islamic architecture are to be found in Cairo and Istanbul.

“Although it may not be an obvious choice, the Mosque of Ahmad ibn Tulun in Cairo is a beautiful example of the interplay of light and shadow,” he says. “The alternating rhythm formed by solid portions of the façade and voids framed by arched openings result in a strong juxtaposition that is made evident through the presence of light.”

“In contrast to the solidity of the Mosque of Ahmad ibn Tulun, the interior of the Rüstem Pasha Mosque in Istanbul exemplifies the architect Sinan’s ability to synthesise structure, space, and ornamentation to create exceptional works of architecture. The light falling across the Iznik tiles that form the interior envelop visitors in blue, whereas the white central dome covering the main prayer hall seems to float on light.”

It is this Islamic legacy of light and architecture that still informs how we build today, be it in the East or the West. ↗

A photograph of three young adults (two women and one man) wearing sunglasses and smiling while looking at a smartphone held by one of the women. The background is bright and out of focus, suggesting an outdoor setting like a beach or boardwalk.

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