

FLASHES

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

NOVEMBER 2017
ISSUE 35

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KNOWLEDGE SUMMIT 2017

Are you ready for the Fourth Industrial Revolution?



REACHING FOR THE STARS

UAE LAUNCHES MARS SCIENCE CITY

KAZUO ISHIGURO

A WORTHY NOBEL PRIZE WINNER

NANOTECHNOLOGY

REVOLUTIONISING HEALTHCARE



**Rise of
the Robots**
Transforming
the workplace





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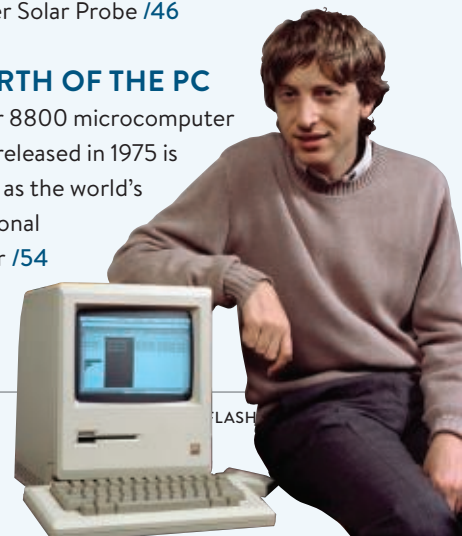
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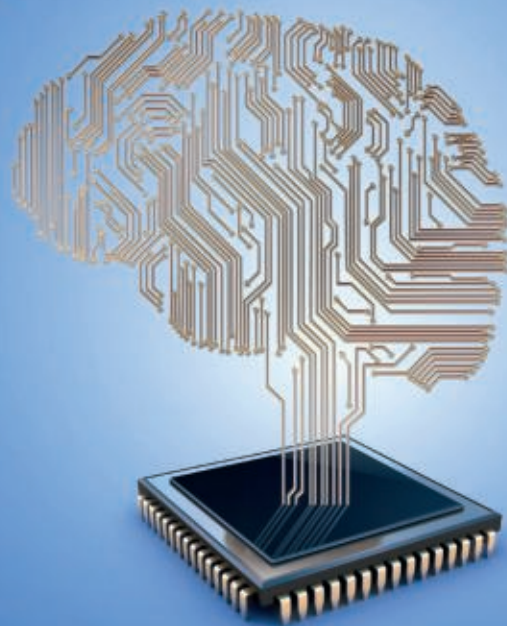
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FOREWORD

Dear readers,

In 1975 the first personal computer was released. Two unknown young men called Bill Gates and Paul Allen, who had founded a small company called Microsoft, had written its software. At the heart of the Altair 8800 was the Intel 4004 microprocessor that had about 4,000 transistors. The latest Intel chip has 7.2 billion.

In 2014, Japanese telecommunication giant Softbank Corp. unveiled a new robot called Pepper. Like other humanoid robots, the four-foot-tall Pepper is capable of verbal and physical communication. What really makes this machine stand out is that it is equipped with an emotion recognition system to decipher what's behind voice tones, allowing Pepper to determine whether a person is in a good or bad mood, happy or sad. This allows Pepper to be an ideal assistant or sales person.

At the start of 2016, the first six Peppers were put to work in a cell phone store in Tokyo. Five months later there were 10,000 Peppers fulfilling a variety of different roles. Such is the rate of change of the Fourth Industrial Revolution.

As Pepper proves, fuelling this change is the rise of increasingly complex Artificial Intelligence. Machines can now handle images, sounds and text in a way that enables them to ingest and analyse data at high volume, without making costly mistakes. According to the *Workforce of the Future* report by PricewaterhouseCoopers, automated

bots could take nearly four in 10 jobs in the US.

However, creative problem solving, people management and social intelligence remain challenging for Artificial Intelligence. This means that even as technology eliminates the need for routine labour, it will also open up new opportunities in industries that leverage creativity and innovation.

According to the World Economic Forum, creativity will be one of the top three skills workers will require in the future, with 'learning agility' – the ability to learn, adapt and apply in quick cycles – of paramount importance. This, in turn, requires a critical look at how education systems will instil the right skills in the workforce of the Fourth Industrial Revolution.

All these topics are covered in this issue of *Flashes*. However, they are just the tip of the iceberg in the many changes and advancements that the Fourth Industrial Revolution is bringing. Robotics, 3D bioprinting of tissues and organs, the many possibilities of nanotechnology, and how the factories of the future will look are just some of the topics that will be addressed at the fourth annual Knowledge Summit being held on November 21-22 at Dubai World Trade Centre. I hope you will join me there for what will be an informative, exciting and futuristic two days.

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



Winner of the Arab Reading Challenge Crowned

His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, crowned Palestinian student Afaf Raed as the winner of the second edition of the Arab Reading Challenge. It is the Middle East's largest initiative that encourages reading.

During the event, HH Sheikh Mohammed announced the challenge to be a global one, and he invited the Arab diaspora to join the next edition of the challenge. "We want to gather all Arabs from around the world in the Arab Reading Challenge," His Highness said. "The Arab Reading Challenge unveiled the passion of our kids for reading. We are a nation of Reading... And it actually does read."

His Highness expressed his pride on the success of the challenge: "The real winner is the Arab World and the Arab youth who is equipped with the power of knowledge and books."

Afaf Raed was announced the 2017 laureate, outshining more than seven million Arab contenders who were vying for the coveted prize of \$150,000. \$100,000 of the total will go towards her university education and \$50,000 to the family for their encouragement.

Al Iman School from Bahrain won \$1 million for its reading initiatives, with \$100,000 going to its principal, \$100,000 to the outstanding supervisor who urged students to participate in the challenge, and the remaining \$800,000 to the school.

The top 20 were also awarded and honoured with rewards in the challenge that gave away Dhs11 million worth of prizes.

While the challenge attracted 3.59 million students in 2016, it saw double the participation this year with over 7.4 million students and 75,000 supervisors from 41,000 schools in 25 countries. Six schools made it to the finals where \$3 million worth of prizes were awarded to finalists and winners.

Launched in September 2015, The Arab Reading Challenge became the largest pan-Arab project that aims for a million students in the Arab region to read 50 million books a year.

UAE Winner



Hafsa Rashid Al-Dhanahani, an Emirati national from Fujairah, was the winner of the UAE chapter of the Arab Reading Challenge. "I am proud of the 300,000 students from the UAE who completed the second edition of the Arab Reading Challenge to read 50 books a year. And congratulations to the winner Hafsa Rashid Al-Dhanahani," HH Sheikh Mohammed tweeted.

UAE Strategy for Artificial Intelligence Launched



His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, launched the UAE Strategy for Artificial Intelligence (AI). It aims to speed up government's performance, and create a conducive creative environment with

high productivity. The strategy is part of the UAE Centennial 2071 objectives.

This is the first such strategy of its kind in the region and the entire world to promote government performance and create an innovative and highly-productive environment by means of investing in AI, and its applications across multiple domains.

"UAE Centennial 2071 forges ahead now by launching mega enterprises like Artificial Intelligence to lay a solid basis for the coming period," said HH Sheikh Mohammed. He affirmed that AI is "the new wave after the Smart Government upon which all our services, sectors and future infrastructure will rely on."

"We initiated electronic services 16 years go and today we are launching a fresh stage relying on Artificial Intelligence," HH Sheikh Mohammed added, noting that "we are seeking to adopt all tools and methodologies related to Artificial Intelligence to expedite and ensure more efficiency for government services at all levels."

The UAE aims to be a major hub for developing AI techniques and legislation, His Highness said. AI applications will generate revenues and provide fresh opportunities for the national economy.

Digital Wealth Initiative and Dubai IoT Strategy



His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, launched the flagship Dubai Internet of Things (IoT) Strategy, as well as the Data Wealth initiative to safeguard the emirate's digital wealth and award Dubai Digital Certificates to outstanding government and private entities.

Data Wealth consists of data, data-storing and processing technologies, smart-tech transformation, paperless transaction policies and systems (such as Blockchain), digital signature and ID, smart living and clean energy, among other elements. It consists of 121 smart initiatives, 200 databases and 1,129 smart services. It is expected to generate AED33.8 billion in three years' time as the Internet of Things

reaches AED17.9 billion in value by 2020. Meanwhile, open and shared data is expected to add AED10.4 billion to the GDP by 2021, while Blockchain applications in government departments could add AED5.5 billion to the GDP by 2020.

The Dubai IoT Strategy seeks to build the world's most advanced Internet of Things ecosystem in the world's smartest city to improve people's lives. The strategy aims to protect Dubai's digital wealth, encourage government departments to join the emirate's smart transformation, and achieve the objectives of the Smart Dubai Plan 2021 to transition to a 100 per cent paperless government.

The strategy will be implemented over four consecutive phases in the coming three years.



MBRF at Frankfurt International Book Fair

The Mohammed Bin Rashid Al Maktoum Knowledge Foundation participated in the 69th edition of the Frankfurt International Book Fair 2017 held from October 11 to 15. The event is the largest and most important exhibition of its kind in the world.



The Foundation showcased its projects as well as knowledge and cultural initiatives, and highlighted its activities related to the fields of culture and science in the UAE and abroad.

His Excellency Jamal bin Huwareb, CEO of MBRF, said: "The Frankfurt International Book Fair is one of the most prestigious international events that brings together leading decision makers, professionals, intellectuals and writers from all over the world under one roof to discuss developments in the knowledge industry and share experiences."

The Foundation showcased the 'Dubai Digital Library' initiative, an ambitious project that seeks to enrich Arabic content on the internet, as well as support the Arabic language by promoting its use and providing an exciting and fast-paced framework of knowledge that is commensurate with the requirements of a modern society.

The Dubai Digital Library aims to engage with the largest possible number of people through its collection, which includes Arabic and foreign books, magazines, dictionaries, translations and biographies, as well as images and maps in addition to books issued by the Dubai International Writing Program, Qindeel Printing and Publishing, and magazines like *Wamadat* and *Flashes*.

The Foundation also showcased the Masmooou.com project, the largest audio books platform in the Arab world. The platform is a value-added tool for all segments of society, and provides a unique opportunity for people with determination to access a world of acquiring knowledge that may not be typically available to them.

Future of Robotics and 3D Bioprinting on Knowledge Summit 2017 Agenda

Robotics, 3D bioprinting of tissues and organs, and many other advancements brought about by the Fourth Industrial Revolution (4IR) are on the agenda as the Mohammed Bin Rashid Al Maktoum Knowledge Foundation (MBRF) prepares to host the fourth annual Knowledge Summit on November 21-22, 2017 at Dubai World Trade Centre.

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 the directives of MBRF Chairman HH Sheikh Ahmed bin Mohammed bin Rashid Al Maktoum, the 2017 Summit bears the theme “Knowledge and the Fourth Industrial Revolution” and will discuss diverse aspects of the 4IR including the challenges and ways to overcome them.

Throughout the Summit, the Foundation aims to shed light on the impact of the 4IR in various fields, especially the medical, technology, economic and media sectors. The Summit will also discuss the engines of the Fourth Industrial Revolution and the exceptional advancements that have made it so significant to the history of humanity.

His Excellency Jamal bin Huwaireb, CEO of MBRF, said that the Knowledge Summit 2017 aims to keep pace with the UAE Government’s plans to take advantage of the prospects and opportunities presented by the Fourth Industrial Revolution: “The event will bring together a number of decision makers, experts and specialists to discuss the ground-breaking 4IR technologies, their dimensions and their role in the decision-making process, as well as its



profound effect on human life from a social, economic and knowledge point of view.”

Saif Al Mansouri, Chairman of the Organizational Committee for the Knowledge Summit 2017, said that the Foundation has set an extensive agenda of discussions for the event. “We are highlighting the most pertinent topics that are of interest to the knowledge industry in the region and the world,” he said, “as the Fourth Industrial Revolution has a profound impact on all aspects of life, and plays a major part in

building the knowledge economy. The Summit will serve as an integrated platform to discuss the main engines of the 4IR and the challenges and opportunities for individuals and nations.”

On the first day, the Summit will go into the aspects of the Fourth Industrial Revolution, as well as its impact on decision-making and on how to prepare to meet its requirements and address the challenges.

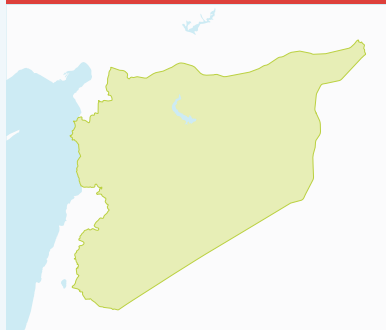
On the second and final day, the Knowledge Summit will discuss the impact of the Fourth Industrial Revolution on the healthcare sector with topics including 3D printing, genetic modification and its role in re-engineering cells, as well as techniques of digital surgery and the development of medical technologies to treat prevalent diseases.

The results of the World Knowledge Index – developed in collaboration with the United Nations Development Program (UNDP) to monitor the realities of knowledge globally – will be announced at the event. To register for the Knowledge Summit 2017, please visit: www.knowledgesummit.org

Paralympic Summer Games’ Rulebook

MBRF announced the release of the Paralympic Summer Games’ Rulebook in Arabic at the Frankfurt International Book Fair. The project was a collaboration between the Foundation and the International Paralympic Committee (IPC), in cooperation with the Dubai Club for People of Determination (people with disabilities). It asserts MBRF’s leading role in promoting knowledge to all segments of society, and reflects its commitment to supporting programmes and initiatives that look to benefit the whole of society. Publishing the Arabic version of the Rulebook also reflects the Foundation’s mission to promote the Arabic language and support its use online.





Reading Rank Overall: 15th
Total Reading Time Per Year: 33 hours
2016 Sample Size: 4,687
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.



45%

EXTENT OF
READING



29%

ACCESS AND
AVAILABILITY

Reading matter
sourced from



33 hrs
Average of total
reading (annual)



28%
Family



38%
School



13
Average number
of books read
(annual)



21%
Society



33

AVERAGE TOTAL
READING HOURS
(ANNUAL)

Made up of



18 hrs
Electronic
documents



16 hrs
Printed documents



14 hrs
Work related



22 hrs
Not work related



42%

PERSONAL
ATTRIBUTES



86%
Skills and abilities



45%
Motivation



49%
Attitudes



13

AVERAGE
NUMBER OF
BOOKS READ

ابت

10

In Arabic

أ

6

In foreign languages



6

Work related



8

Not work related

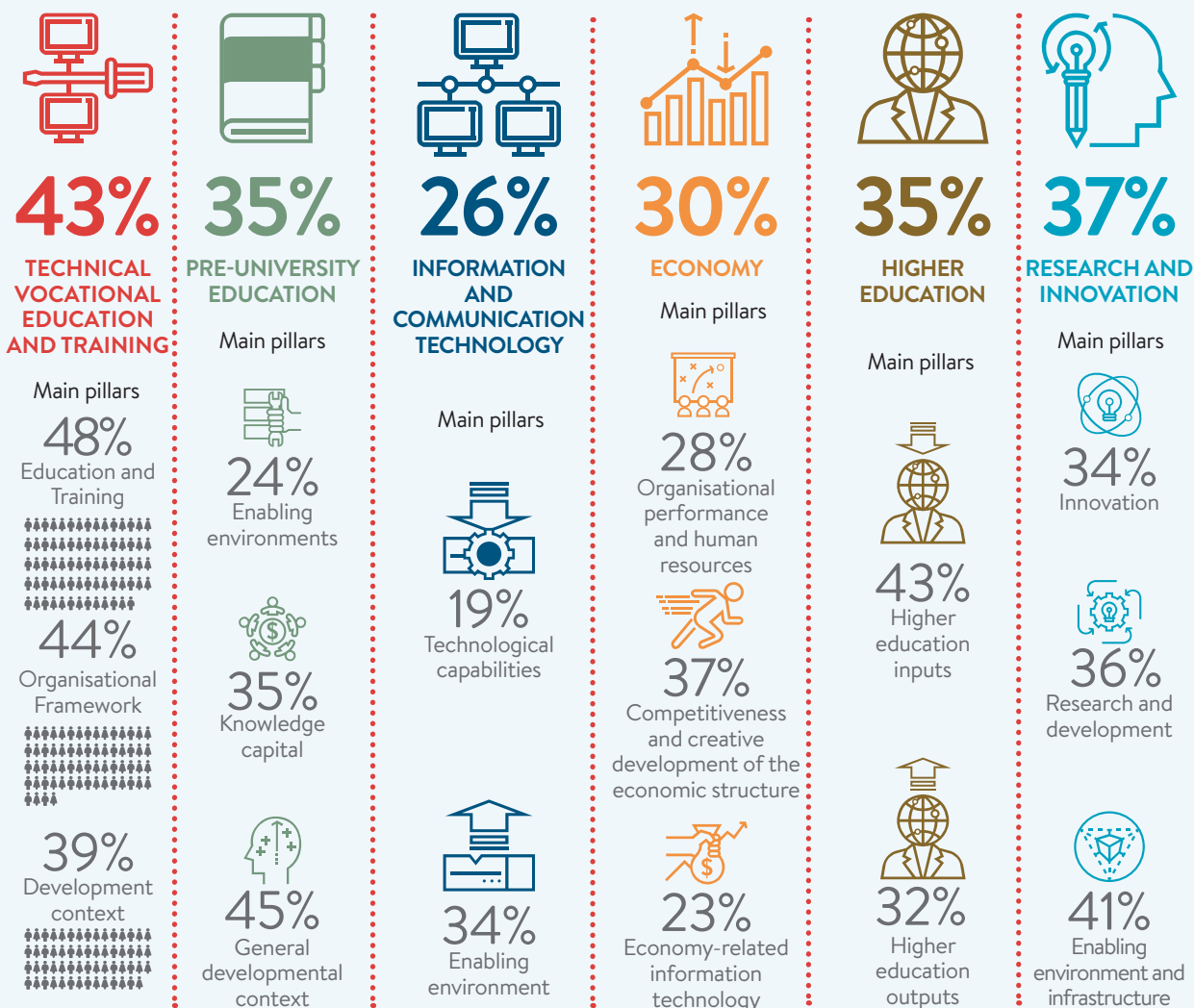
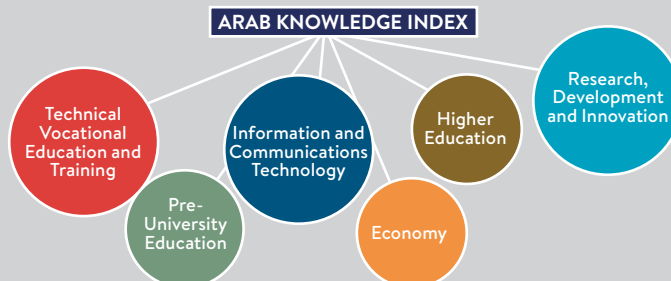
The Arab Reading Index is done in partnership by the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF) and the United Nations Development Programme (UNDP).

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 KNOWLEDGE SUMMIT 2017

The fourth edition of this annual event is being held under the theme “Knowledge and the 4th Industrial Revolution”.

The fourth annual Knowledge Summit in Dubai, which is organised by the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF), will take place on November 21-22. 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 2017 event is being held under the theme “Knowledge and the 4th Industrial Revolution”.

The Knowledge Summit 2017 is a platform that brings together decision makers, thinkers, experts and pioneers in the knowledge industry, as well as scientists, academics and specialists from all around the world, to discuss pressing issues and challenges facing the industry, review best practices and experiences and offer solutions to meet the challenges.

Moreover, the Summit will include the announcement of the winners of the Mohammed bin Rashid Al Maktoum Knowledge Award 2017. This prestigious award honours those who have made significant contributions to the regional and international knowledge industry.

Another highlight is that the results of the Global Knowledge Index 2017 will be released during the Summit. The Index was launched by the Foundation in collaboration with the United Nations Development Program (UNDP) to study knowledge at an international level, identify opportunities and challenges in the Arab world and compare them with those of other countries around the world. The Global Knowledge Index has engaged more than 140 countries.

KNOWLEDGE AND THE 4TH INDUSTRIAL REVOLUTION

The first three Industrial Revolutions played a major role in transforming societies and people's lives for



the better. They also played a major role in supporting the development of knowledge societies.

The First Industrial Revolution was brought about by the invention of the steam engine, while the second was characterized by electricity replacing steam. The use of electric power had a huge impact on industry as it enabled the rise of mass manufacturing, global communication and improved transportation. The Third Industrial Revolution saw the world move from the analogue into the digital realm with the widespread adoption of computers, exponential improvements in computing power and the rise of the Internet. This great technological leap forward



“ Today, we are in the throes of the Fourth Industrial Revolution – also known as “The Digital Revolution” – which began at the outset of the 21st Century

infiltrated almost every aspect of manufacturing, communications and education.

Today, we are in the throes of the Fourth Industrial Revolution – also known as “The Digital Revolution” – which began at the outset of the 21st Century coinciding with the large-scale proliferation of the Internet, smartphones and artificial intelligence (AI) around the world. The distinguishing factor of the Fourth Industrial Revolution (4IR) from its predecessors is the sheer pace, complexity and magnitude of change. It is a cross-sectoral transformation unprecedented in human history.

This revolution is spearheaded by rapid advancement in a number of key technologies, most notably artificial intelligence, robotics, self-driving cars, 3D printing, Big Data, Blockchain and digital currencies, the Internet of Things (IoT), nanotechnology, biotechnology, energy storage and quantum computing.

Experts believe the Fourth Industrial Revolution will affect every aspect of life – political, social and economic – and will enhance the production of knowledge. Given this significant and far-reaching impact, it is important for governments, corporations, civil society organisations and all stakeholders to thoroughly understand these developments, anticipate the challenges they come with and develop solutions for them, while developing a set of common values and standards.

Perhaps the most pertinent analysis of the Fourth Industrial Revolution can be found in the 2016 book *The Fourth Industrial Revolution*, written by Professor Klaus Schwab, President and Founder of the World Economic Forum (WEF). The book examines the key dimensions of the 4IR, based on Professor Schwab’s extensive experience and his first-hand insight into how prominent world leaders have strategized to steer the digital revolution, in addition





to highlighting the opportunities and challenges brought about by the 4IR.

According to Professor Schwab, the effects of the 4IR will extend to the structure of society and transform the current social class system. It will create new jobs and eliminate existing ones: self-driving cars will replace chauffeurs, robots will replace workers, drones will replace delivery workers, etc. On the flip side, however, the Revolution will promote the use of three-dimensional printers, bringing about new opportunities for design and production, as well as online shopping, which will necessitate the development of better e-payment systems.

PREPARING FOR CHANGE

It is essential for governments, companies, civil society organisations and even academics and experts to understand the developments and challenges posed by the Fourth Industrial Revolution, in order to effectively prepare for it, stresses Klaus Schwab, urging world leaders to bring together the world's brightest minds across government and private sectors and develop a holistic approach to address this revolution. Values and ethics must remain at the core of our individual and collective behaviour; we must move from tolerance and respect to genuine care, compassion, empowerment and inclusion.

Schwab also called for restructuring the prevailing economic, social and political systems: the 4IR will affect people, culture and values, so it is important to prioritise people in order to achieve sustainable and holistic development.

BRINGING TOGETHER THE WORLD'S BRIGHTEST MINDS

The fourth annual Knowledge Summit in Dubai is doing exactly what Professor Klaus Schwab



advises: bringing the world's brightest minds together. Over the two days of the event, a variety of crucial topics such as AI, fake news, big data, cybersecurity, nanotechnology, genetic editing and human organ printing will be tackled across three halls in the Dubai World Trade Centre.

The first session on Day 1 in Hall 1 is titled: UAE & The 4th Industrial Revolution: Leading the Race Toward the Future. It will focus on key points such as the role of the UAE's Fourth Industrial Revolution Council, the UAE's 4th Industrial Revolution Strategy, why the UAE is investing in the 4th Industrial

Revolution, and the history of the previous industrial revolutions. Among the key speakers are

HE Sultan bin Saeed Al Mansoori, Minister of Economy, UAE; HE Shamma bint Suhail Faris Al Mazrui, Minister of State for Youth, UAE; Arif Sultan Al Hammadi, Executive Vice President, Khalifa University; and Hamad Obaid Al Mansoori, Director General at the General Authority for Regulating the

It is essential for governments, companies, civil society organisations and even academics and experts to understand the developments and challenges posed by the Fourth Industrial Revolution.





“ **Values and ethics must remain at the core of our individual and collective behaviour; we must move from tolerance and respect to genuine care, compassion, empowerment and inclusion.** ”

Telecommunications Sector.

This will be followed by the Opening Ceremony, during which the Global Knowledge Index Results will be announced, and the Awards Ceremony of the Mohammed Bin Rashid Al Maktoum Knowledge Award will be held. The speakers are HE Jamal bin Huwareb, CEO of MBRF; Sherif Ismail, the Egyptian Prime Minister; Hani Al Mulqi, the Jordanian Prime Minister; and Achim Steiner, UNDP Administrator.

On Day 2, the first session in Hall 3 focuses on the key findings of this year's Global Knowledge Index. Among the topics are the importance of indicators of pre-university and technical education, challenges facing indicators, key findings, how to use the findings across the Arab region and the world, and promoting the indicators. The findings will once again be discussed by a stellar panel of experts.



In total, there will be more than 30 sessions covering further topics such as The Digital Revolution and its Role in Traditional and Social Media, The Role of Technology in Improving Our Lives, Digital Disruption – A New Way to Think About Change, Education: Universities of the Future and the Requirements of the Fourth Industrial Revolution, and Human Organs 3D Printing & Genetic Editing: A Disabilities-Free Future.

By the time the closing ceremony arrives at the end of Day 2, a who's who of decision makers, academics, scientists and specialists will have shared their expertise with the knowledge seekers.

To register for the fourth annual Knowledge Summit please visit knowledgesummit.org

REMAINS OF THE DAY

Kazuo Ishiguro, one of the most celebrated contemporary fiction authors in the English-speaking world, was the popular winner of this year's Nobel Literature Prize.

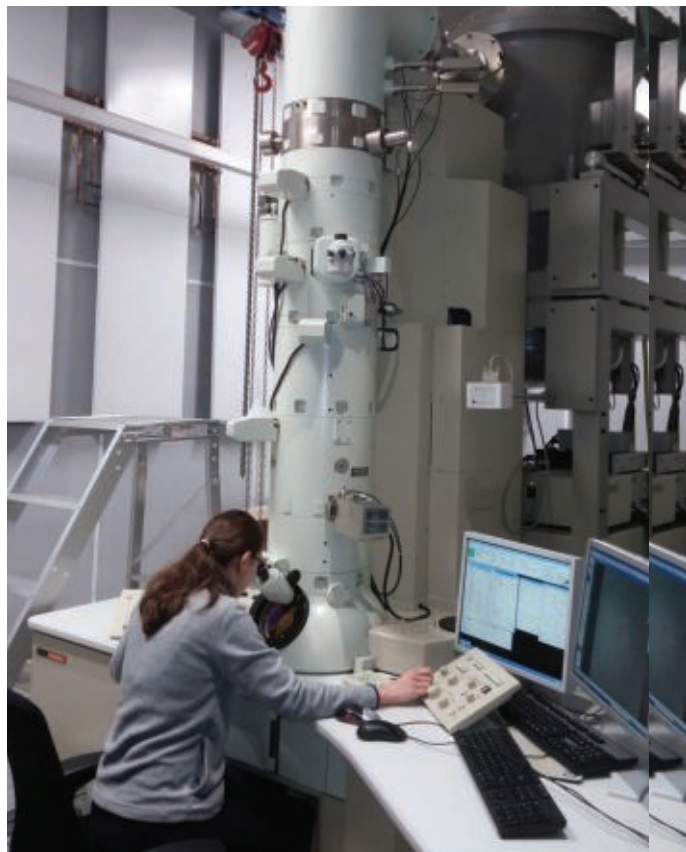
Last year's selection of Bob Dylan as the 113th winner of the Nobel Literature Prize was controversial in some quarters. While he's written numerous books, Bob Dylan is primarily a songwriter and performer, not a poet, playwright, journalist, or fiction writer. In other words, can his music be considered literature?

This year, the Swedish Academy was once again in charge of picking as a laureate "the person who shall have produced in the field of literature the most outstanding work in an ideal direction," according to Swedish industrialist Alfred Nobel's original terms. Recipients are chosen by a five-member subset of the 18-member Swedish Academy (comprised of "writers,

linguists, literary scholars, historians and a prominent jurist"), and the entire process is very opaque. Unlike many other literary prizes, there is no public shortlist and the deliberations are extremely secretive.

That doesn't mean that literature fans don't come up with their own lists. Among this year's favourites were Kenya's Ngugi wa Thiong'o, a playwright and author whose works touch topics of British colonialism; Margaret Atwood, the Canadian novelist who wrote *The Handmaid's Tale*; Amos Oz, who has published 14 books and is widely considered one of the most gifted writers still alive; and Haruki Murakami, the celebrated Japanese author who wrote *Norwegian Wood* and *Kafka On The Shore*. >

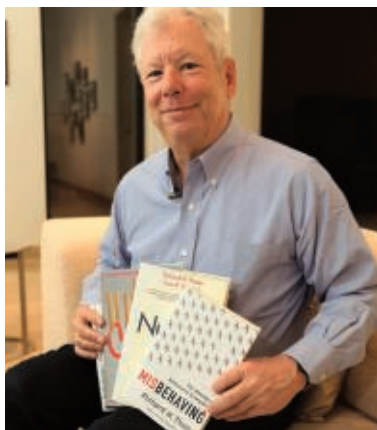
NOBEL PRIZE



Left: Kazuo Ishiguro won the Booker Prize in 1989 for *The Remains of the Day*.

Above: Cryo-electron microscopy allows biomolecules to be visualized in their natural configuration.

THE 2017 SVERIGES RIKSBANK PRIZE IN ECONOMIC SCIENCES IN MEMORY OF ALFRED NOBEL



Are humans rational, especially when it comes to their economic behavior and decision making? That is the focus of this year's winner, Richard Thaler, who's work examines how human psychology impacts economic and financial decision making, as well as trying to make economists realise that "economic agents are human" and cannot always be treated as rational actors.

According to the Nobel committee, Thaler "incorporated psychologically realistic assumptions into analyses of economic decision-making."

"By exploring the consequences of

limited rationality, social preferences, and lack of self-control, he has shown how these human traits systematically affect individual decisions as well as market outcomes."

While the prize has been awarded to lesser known economists several times in recent years, Thaler is one of the world's best known economists and his book *Nudge: Improving Decisions About Health, Wealth, and Happiness*, which he co-authored with Harvard professor Cass Sunstein, is one of the most widely read economics books of recent years.

NIH GRANTEES WIN 2017 NOBEL PRIZE IN PHYSIOLOGY OR MEDICINE



The 2017 Nobel Prize in Physiology or Medicine was awarded to National Institutes of Health grantees Jeffrey Hall of the University of Maine, Orono; Michael Rosbash of Brandeis University, Waltham, Massachusetts; and Michael Young of Rockefeller University, New York City, for their discoveries of

molecular mechanisms controlling the circadian rhythm.

The Royal Swedish Academy of Sciences said, “the paradigm-shifting discoveries by the laureates established key mechanistic principles for the biological clock.”

Living organisms, including humans, have an internal, biological clock that helps

them anticipate and adapt to the regular rhythm of the day. Drs Hall, Rosbash and Young aimed to discover how that clock works. They used fruit flies to isolate the gene called period that controls the normal biological rhythm of the day. Clock genes contain instructions for making clock proteins, whose levels rise and fall in a regular cyclic pattern. The researchers went on to discover that PER, the protein encoded by period, accumulated during the night and was degraded during the day. Their discoveries explain how plants, animals and humans adapt their biological rhythm so that it is synchronized with the Earth's revolutions.

Our clocks influence alertness, hunger, metabolism, fertility, mood and other physiological conditions. For this reason, clock dysfunction is associated with various disorders, including insomnia, diabetes and depression.

As it turned out, the Swedish Academy made a safe and popular choice by giving the Nobel Literature Prize to Kazuo Ishiguro – a Japanese-born British novelist, screenwriter, and short story writer. Ishiguro's work has been translated into over 40 languages, it has inspired major film adaptations, and his reputation as a literary craftsman is well established. The Swedish Academy described him in its citation as a writer “who, in novels of great emotional force, has uncovered the abyss beneath our illusory sense of connection with the world”.

Sara Danius, permanent secretary at the Swedish Academy, made the announcement on October 5 in Stockholm. She praised Ishiguro as a “wonderful and truly exquisite” writer, naming her favourite of his titles *The Buried Giant* and *Remains of the Day*.

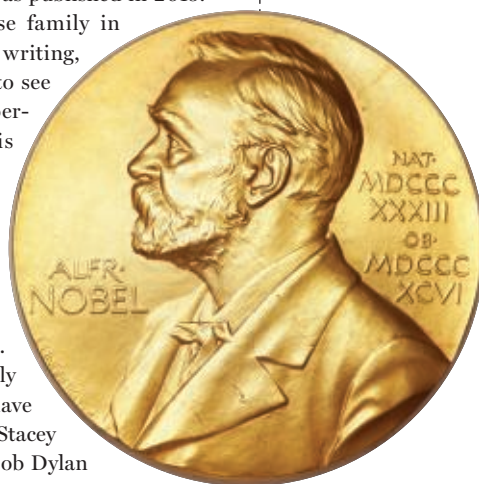
“If you mix Jane Austen and Franz Kafka, then you'll get Kazuo Ishiguro in a nutshell,” she said. “But you have to add a little bit of Marcel Proust into the mix, stir but not too much, and then you have his writing. At the same time, he's a writer of great integrity, he doesn't look to the side, he's developed an aesthetic universe of his own.”

In response to receiving the award, Ishiguro stated: “It's a magnificent honour, mainly because it means that I'm in the footsteps of the greatest authors that have lived, so that's a terrific commendation. The world is in a very uncertain moment and I would hope all the Nobel Prizes would be a force for something positive in the world as it is at the moment. I'll be deeply moved if I could in some way be part of some sort of climate this year in contributing to some sort of positive atmosphere at a very uncertain time.”

Ishiguro is considered one of the most celebrated contemporary fiction authors in the English-speaking world, having received four Man Booker Prize nominations and winning the 1989 award for his novel *The Remains of the Day*. His 2005 novel, *Never Let Me Go*, was named by *Time* as the best novel of 2005 and included in its list of the 100 best English-language novels from 1923 to 2005. His seventh novel, *The Buried Giant*, was published in 2015. Growing up in a Japanese family in the UK was crucial to his writing, as he says it enabled him to see things from a different perspective to many of his British peers.

Besides his seven novels, Ishiguro has also written four screenplays and numerous short stories. He also happens to be a “great admirer of Bob Dylan”. Ishiguro, whose own wittily oblique lyrics for songs have been recorded by jazz singer Stacey Kent, snaps up each new Bob Dylan album as it appears. Before he turned to fiction, the teenaged child of Japanese parents, transplanted aged five from Nagasaki to Surrey in 1960, wrote Dylan-esque ditties in Guildford.

In many ways, Ishiguro is a reflection of our time having left his homeland at a young age in a cross-cultural migration, he's a fan of both music and cinema,



NOBEL PRIZE IN PHYSICS



Three American physicists – Rainer Weiss, Barry Barish and Kip Thorne – won the Nobel Prize in Physics for the first observations of gravitational waves, ripples in the fabric of spacetime that were anticipated by Albert Einstein a century ago.

All three scientists have played leading roles in the Laser Interferometer Gravitational-Wave Observatory, or Ligo, experiment, which in 2015 made the first historic observation of gravitational waves triggered by the violent merger of two

black holes a billion light years away.

Professor Olga Botner, a member of the Nobel committee for physics, described this as “a discovery that shook the world”.

The Ligo detections finally confirmed Einstein’s century-old prediction that during cataclysmic events the fabric of spacetime itself can be stretched and squeezed, sending gravitational tremors out across the universe like ripples on a pond.

The direct detection of gravitational waves also opens a new vista on the “dark” side of the cosmos, to times and places from which no optical light escapes. This includes just fractions of a second after the Big Bang, 13.7 billion years ago, when scientists believe gravitational waves left a permanent imprint on the cosmos that may still be perceptible today.

Right: Emma Thompson and Anthony Hopkins starred in the acclaimed film adaptation of *The Remains of the Day*.



and his polished yet approachable prose has made him a popular artist of our time.

Renowned author Salman Rushdie summed it up succinctly: “Many congratulations to my old friend Ish, whose work I’ve loved and admired ever since I first read *A Pale View of Hills*. And he plays the guitar and writes songs, too! Roll over Bob Dylan.”

WHO IS KAZUO ISHIGURO?

- Born in Nagasaki, Japan, in 1954, he moved to England with his family when his father was offered a post as an oceanographer in Surrey.
- He read English and philosophy at the University of Kent after a gap year that included working as a grouse beater for the Queen Mother at Balmoral.
- He studied an MA in creative writing at the University of East Anglia, where his tutors were Malcolm Bradbury and Angela Carter.
- His thesis became his critically acclaimed first novel, *A Pale View of Hills*, published in 1982.
- He won the Booker Prize in 1989 for *The Remains of the Day*. ↗



NOBEL PRIZE IN CHEMISTRY

Jacques Dubochet, Joachim Frank and Richard Henderson won the Nobel Prize in Chemistry for developing a technique to produce images of molecules of life frozen in time.

The technique, called cryo-electron microscopy, allowed biomolecules to be visualised in their natural configuration for the first time, triggering a “revolution in biochemistry”, according to the Nobel committee. The latest versions of the technology mean scientists can record biochemical processes as they unfold in film-like sequences.

In 1990, Richard Henderson, a molecular biologist at Cambridge University, managed to use an electron microscope, designed for the study of inert material, to visualize – in three dimensions and at atomic scale – the structure of a protein found in photosynthetic cells. The chemistry of life, once obscure, was now visible in astonishing detail. Joachim Frank, a biochemist at Columbia University, and Jacques Dubochet, of the University of Lausanne, in Switzerland, made crucial refinements to the method and widened its application.

One major problem remained – how to keep biological samples from drying out under the microscope, since freezing them introduced ice crystals, which disrupted the electron beam and ruined the images. Dubochet found a way to add water to the samples and freeze it so quickly that it formed a kind of liquid glass; this kept the molecules from collapsing without diffracting the electron beam. Together, the three laureates’ work constitutes cryo-electron microscopy, “which both simplifies and improves the imaging of biomolecules,” as the Royal Swedish Academy of Sciences noted in a press release, pushing “biochemistry into a new era.”

Scientists can now stop biological molecules cold, peer inside, and visualise the inner workings with unprecedented clarity, an advance that is already helping pharmaceutical companies discover and develop new and better drugs.



INVESTING IN SPACE

*The UAE National Space Programme is aiming for the stars,
but its benefits will be here on Earth.*



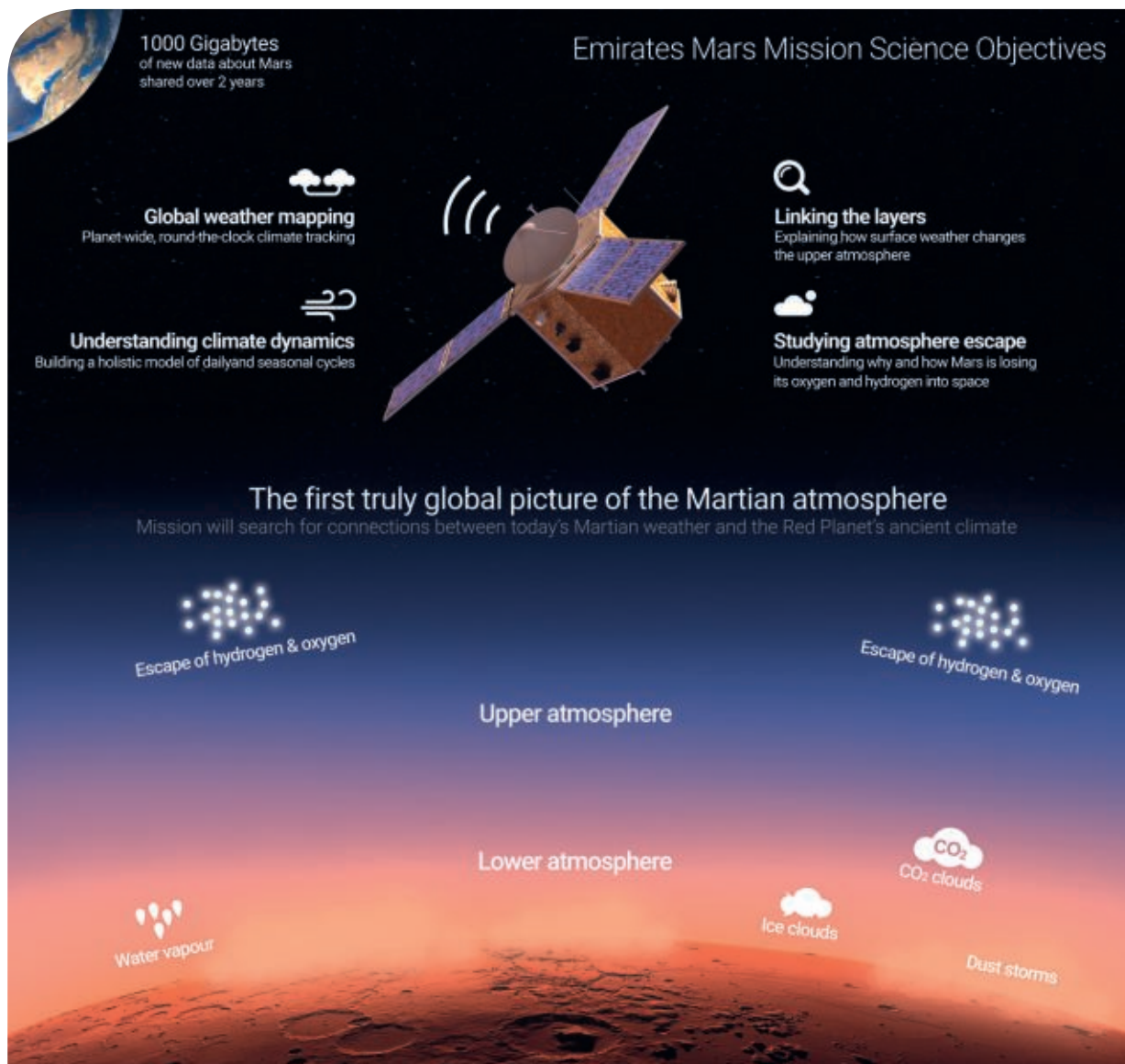
With everything going according to plan, in 2021 the UAE will commemorate the 50th anniversary of its founding with the country's first space probe, Hope, reaching Mars. This will mark the first time for an Arab or Muslim country to send a spacecraft to the Red Planet.

This achievement will be the culmination of a seven-year plan that began in July 2014, when the UAE launched its own space programme, becoming one of only a handful of nations, including the US, Russia, China, Japan and the EU that fund space exploration programmes.

The space industry is a relatively young field that appeared after 1945. It comprises a long chain, starting

with research and development actors and manufacturers of space hardware and ending with the providers of space-enabled products and services to final users. This means the space industry creates new ideas and offers multiple business opportunities for start-ups and the private sector as well. This leads to establishing new sectors that are based entirely on science, knowledge and technology, factors that are very attractive to the UAE as it seeks to diversify its economy. The space industry consists of many segments including space exploration, space technology industries, space tourism and communication.





Above: The Hope Probe will conduct analysis on the lower and upper atmospheres of the Red Planet, hoping to uncover crucial data which will give insight why the atmosphere on Mars is escaping into space.

STEPPING INTO THE FUTURE

The UAE National Space Programme is therefore part of a bold step in building a knowledge based and diversified economy. The sustained investment in a range of industries has helped increase economic growth with the UAE's GDP growing 3.0% in 2016. In comparison, the global space industry is expected to grow at 8% per annum. In other words, the UAE National Space Programme is a viable investment that ticks all the right boxes for the country's ambitious future plans.

The UAE's location on the southeastern edge of the Arabian Gulf also happens to be perfect for a future spaceport. The country's expansive deserts and miles of coastline provide many options for safe rocket launches, and its position near the equator makes it

especially appealing as the spin of the Earth provides an extra push, meaning less fuel is needed to get payloads into orbit.

Even before the UAE National Space Programme was formally developed, the country was already building its international space partnerships. In 2010, the government invested in Virgin Galactic, and today it owns a 37.8% share of the company worth about \$380 million. It also signed Memoranda of Understanding with space programmes in countries including China, France, Russia, the UK, India, and Japan, which establish official partnerships for knowledge-transfer and other resource sharing. In June of last year, the agency signed an Agreement to Collaborate with NASA.

According to Dr Mohammed Al Ahabbi,



Left: HI-SEAS V is an 8-month Mars isolation mission being held on the slopes of the Mauna Loa volcano in Hawaii. The UAE's Mars Science City will run similar projects.

Director-General of the UAE Space Agency: "Space is a key and significant tool to any economy, contributing to a knowledge based economy. Our leadership believes that space is the key to our future."

The UAE National Space Programme is the natural evolution of the country's long-held interest in space. Back in the 1970s, the Founding Father of the UAE, Sheikh Zayed bin Sultan Al Nahyan, held meetings about exploring the solar system and met with US astronauts.

The Emirates Institution for Advanced Science and Technology in Dubai launched its first satellite – DubaiSat-1 in 2009. This was followed by DubaiSat-2 in November 2013. Each of these satellites marked a steady progression in local skills. About 30 per cent of DubaiSat-1 was built by Emiratis, and UAE engineers were responsible for about half of DubaiSat-2's design. Khalifa-Sat, due to launch in 2018, is 100 per cent designed and built by Emiratis. Naturally, this experience is being put to good use on the Hope probe.

The global space industry is estimated to be worth around \$300 billion annually and the UAE has made

over \$5.5 billion in space-related investments to date. Already more than 3,000 students have been trained by the UAE Space Agency, in order to gain knowledge, as well as develop passion for what is beyond the planet. The Mars Hope mission is a spearhead project for the new space technology industry in the country.

MARS SCIENCE CITY

Although it's an incredibly exciting mission to inspire the whole country, the UAE Space Agency's vision goes way beyond the Hope probe mission. During the 5th World Government Summit in February this year, the UAE announced the "Mars 2117 Project", with the ultimate goal of establishing the first human settlement on Mars in the next century. In order to achieve this aim, the AED500-million Mars Science City project was announced in September, with plans to construct a 1.9 million-square-foot prototype city in the UAE desert.

His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE and Ruler of Dubai, stated, "The new project is a seed that we plant today, and we expect future



TESTING HUMAN ENDURANCE

The Mars-500 mission was a joint programme run by Russia, the European Space Agency and China. Between 2007 and 2011, three different crews of volunteers lived and worked in a mock-up spacecraft at the Russian Academy of Sciences' Institute of Biomedical Problems (IBMP) in Moscow. The final stage of the experiment simulated a 520-day manned mission that yielded important data on the physiological, social and psychological effects of long-term close-quarters isolation.

The Hawaii Space Exploration Analogue and Simulation (HI-SEAS) is an analogue habitat for human

spaceflight to Mars. The purpose of the detailed research studies is to determine what is required to keep a space flight crew happy and healthy during an extended mission to Mars and while living on Mars. Research into food, crew dynamics, behaviours, roles and performance, and other aspects of space flight and a mission on Mars itself is the primary focus. HI-SEAS is located in an isolated position on the slopes of the Mauna Loa volcano on the island of Hawaii. The area has Mars-like features and an elevation of approximately 2,500m above sea level.

- The first HI-SEAS mission had six members and lasted for four

months from mid-April to 13 August 2013 with culinary and psychological aspects.

- HI-SEAS II with a crew of six people began 28 March 2014 and lasted 120 days, until 25 July 2014.
- HI-SEAS III began on 15 October 2014, and included six crew members and two reserve crew members. This was the first 8-month stay for a crew.
- HI-SEAS IV began on 29 August 2015 and lasted for exactly one year. During the mission many aspects of a Mars mission were simulated, such as a communication delay time and isolation.

Above: The 'astronauts' of the Mars-500 experiment during the 520-day manned mission simulation.

generations to reap the benefits, driven by its passion to learn and to unveil new knowledge. The landing of people on other planets has been a long-time dream for humans. Our aim is that the UAE will spearhead international efforts to make this dream a reality."

"The UAE aims to be part of the world consortium in establishing the first settlement on Mars," explained Dr Mohammed Al Ahbabi. "The reason behind that is because we want to inspire young people, we want to educate them and solve challenges that we are facing on Earth today. By having the finest scientists in the world, who may help solve the challenges on Mars – we could find solutions on Earth."

The preparation for this trailblazing and ambitious project is naturally grounded on Earth. Mars Science City will be built in the desert, which will act as a substitute for the dust ravaged and dry surface of the Red Planet. The city will consist of several domes constructed of materials that can block solar radiation (which is stronger on Mars than on Earth, due to its lack of a protective atmosphere). A team of Emirati scientists, engineers and designers, led by a team from the Mohammed Bin Rashid Space Centre and Dubai Municipality, will carry out the project in cooperation with the internationally renowned architecture firm Bjarke Ingels Group.



The city is expected to include a giant greenhouse to test agricultural techniques, as well as laboratories designed to explore how to store food, generate energy, and get water. The greenhouse plan calls for the use of an agricultural technique called vertical farming. Instead of natural sunlight, crops would grow under LEDs on stacked trays in a climate-controlled environment.

The Mars Science City will also boast a museum that displays humanity's greatest space achievements, including educational areas meant to engage young citizens with space and inspire a passion in them for exploration and discovery. The walls of the museum will be 3D printed, using sand from the UAE desert.

The Mars Science City project will also have a simulation aspect where a specialist team of scientists and field experts will live in the Mars City for at least 12 months. During this time they will develop and hone self-sufficient processes that will keep the future astronauts of the actual Mars mission alive and well.

The city will also be a progressive headquarter for teams of scientists and engineers to experiment and prototype. An Emirati scientific team will first implement this initiative, but it will eventually expand to include international scientists and researchers to run in parallel with the coordination of human research efforts in the field of exploring and inhabiting Mars.

This research will naturally benefit people's lives on Earth through the useful advances made in farming, building strategies, transportation, energy and food. The beneficial by-product of space research improving life on Earth is long established.

In the field of medicine, for example, there have been numerous applications. NASA's innovations in robotics and shock-absorption materials have enabled the private sector to create more comfortable and effective solutions for animal and human prostheses. Other space-related inventions that have been widely adopted on Earth include scratch-resistant glasses, cordless tools, smoke detectors and even nicer-tasting baby food.

It will take time for the benefits of the UAE National Space Programme to materialise, but it will definitely have an impact on the country and the world in many sectors. ↑

Above: Mars Science City will consist of several domes constructed of a special material that blocks solar radiation.

Above left: The museum will have walls 3D printed using sand from the UAE's desert.

Left: One of the most important goals of the Hope mission is to build a generation of national experts in different areas of science.



A FOCUS ON **LEARNING**

Rana Khalid Al Mutawa, who has a passion for Middle Eastern culture, is the first winner of the MBRF-Oxford Scholarship

Last year, the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF) joined hands with the University of Oxford to offer scholarships to graduate students from 22 Arab League Nations. The scholarship is open to students looking to pursue Master's and DPhil (PhD) courses, with preference being given to applicants from the UAE as well as those studying courses relevant to Arab heritage.

"This scholarship presents valuable opportunities to young Arabs," said Jamal Bin Huwaireb, CEO of MBRF. "Studying at such a prominent institution as Oxford University will provide a notable leverage for the scholars in their academic and professional careers."

Flashes spoke to Rana Khalid Al Mutawa, the first recipient of the MBRF-Oxford Scholarship, about her interests, passion for learning and future plans.

FLASHES: *Tell us about your formative years. What influenced your thirst for learning?*

RANA KHALID AL MUTAWA: I've always enjoyed reading, which is an activity that is popular among my immediate family. English literature was my favourite subject as that class always transported me into another world. My experience with English helped me to discover my passion about learning, or at least certain kinds of learning. It showed me how being passionate about a certain subject can change your entire learning curve and understanding of that subject.

In this sense, I consider myself lucky to have experienced subjects that interested me at a young age. I believe that some people never realise their passion for learning, not because they don't have it, but due to the fact they haven't discovered the right subject or activity that engages them. It is critical to have the right kind of exposure to many different activities in order for a person to discover what they love to learn.

Can you give us a brief map of your academic journey?

My academic pursuits have taken me around the world. I did my bachelor's degree in Business Administration at the American University in Dubai. However, I didn't particularly enjoy studying business. I wanted to explore other avenues and started my journey of discovery in Tokyo, where I studied the Japanese language followed by a Master's degree in Public Policy. My next stop was on the other side of the globe in New York where I did a Master's in Education.

How do you feel being the first winner of the MBRF-Oxford Scholarship? What does it mean to you, both personally and academically?

I am very fortunate to be the first recipient of the scholarship. I did not expect it at all and was very surprised when I received the email telling me I was chosen. HH Sheikh Mohammed Bin Rashid Al Maktoum is my role model and I ardently admire him and what he has done for Dubai. Most of my research is specific to Dubai, so I was doubly pleased to receive the eponymous scholarship. Professionally, having a

scholarship like this is highly valuable. As an academic, we often need to show that we are able to get prestigious funding for our research. Such scholarships make our academic opportunities in the future much better.

What will your area of focus be for the post-graduate programme at Oxford?

Currently, I'm focusing on Middle Eastern studies and specifically researching Emirati society. I'm interested in societies and cultures in general. There are so many interesting things about Gulf societies that haven't been studied yet. Some of the studies that are available are mainly from a foreigner's perspective. I want to study these from a local perspective, thereby giving the world a more accurate portrayal of our customs and culture.

What do you plan to do after completion of the scholarship program?

I love academia. I have taught at Zayed University for three years and also did research there. I am thinking about developing an educational business in relation to cultural studies at some point in the future.

How will you "give back" to the country that has given you this remarkable opportunity?

Giving back occurs in different ways. In my case, I'm hoping to increase the local production of knowledge, specifically about the region, rather than having it constantly studied from outside. Another aspect is my aim to get the local population interested to learn more about studies or research that concerns their society by presenting these studies in a more engaging manner.

How do you think this scholarship will aid students?

Other than the obvious financial benefits, as this scholarship programme grows it will hopefully build a network of Arab students who are passionate about improving their societies.

Any tips for future aspirants?

People have often advised me to take certain career or professional routes that may look better on my CV or place me in higher positions career-wise. Personally, I don't believe that is the right way to grow. I think you should always choose to do something you love even if it is less prestigious or less well paid. I would encourage everyone to at least explore what they are passionate about even if other people think they are silly for missing out on more "prestigious" opportunities. It's very common to be pressured to do something that is higher on the career-ladder but it comes at the cost of losing your passion and excitement for life. †



In my case, I'm hoping to increase the local production of knowledge, specifically about the region, rather than having it constantly studied from outside.

EXPLORE



WHY

HELIUM MATTERS

Helium has become an increasingly rare commodity on Earth, which is why a huge discovery in East Africa is welcome news for medicine, scientific research and the tech industry.

If playing a word association game, it's a safe bet that most people would respond to the word "helium" with "balloon". Beyond balloons though, common knowledge about helium is fairly scant.

This is surprising, considering how prevalent it is. Helium is the second most abundant chemical in the universe, forming about 23 per cent of all matter. Besides birthday celebrations, helium plays a vital role across multiple industries, in scientific research and in medicine. One of the most notable uses is within hospital MRI scanners, but helium is also a critical component in deep sea diving, welding, cryogenics and fibre optics. As helium easily liquefies at low temperatures it is used as a coolant for powerful superconducting electromagnets like those used in the Large Hadron Collider.

Despite this naturally occurring abundance, helium is incredibly difficult to detect and only a few countries can actually capture and store it. Helium is a non-renewable and finite resource, and according to annual assessments by the US Geological Survey, the levels of stored helium have been shrinking to alarmingly low rates in recent decades.

While helium makes up around 45 per cent of the mass of the sun, where it is formed at scorching temperatures by the fusion of hydrogen – the primary process that keeps the sun and all the stars burning – it can't be formed at will here on Earth. It takes billions of years for pockets of helium to form in the Earth's crust from the radioactive decay of heavy elements such as uranium and thorium. And as helium is lighter than air, most of it escapes into the atmosphere before it can be captured, making it an increasingly rare commodity.

In September 2017, the European Commission added helium to its list of critical raw materials



for European industry. Unsurprisingly, the price of helium has soared 500 per cent over the last 15 years but continued growth in the various industries that rely on helium mean shortages or outages are of the utmost concern. So the recent discovery of a vast repository of helium gas in the Great Rift Valley region of Tanzania in East Africa was of critical importance.

The discovery was made in 2016 by Helium One, a Norwegian-based helium exploration company founded in 2015, together with a team of scientists and researchers from the University of Oxford and Durham University in the UK.

Thomas Abraham-James, a geologist and the CEO of Helium One, began searching for helium in Tanzania several years ago after learning that a 1950s British survey of the region had reported high concentrations of the gas in ground seeps.

The initial prospecting trip in 2015 delivered an estimate of 54 billion cubic feet (1.5 billion cubic metres) of helium, combined predominantly with nitrogen gas – just under seven times the annual global consumption of helium, which is about eight billion cubic feet (0.23 billion cubic metres) per year. The independent resource assessors collected samples of gases to be analysed back at the laboratory, but this procedure allowed air to dilute the concentration of helium.

In 2016 the helium deposits, which are situated near Lake Rukwa, were tested again. Abraham-James brought geochemists Chris Ballentine and Peter Barry from the University of Oxford's Department of Earth Sciences to take samples from underground gas outflows in the Rift Valley area. They used a portable mass spectrometer to make measurements from the gas seeps in real time, which is a far more accurate method. ➤



Above and above right: Liquid helium is used to keep the superconducting magnets cool in an MRI machine. The same concept is utilised in the Large Hadron Collider to accelerate particles to near the speed of light.

The subsequent reanalysis by Ballentine and Barry found that helium concentrations in the gas deposits were far higher than what the first sampling method had found. This means the reserve may hold almost double the initial estimate at around 98.6 billion cubic feet (2.8 billion cubic metres) of helium gas.

Professor Ballentine says, “We sampled helium gas just bubbling out of the ground in the Tanzanian East African Rift valley. This is a game changer for the future security of society’s helium needs, and similar finds in the future may not be far away.”

Aside from the tremendous quantity of helium that will help address global scarcity fears, the major breakthrough is the new methodology for honing in on helium deposits, rather than accidentally acquiring it as a by-product of oil and gas drilling.

The new theory posits that volcanic heat liberates the helium from the ancient rocks where it forms, trapping the gas in underground pockets. In volcanic areas such as Tanzania’s Rift Valley, the trapped helium can seep through weaknesses in the Earth’s crust and bubble up through hot springs. Combining helium geochemistry with seismic images of gas-trapping structures, prospectors and scientists are now much better equipped to locate and measure new helium reserves.

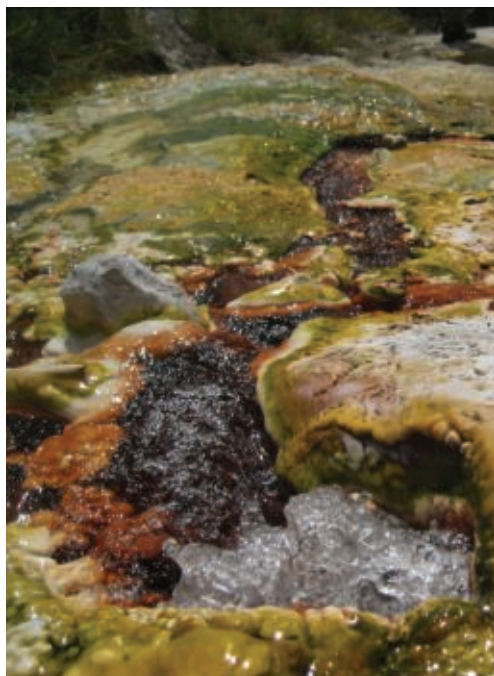
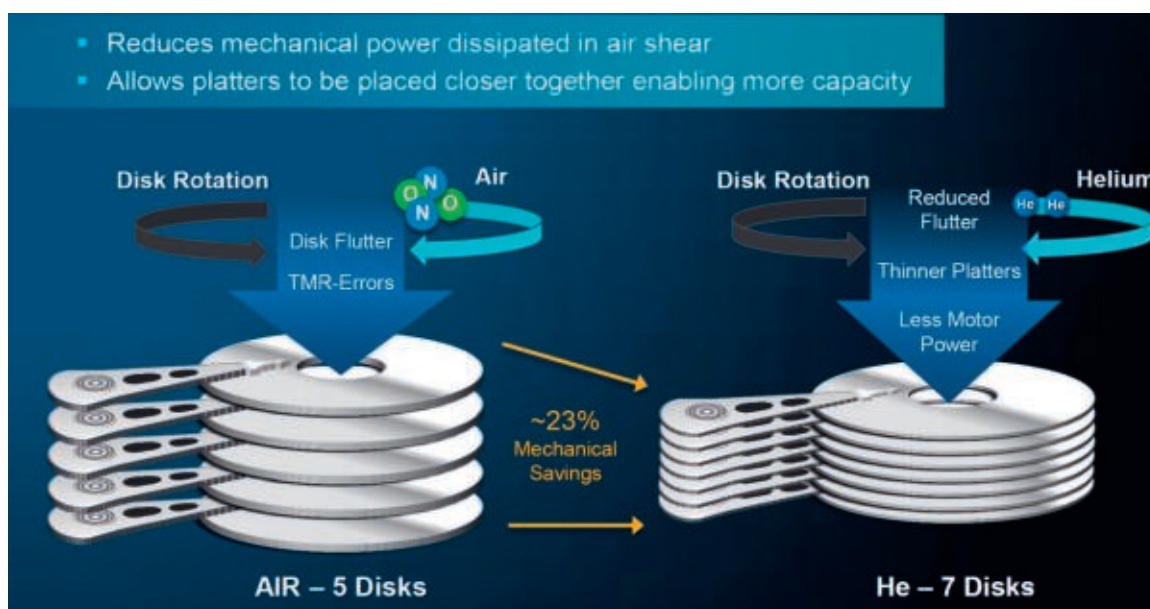


In their 2016 Oxford University report, Professor Chris Ballentine and Dr Peter Barry state, “There needs to be a thermal release of helium from the ancient crustal material, which is why high helium deposits are so rare. Tanzania meets this very rare criterion as it sits atop an active ‘spreading centre’, which results from a deep mantle plume.”

Geologist Jon Gluyas of Durham University, one of the project leaders, believes the gas field in Tanzania might only be a small part of what the whole Rift Valley area could contain.

Gluyas says, “It could be substantially larger. We still have a lot of data to collect to be really confident, but this is a globally significant discovery. Almost more significant than the volume of helium found,” he adds, “is that it was found on purpose. Every other discovery of helium to date has been found by accident.”

Using these new methods, Helium One is highly likely to succeed in substantially increasing the world’s helium inventory. Helium One CEO Abraham-James says exploratory drilling will begin next year and his company plans to establish a regional processing plant for gas production. “Probably by the end of 2020, people will start using Tanzanian helium,” he says.



The timing couldn't be better as one of the world's main helium suppliers to date – the Federal Helium Reserve near Amarillo, Texas, established after World War I to secure American supplies of helium as a lifting gas for military airships – is on track to cease supply by 2021.

The new supply will add some stability to the tight, highly competitive and unpredictable global helium market. With just a few worldwide suppliers any single disruption causes helium shortages, sending prices soaring and potentially affecting its use across an array of industries.

Abraham-James says, “The supply dynamics at the moment are very challenging, particularly with US output stopping in 2021. The world needs a reliable source of helium so that we don't see the fluctuations that we have in recent times.”

That is important as new applications for helium are appearing in more sectors. The gas is now considered a high-tech element due to its increased use in electronics manufacturing. For example, Netflix – the global market leader in video-streaming – uses HGST helium filled computer drives, which doubled their capacity and slashed the company's energy usage by almost a quarter.

There is also new innovation in Hybrid Air Vehicles coming from global aerospace firm Lockheed Martin. And – returning to balloons – there is Project Loon; a trailblazing new project developed by X (formerly Google X) that plans to use a network of helium powered balloons travelling on the edge of space to extend internet connectivity to communities in some of the world's rural and remote areas.

It seems the global helium crisis has been averted in the nick of time. ↑

Above: Helium is used in some hard drives as it is less dense than air, which increases speed and storage density.

Left: In the Tanzanian part of Africa's Rift Valley, helium is bubbling from volcanic vents.

THE END OF THE BRICK- AND- MORTAR TRADE?

So far this year 6,403 stores have closed in the US alone. That raises the question how the rise of e-commerce in the GCC will affect brick-and-mortar retail stores.

Jeff Bezos is synonymous with e-commerce. In July this year, the founder of Amazon.com usurped the title of the richest man in the world from Microsoft founder Bill Gates. At the time, his net worth was valued at \$90.6 billion – \$500 million more than Bill Gate's net worth. Hours after he took pole position, Amazon's stock price dropped and Bill Gates reclaimed his spot.

Bezos' rise started in the early 1990s. The then 30-year-old noticed that a new phenomenon called the internet was growing at an unprecedented rate of 2,300 per cent per year. Not one to miss out on opportunities, Bezos quickly made a list of 20 possible products to sell online, and eventually settled on books because of their low cost and the universal demand. Eventually, he expanded to music, movies, electronics and toys before finally allowing the addition of third-party vendors – who now account for 40 per cent of Amazon's \$107 billion in sales. To call Amazon an e-commerce website would be doing it a disservice. A more apt term to describe Bezos' behemoth would be to call it the world's first e-conglomerate.



In July this year, Jeff Bezos' e-commerce giant acquired Dubai-based retail and marketplace platform Souq.com to the tune of \$700 million. Shortly after that, Souq – which was growing at such an unparalleled rate that it was dubbed “the Amazon of the Middle East” – went on to acquire Wing.ae, a marketplace for merchants and couriers based in the UAE. This acquisition is expected to boost Souq's last mile delivery.

Although the biggest, Souq isn't the only unicorn to come out of the UAE. Noon, the \$1 billion e-commerce platform founded by Emaar Properties chairman Mohamed Alabbar, started operations in the UAE last month while in February last year, Dubai-based Wadi.com announced it had raised \$67 million in Series A funding with Al Tayyar Travel Group as the lead investor. Elsewhere, Net-a-Porter reported that the average order value in the Middle East is 50 per cent higher than the rest of world. It's therefore little

wonder that in April last year, Alabbar's Symphony Investments announced a joint venture with Yoox Net-A-Porter Group (YNAP), which will see Alabbar focus his entire online luxury retail activity in the GCC exclusively through the joint-venture, of which Symphony Investments owns 40 per cent. Off-price brands Yoox and The Outnet are set to debut localised sites in the region in 2018, while Net-a-Porter and Mr Porter will launch in 2019.

It doesn't stop there. Another big player in the UAE's e-commerce battlefield is Namshi. Part of the Global Fashion E-commerce Group and created by Rocket >



MIDDLE EAST LAGS BEHIND FOR E-COMMERCE



Top: Souq.com was founded by Ronaldo Mouchawar and Samih Toukan in 2005. It was bought by Amazon this year for \$580 million.

Right: Emaar Properties chairman Mohamed Alabbar invested \$1 billion in Noon.com.



Internet, Namshi is a Dubai-based online fashion retailer with over 40,000 exclusive in-house collections and brands. It posted a \$1.8 million profit last year.

E-commerce is set to become the next big thing for burgeoning businesses in the region with the market expected to be valued at \$10 billion by 2018, according to Frost & Sullivan. Those numbers are subject to the growth of complementary industries such as smartphones. Thankfully for e-commerce entrepreneurs, the UAE's smartphone penetration is the highest in the world at 73.8 per cent, with more than 90 per cent of the population having access to the internet. And with figures from AT Kearney showing that e-commerce contributes precious little to the GCC's economy, accounting for just 0.4 per cent of GDP in 2015, there can only be good news for these internet-dependant businesses.

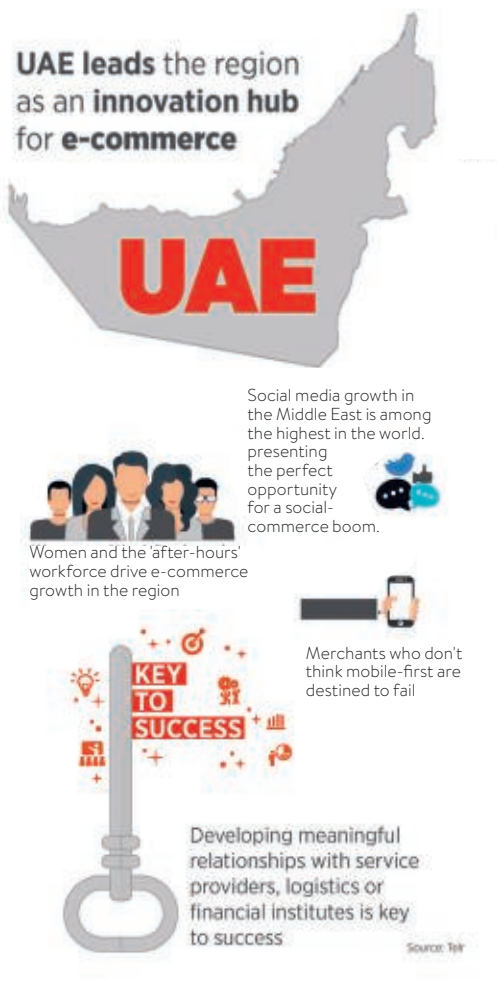
The fear with the rise of e-commerce – as with anything digital-oriented – is the impact it will have on the physical world. In the West, e-commerce has been around long enough to provide insights in contrast to the nascent GCC region. The arguments about e-commerce usually tend to start with jobs. The e-commerce drive in the US has led to layoffs, particularly in roles such as sales clerks. Consumers no longer need to head out into stores and buy apparel they can get online. This phenomenon has led to a “retail apocalypse” wherein US retailers are closing thousands of stores following years of declining sales and customer traffic. At last count, the store closure tally for 2017 alone stood at 6,403.



THOSE ARE FACTS THAT CAN'T BE DISPUTED

However, economist Michel Mandel believes we shouldn't focus too much on these figures. The chief economic strategist at the Progressive Policy Institute in Washington asserts that the move toward e-commerce is creating more jobs than are being lost in the brick-and-mortar retailing industry, and that these new jobs are paying much higher wages than traditional retail jobs. Mandel claims most economists are using the wrong job numbers to measure the e-commerce industry. He says that government numbers and conventional industry classifications don't properly count all the jobs associated with e-commerce – in particular, the numbers omit large parts of the industry such as distribution warehouses. Due to the growing volume of big brown boxes being delivered to

E-COMMERCE IN THE MIDDLE EAST



e-commerce is only getting started. According to MasterCard's 2015 Online Shopping Behaviour Study for the Middle East, 83 per cent of UAE residents had made a purchase online during the three months prior to the study being conducted, and 42 per cent of the Middle East's population uses the internet to shop. Despite that, retailers in the region are yet to feel the pinch.

It helps that the UAE is widely considered to be one of the best shopping destinations in the world. The country even ranks higher than New York, London and Paris in terms of shopping mall density and these continue to be the go-to destination for the millions of visitors and residents in the UAE.

If you need further evidence about the region's brick-and-mortar industry strength, look no further than Souq. Earlier this year, the online marketplace mirrored its parent company (Amazon) by opening a physical store on Dubai's Sheikh Zayed Road. The region's largest e-commerce platform isn't alone in making the switch. Amazon has already opened physical bookstores in the US and is reportedly planning to expand its network of grocery stores to about 2,000 outlets.

Elsewhere, China's Alibaba, accounting for more than one-tenth of the country's total retail sales, spent \$2.6 billion to acquire a leading domestic department store at the beginning of the year. If retail – and by extension brick-and-mortar – is, in fact, dead, why are some of the world's largest e-commerce platforms in a race to open more physical stores? You don't need two guesses to answer that.

Above: In 2016 the value of the UAE retail sector stood at \$56.6 billion according to recent data from Euromonitor International, and the UAE boasts one of the highest numbers of shops per capita in the world.

people's homes, these facilities are expanding rapidly.

In fact, Mandel has painstakingly combed through the job statistics on a county-by-county basis and found that from December 2007 to May 2017, the e-commerce industry has created 397,000 jobs in the United States, compared to the loss of 76,000 jobs in the traditional retail industry. What's more, those jobs related to e-commerce pay about 30 per cent more than the brick-and-mortar ones.

According to data analysis by the United States Bureau of Labour Statistics, high-productivity digital companies are expanding and the gains are going not just to well-educated software developers, but to mid-skilled sales people and office staff. Jeff Bezos' Amazon has reached 100,000 employees faster than any other company in United States history.

Looking at the GCC, and the UAE in particular, the brick-and-mortar industry is in a comparatively better shape than its United States counterpart as



The Fourth Industrial Revolution will require new skill sets from employees, which in turn will necessitate a change in education.

TEACHING FOR THE FUTURE

The Fourth Industrial Revolution is transforming our world at a staggering pace, with never-before-dreamt-of innovation accelerating the move away from mechanical and analogue electronic technology towards digital electronics and the Internet of Things.

The effect this will have on educational requirements could well be profound, with over one-third of the skills considered important in today's workforce predicted to change by 2020, according to the World Economic Forum.

In a world where Artificial Intelligence (AI), robotics, big data, machine learning, natural-language recognition and biometrics are ubiquitous, how should education evolve to ensure the world's future employment needs are met?

It is a deeply contested topic. Should schools and universities alter what they teach and how they teach it, or should they stick to the ancient and imbedded principles

of learning? Will the world of science trump that of the humanities? What's more, is there room for philosophy and sociology in a landscape dominated by technological disruption?

For many policymakers, a natural response to this shift towards AI and robotics has been to increase the focus and improve training in the so-called STEM subjects – science, technology, engineering and mathematics. The US, for example, has seen significant development in the area of data science degrees, while schools are faced with the question of whether to provide software education for all students.

THE ROLE OF LIBERAL ARTS

However, what is often less appreciated is the role liberal arts will play.

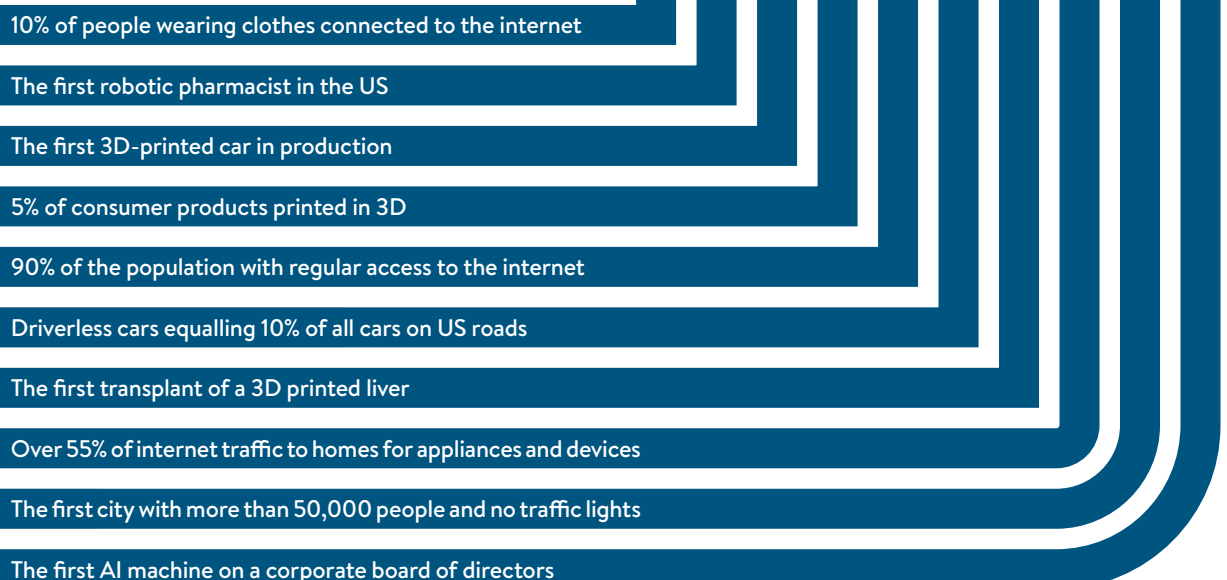
“As many studies now demonstrate, creative problem-solving, people management, and social intelligence

WHEN WILL THE FUTURE ARRIVE?

800 technology executives and experts from the information and communications technology sector were surveyed as part of our Technology Tipping Points and Societal Impact report

Percentage of respondents

TECHNOLOGY TIPPING POINTS EXPECTED TO OCCUR BY 2025



remain significant bottlenecks to machine learning,” wrote Daniel Araya and Creig Lamb in a report for the Brookings Institution. “This suggests that these ‘soft’ skills will increase in value as AI matures. Indeed, even as technology eliminates the need for routine labour, it will also open up whole new opportunities in industries that leverage creativity and innovation. Surfing this Fourth Industrial Revolution will mean marrying human intelligence to machine intelligence in new and creative ways.”

Much of academia believes this human intelligence is best encouraged and developed, not via a focus on technology itself, but on critical thinking. Indeed, according to the World Economic Forum, creativity will become one of the top three skills workers will require in the future, with ‘learning agility’ – the ability to learn, adapt and apply in quick cycles – of paramount importance.

“Technologies will evolve – often rapidly – and jobs

that are here today will disappear,” says Kevin Mitchell, Vice Provost for Undergraduate Affairs and Instruction at the American University of Sharjah. “This is one of the reasons that I reject the notion that education should be focused on job preparation, although I do think that the region does need comprehensive vocational education that aims to prepare students who may not have the desire or inclination to pursue a university education.

“I also do not believe that one teaches creativity by setting out to teach creativity, rather one teaches in a manner that fosters critical thinking about questions or problems by demanding both depth of thinking and fostering a desire to seek broader connections between ideas that may not be immediately obvious.

“I am an advocate of the liberal arts as a core part of a university education because it prepares students for uncertainty by allowing one to confront questions rather than establish definitive answers. Success in an



Above: Interactive learning is an important component of modern teaching methods.

ever-changing world will depend on thinking that is characterised by flexibility and rigour.”

Mitchell offers two examples, both former students at the American University of Sharjah. The first is Ahmed Hosny, now a PhD candidate at Harvard University’s Dana Farber Cancer Institute’s Computational Imaging and Bioinformatics lab, and Maastricht University in the Netherlands. His research explores the capturing of tumour phenotypes through computer vision, machine learning and quantitative shape descriptors.

The second is Mostafa ElSayed, who co-founded Automata Technologies in London, which explores the development of low-cost robotics. Both pursued defined professional degrees, but their ability to transcend disciplinary boundaries led them to alternative paths in areas that are at the forefront of technological development.

“I advocate for a position that views digital tools as tools that are only effective if students possess the ability to think critically about the way in which the tools are manipulated,” says Mitchell. “The fundamentals of craft are extremely important – and rarely addressed – in education in the region. One can easily purchase the technology if means are available; however, in my view, one should never begin with questions focused on technology but rather with critical thinking about the challenges to be solved.”

As Araya and Lamb state, an “AI-driven society will increasingly demand an entrepreneurial workforce, well versed in the application of knowledge”.

“At the same time, AI has limitations,” they wrote. “Machine learning has been particularly effective at making predictions, but it has been much less successful at managing challenges associated with judgment, decision-making, and interpretation. What is striking is that these kinds of skills are not generally the focus of STEM disciplines. In fact, they more closely align with the type of learning that liberal arts degrees are equipped to deliver.”

The Brookings Institution report quoted Steve Jobs, the late CEO of Apple, who said: “It is the marriage of technology with the liberal arts and humanities that is the secret to leading change.”

It’s a belief that is gaining traction, with the ‘STEAM movement’ encouraging students to combine STEM and art subjects at both secondary school and university.

In the UAE, with its move towards a knowledge-based economy, education is one of the seven future challenges identified by Dubai Future Foundation. To this end, Dubai Knowledge and Human Development Authority will test 21st century assessment systems and personalised learning solutions that work across curriculums. Amongst them will be STEAM.

TEACHING NEEDS TO EVOLVE

None of this means, however, that the practice of teaching does not need to evolve. Old pedagogical methods of instruction are becoming increasingly redundant as the demand for interactive learning increases.



"We must recognise that the emergence of Generation Z brings to us different candidates," wrote Jacques Biot, President of École Polytechnique, for Times Higher Education. "At the end of their learning process, industry will request from graduates that they be savvy at solving complex issues involving several sciences, and respectful of general interest. This involves from us a specific effort to develop new pedagogical tools and channels aimed at fostering multidisciplinary approaches."

Lance de Masi, President of the American University in Dubai, readily acknowledges that there is a notable dissatisfaction among employers in the GCC with university graduates' skill sets.

"I believe that the gap between skills expected and skills delivered can most essentially be attributed to the conflicting values held by academics and so-called 'real world' professionals," adds de Masi. "In spite of some commonality in intention, the priorities set by the two sides vary considerably, and the contrast has serious implications for curriculum design, teaching, course and classroom management, standard-setting and assessment."



For example, courses, in whole or part, must be explicitly designed for soft skill acquisition. "This is a curricular matter, all too often either ignored or left to chance," says de Masi. "Universities must reflect the input of business and government advisory councils in their curricula."

"As far as the classroom per se is concerned, it is detrimental to conserve the belief that traditional pedagogical approaches (e.g. the lecture), in which students are passive recipients of knowledge, favours the development of the critical thinking and pro-activity in high demand by employers."

A learning environment that is participatory and interactive is necessary, with a rejection of spoon-fed information and an enabling of students to take charge of their own learning. All are key to the formation of the professional citizenry of the future.

"My contention is that the greater the convergence between the standards and mechanisms on both sides of the divide, the more graduates will be prepared to meet employers' expectations," says de Masi. "Right now, with inflation having hijacked many grading practices, many students are under the illusion that something is excellent or very good when it is only seen as average by IBM or Al Futtaim."

He adds: "I hope that my comments are not misconstrued to suggest that I favour turning universities into training institutes. Universities are houses of learning, for today and tomorrow, and nothing is more sacred to them than the cultivation of the mind."

"Education is a much bigger and more encompassing activity than training. My point, however, is that there is no reason for universities to have to choose between the vocational and the educational. Both can live side by side to the greater satisfaction of employers." 🏹

Above: A participatory learning environment is essential in order to create critical thinking.

Left: The focus is moving from STEM learning to STEAM learning, with the latter including art subjects.

SMALL BEGINNINGS BIG FUTURE

The science of material at its smallest level – nanotechnology – packs an enormous punch, especially in medicine.

It may be invisible to the naked eye, but nanotechnology will change the way we view health matters in the future. The science involves manipulating particles smaller than 100 nanometres to develop materials or devices within that size to enhance a variety of healthcare procedures ranging from effective drug delivery to faster diagnoses. When reduced to the nanoscale, the physics and chemistry of materials are radically different. They exhibit different strengths, conductivity and reactivity and exploiting these could revolutionise medicine. Apart from the application of nanoparticles as a panacea for almost all human ills, scientists have also undertaken futuristic research that involves the use of nano-robots to make repairs at the cellular level.

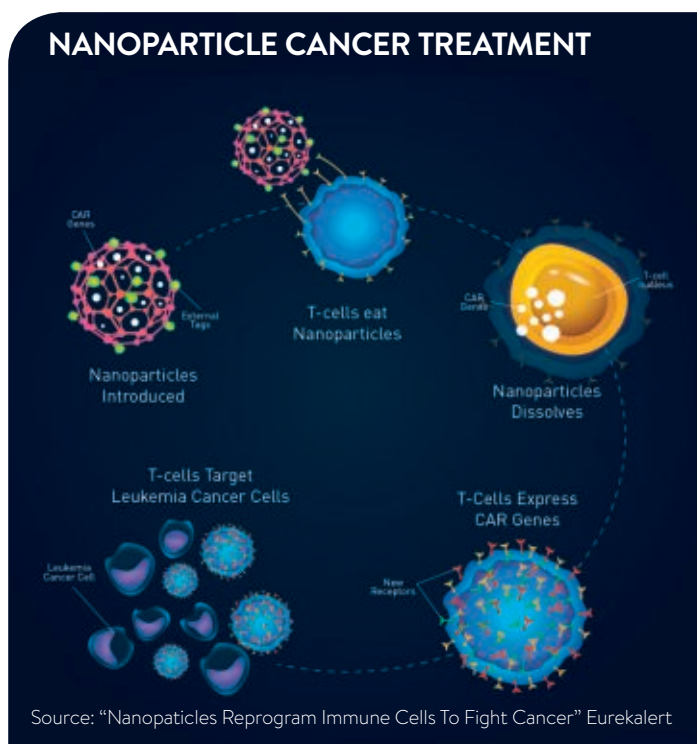
ALWAYS ON THE MARK

In the developed world, cancer tops the list of diseases being targeted for nanomedical treatment. Recently, biotechnology company CytImmune published the preliminary results of a phase 1 clinical trial of a targeted chemotherapy treatment method. They attached gold nanoparticles to the molecules of TNF (a tumour killing agent), as well as to molecules that shielded the nanoparticles from the body's immune system. This allowed the gold nanoparticles to flow through the blood stream without being attacked. The particles attached to the tumour killing agent showed a tendency to accumulate in the cancer tumour, avoiding the other regions of the body. Unlike traditional chemotherapy, which also destroys healthy cells, this technique showed the possibility of limiting the toxic effects of TNF on healthy cells. While the process seems deceptively simple, researchers had to pay minute attention to a number of details – determining the right size of the nanoparticle, finding a way to hide it from the immune system and choosing the ideal targeting molecule to bind to the cancer tumour – making the journey from the research concept to clinical testing a laborious one.

Researchers at the Houston Methodist Research Institute used silicon nanoparticles to demonstrate a targeted drug delivery system. The silicon particles degrade >







Clockwise from above:

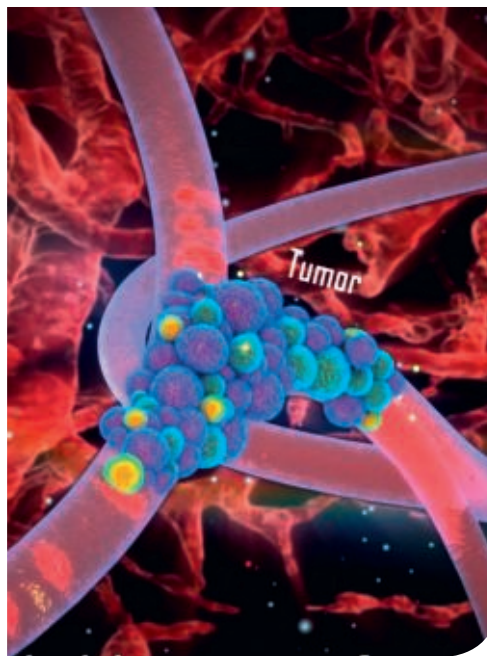
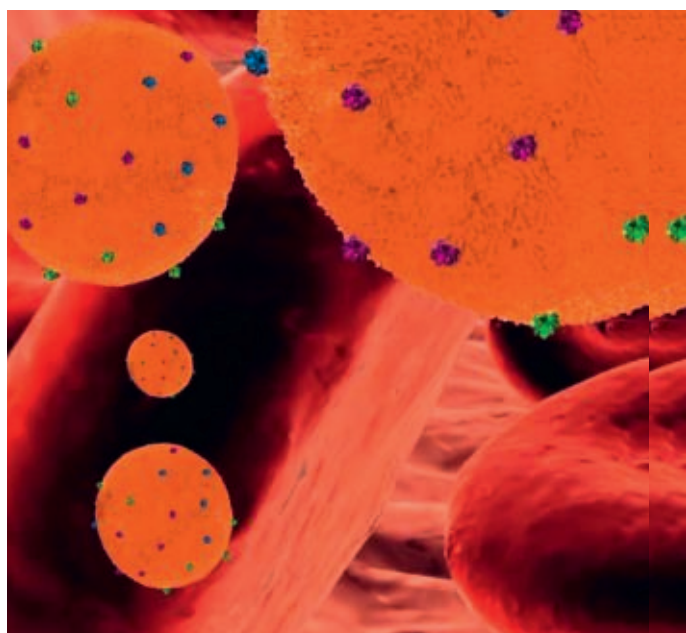
Nanoparticles are being used to bypass the body's natural immune system to deliver drugs; Nanosponges absorb and remove toxins from the bloodstream; Carbon nanotube coated lenses can convert light from lasers to sound or electricity; Gold nanoparticles have a tendency to accumulate in tumours.

inside the cancerous tumour releasing polymer strands. These strands form another nanoparticle that contains the drug to destroy the cancer cells.

Other research shows that gelatin nanoparticles deliver drugs to damaged brain tissue more effectively than standard methods. Across the world in India, scientists are testing the use of nanotechnology for the treatment of tuberculosis.

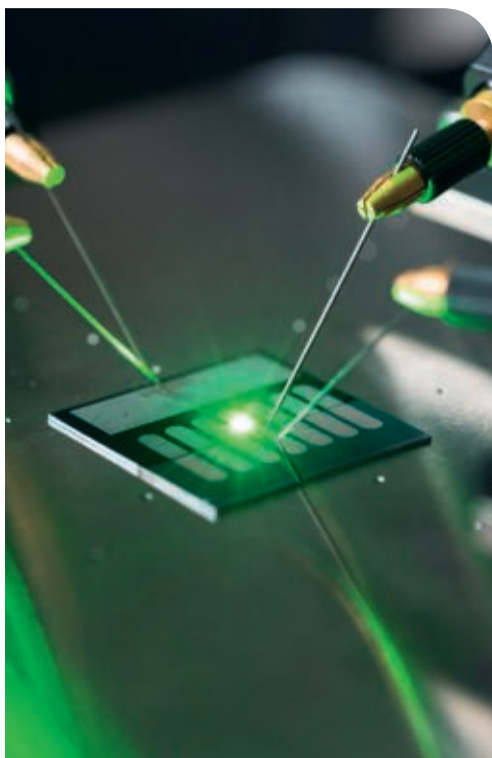
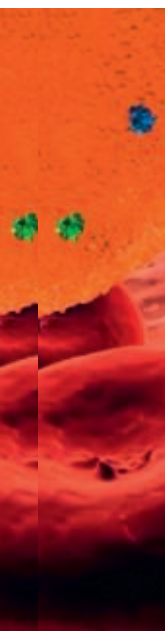
One of the most important medical challenges nanotechnology can help overcome is sustained drug release in the body and improvement in bioavailability – the amount of active ingredients per dose. Some drugs have short lives and nanovehicles such as liposomes could potentially make them active for longer. Experts believe that nanotechnology holds the potential to usher in a new era for immunization, emerging as alternates to injectable vaccines. Nanoparticles within the vaccine would protect it, allowing it a longer time to trigger a stronger immune response.

Apart from cancer treatments, researchers are also exploring nanotechnology for other therapies. Nanosponges that absorb and remove toxins from the bloodstream; nanofibres to stimulate the production of cartilage in damaged joints and nanoparticles that reduce bleeding by hastening the body's blood clotting mechanism or by acting as synthetic platelets, and nanofibres that self assemble inside decayed teeth to regenerate into healthy tissue – all are being researched at various labs around the world.



FROM INSIDE TO OUTSIDE

The science of small is set to play a big role in diagnostic techniques. In third-world countries, quick diagnosis is often the fine line between life and death and nanotechnology has the potential to make detecting diseases efficient and rapid. The options include using nanoparticles in the form of fluorescent quantum dots, carbon nanotubes and nanowires to act as biosensors to detect diseases such as malaria, HIV and cancer. Gold nanorods programmed to attach themselves to



proteins generated by failing kidneys will flag up kidney damage

Carbon nanotubes could also be the next breakthrough in non-invasive surgery. Researchers have developed carbon nanotube coated lenses that convert light from lasers to focused sound waves capable of blasting tumours or other diseased areas without damaging healthy tissue.

Drug resistant bacteria could finally meet their match in nanoparticles. A combination of gold nanoparticles and infrared light promises elimination of the deadly biofilm that forms over instruments in operating theatres. Also under investigation is the use of quantum dots to treat antibiotic resistant infection and polymer coated iron oxide nano particles to fight chronic bacterial infections.

Wearable technology is another target for nanotechnology with manufacturers using graphene or silver nanoparticles in RFID tags, fitness bracelets and wristbands. Including nanoparticles in the devices makes them even more sensitive to the slightest bodily changes, allowing the wearer more accurate health monitoring.

GROWING BIG

Nanotechnology is being hotly pursued in rich countries that are investing heavily in its research and development (R&D). The global market for healthcare nanotechnology is expected to reach \$196.02 billion

by 2020 growing at a compound annual growth rate (CAGR) of 12.1 per cent, according to a new study by business consulting firm Grand View Research, Inc. In another report, Research and Markets, the world's largest market research company predicts the nanomedicine market will grow at a CAGR of 17.1 per cent to reach \$392.80 billion by 2023. Countries around the world are allocating massive amounts of resources for R&D in nanotechnology, reaffirming the vital role it will play in improving human health. In the United States alone, \$1.4 billion has been set aside for the National Nanotechnology Initiative as part of the 2017 Federal Budget.

Amongst developing nations, China tops the leaderboard in nanotechnology R&D. Its national nanotechnology programme has been in place since the 1990s and has registered the most nanotechnology patents since then. China also has a huge number of new nanotechnology companies setting up shop every year. In the Asian subcontinent, over 30 biotechnology institutions are researching nanotechnology in India. Further south-east, Malaysia, the Philippines, Thailand and Vietnam are all actively engaged in nanotechnology research.

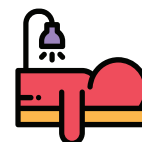
Brazil leads nanotechnology research in South America and has partnered with institutions in South Africa and India through the IBSA Nanotechnology Initiative, which prioritises research in the fields of health, water treatment and agriculture.

While the first generation of cancer drugs to be delivered via nanoparticles has already been approved by the US Food and Drug Administration, nanomedicine still has a long way to go in healthcare. There is concern amongst the scientific community that not enough has been done to study the toxicity of nanoparticles to human health and the environment. For instance, a 2004 report by the UK Royal Society and Royal Academy of Engineering recommended that nanoparticles and nanotubes be treated as hazardous waste. Other critics point to the high costs of R&D and question the wisdom of developing countries investing in cutting-edge nanotechnology when millions of their people are dying due to a lack of basic healthcare.

Despite the different outlooks, there is consensus that nanotechnology could, in the long run, save more lives than conventional methods by making diagnosis and treatment far more effective. It has shown much success within laboratories but additional work is needed to adapt the technique to humans. While some techniques are still at the discussion stage, others are being painstakingly tested and some are already in use. At whatever stage they are, the use of nanotechnology in medicine promises to revolutionise the way we detect and treat disease and trauma to the human body in the future. ↑

BIOMETRICAL APPLICATIONS OF NANOTHERAPEUTICS

TARGETED THERAPY



GENE DELIVERY



DETECTION AND DIAGNOSIS



MOLECULAR IMAGING



BIOMARKER MAPPING



DRUG DELIVERY



TOUCHING THE SUN

It's big, yellow and all life on Earth depends on it. Yet we have some major knowledge holes when it comes to the Sun, which may be answered by NASA's latest venture: the Parker Solar Probe.

In July, Nasa announced it had identified a huge hole in the Sun, measuring an estimated 75,000 miles wide. This specific sunspot is actually larger than the Earth and experts at Nasa's Solar Dynamics Observatory, which discovered the hole, said at this stage it was too early to predict how the sunspot will behave. Nonetheless it is large enough that it is visible from Earth and has the potential to produce flares that could cause radiation storms.

Sunspots, which scientists first saw in 1610, have far stronger magnetic fields than the rest of the Sun's surface. This means that sunspots are somehow related to the Sun's magnetic field, but the exact cause is not yet clear.

Now, another hole has been discovered in the Sun and this one has startled scientists. Right in the middle of the Sun, a mass the size of 1,500 Earths has simply disappeared. Much of what scientists know about the Sun's behaviour says it should be there – but when the data encoded in sunlight is interpreted, it is nowhere to be seen.

That has disrupted our understanding of how the Sun works, and physicists are struggling to figure out what fills that hole. It could be a thing, such as dark matter. It could be a concept, with

elements such as carbon and nitrogen simply behaving in a way scientists didn't expect under crushing pressure. Or perhaps we're looking at the Sun in the wrong way. If the latter is true, it has ramifications for stellar evolution and every planetary system that is being studied.

That the Sun is an enigma is nothing new. For example, the Sun has such broad emissions and absorption lines that it is difficult to tell its precise elemental composition. Imaging results have to be fed into models that include information on the circulation of matter and energy in order to generate estimates of its elemental composition. These models have produced estimates that were in line with data obtained about the body's interior.

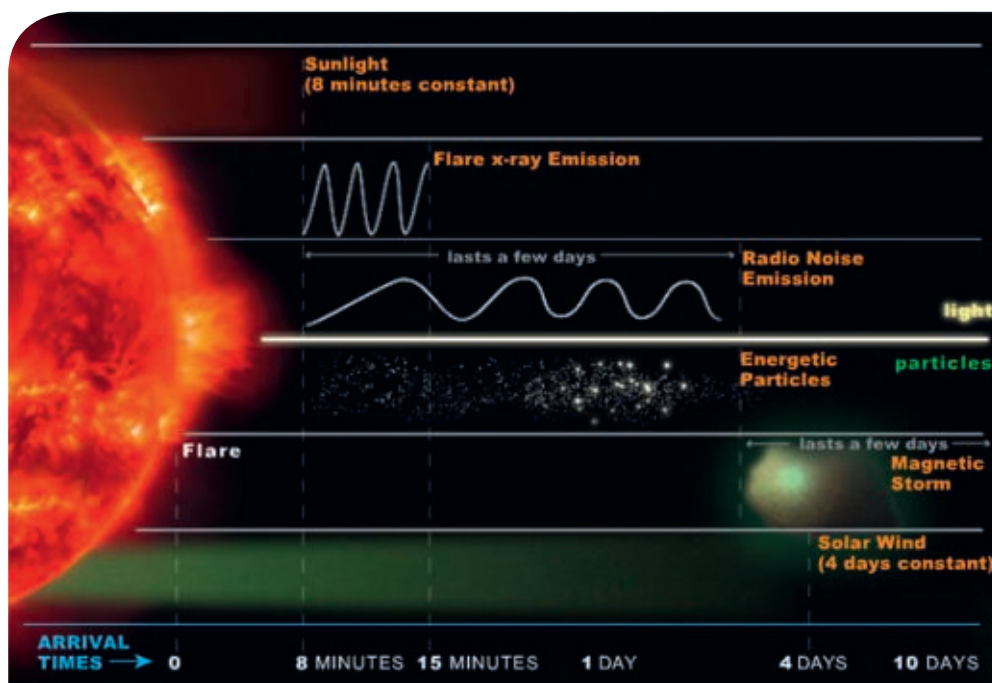
The problem is that if the surface composition is used to construct a model of the interior, it produces something that is inconsistent with the data obtained from helioseismology, which tracks the propagation of sound waves through the interior of the Sun. In other words, the two study approaches are getting different results that can't be reconciled, underlining what we don't know. Simply put, more data is needed. Fortunately, help is on the way.

TRUE TRAILBLAZER

Until now, the Sun's searing heat has been the greatest deterrent in exploring the star. But NASA's newest unmanned spacecraft, the Parker Solar Probe, promises to conquer that obstacle next year. Named after Eugene Parker, the astrophysicist who predicted the existence of supersonic solar winds, the craft will fly directly into the Sun in an attempt to answer some of the most perplexing solar secrets.

The nearest we have come to the Sun was in 1976 with the Helios 2 mission which flew to within 27 million miles. The Parker Probe's

seven year mission will take it seven times closer to the Sun's surface than any previous flight. In a gruelling space journey, the probe will pierce the Sun's outer layer, the corona, to travel within four million miles of its surface, while withstanding temperatures of almost 1,400°C. Taking off in mid-2018 from Cape Canaveral, the spacecraft will go into an independent orbit and make up to 24 loops around the Sun between November of that year and June 2025. It will take nearly 88 days to complete each orbit – that is the same time Mercury takes to revolve around the Sun. >



SWEAP SPC
Solar Array Cooling System
High Gain Antenna
SWEAP SPAN B

Above: The Sun is the source of the solar wind; a flow of ionized gases that streams from it past Earth at speeds of more than 500 km per second (a million miles per hour).

Parker's planned trajectory involves a series of complex manoeuvres. It will engage in repeated flybys of the planet Venus, using it as a gravitational brake to come closer to the Sun. Then, accelerating to a speed of 430,000 miles per hour, it will dive into the Sun's surface. The \$1.5 billion probe's flight will set two new records – it will be the closest we have gotten to the blazing star and the probe will be, by far, the fastest man-made object ever.

The probe is fitted with a host of state of the art equipment, including four suites of sensitive instruments to measure electrical fields, magnetic fields, and electrons and heavy ions, as well as a camera that will send back to Earth the first-ever images from within the corona. Parker's white light imager, dubbed the 'Whisper', will photograph solar waves as it flies through them. Protecting the equipment from the Sun's brutal heat is a 4.5 inch thick heat shield made of carbon composites. The shield is so effective that behind it, the instruments will operate at room temperature.

REVOLUTIONISING PHYSICS

Although a network of satellites is in place to observe the surface of the Sun, they have not yielded enough information to enable proper understanding of solar storms or violent eruptions of charged particles from the Sun that travel outward through the solar system. Radioactive solar storms can wreak havoc with Earth's satellites and power supplies, disrupting communication

and GPS services. They can also potentially shut down electrical grids over vast expanses of our planet. According to a study by the National Academy of Sciences, a virulent solar storm could cause up to \$2 trillion in damage in the US alone and black out the country's eastern coast for up to a year.

For scientists, the Parker Probe will not only seal the gaps in our knowledge of the Sun but will 'revolutionise' our understanding of the Sun and the origin of physics. Once the Parker Probe enters the corona, its telescopes will capture unprecedented close up images of the Sun. The probe will also beam back information on how solar winds work and the Sun's magnetic fields. One of the most pertinent questions the probe will answer is what causes the solar storms, enabling scientists to predict them and come up with solutions necessary to protect us.

Another mystery scientists hope the Parker Probe will solve is that of the temperature inversion on the Sun's surface and its outer atmosphere, the corona. Temperatures in the corona-sphere soar up to between a million and 10 million degrees, while the surface is a mere 5,500°C.

Nicola Fox, one of the mission project scientists, said: "We have really come as far as we can with looking at things and it's time to pay it a visit.

"It's time to touch the Sun. 🚀

THE PARKER SOLAR PROBE

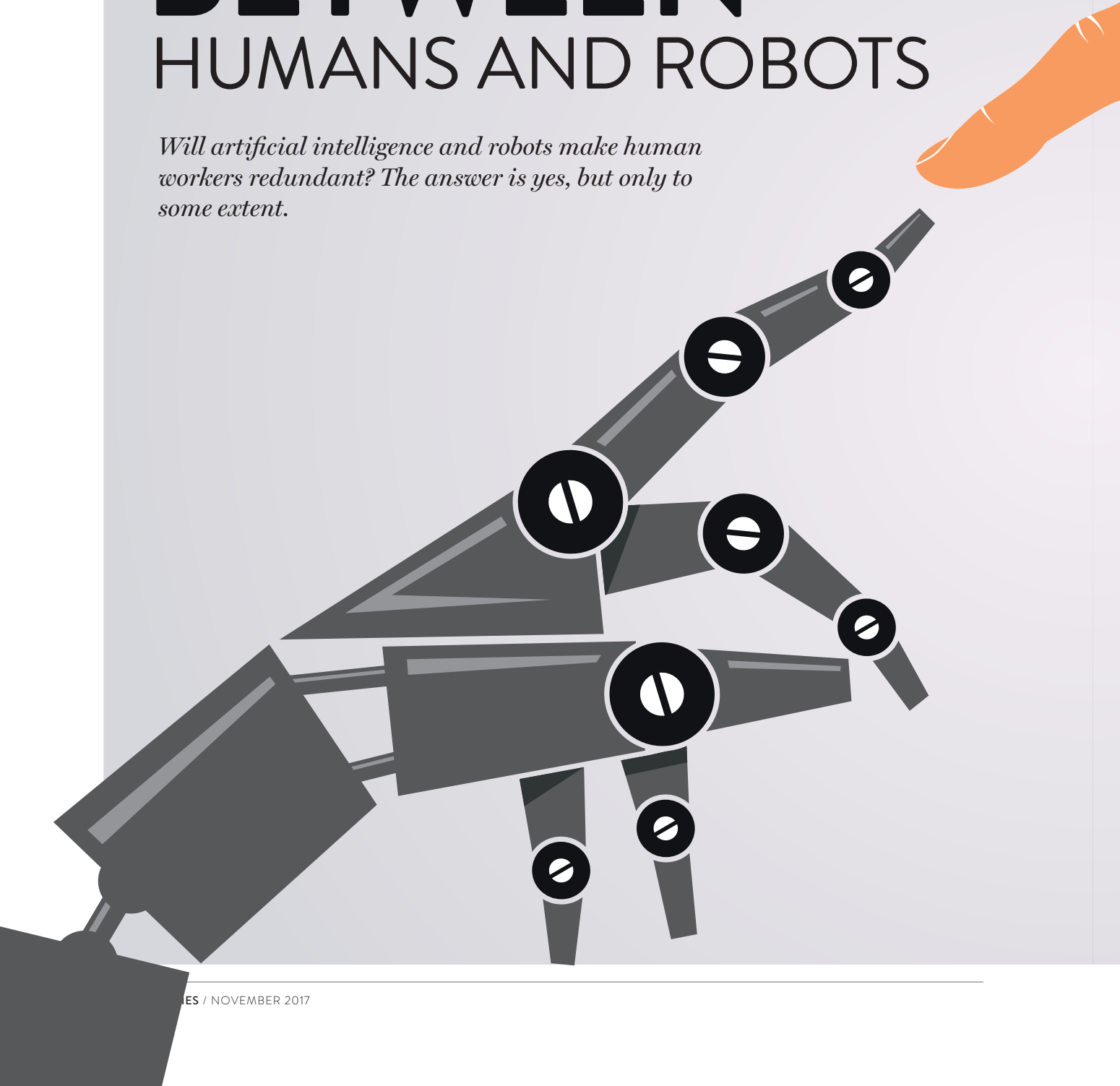
Thermal
Protection
System

Solar Array Wings (2)

Charged particles from the Sun striking the Earth's atmosphere cause the Northern Lights (Aurora Borealis).

BETWEEN HUMANS AND ROBOTS

Will artificial intelligence and robots make human workers redundant? The answer is yes, but only to some extent.





In 2014, Japanese telecommunications giant Softbank Corp. unveiled a new humanoid robot named Pepper. Pepper wasn't the first of its kind; at the time, Honda had Asimo and NASA had Robonaut. Unlike Robonaut though, Pepper wasn't going to function in places where it was too dangerous for humans. Instead, Pepper would work alongside mankind, maybe even replace them.

Like other humanoid robots, the four-foot-tall Pepper is capable of verbal and physical communication. Unlike the others though, Pepper is equipped with an emotion recognition system to decipher what's behind voice tones. The talking bot can identify joy, sadness, anger, surprise and determine whether a person is in a good or bad mood – abilities that Pepper's engineers figured would make "him" an ideal personal assistant or salesperson.

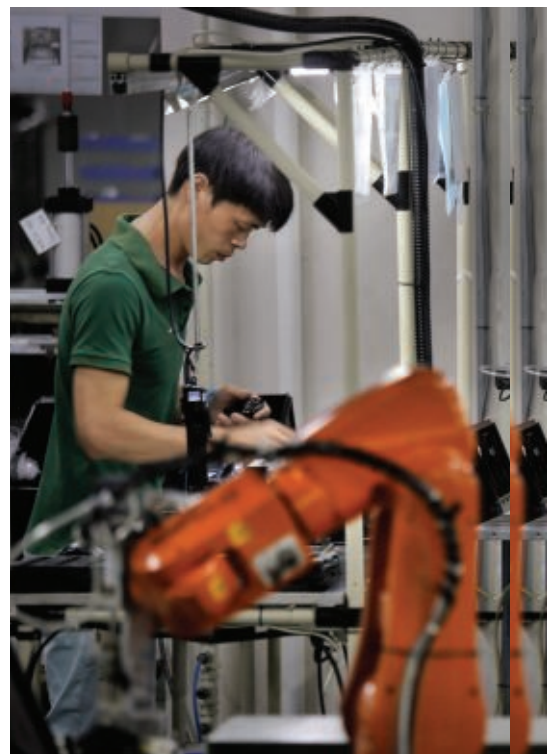
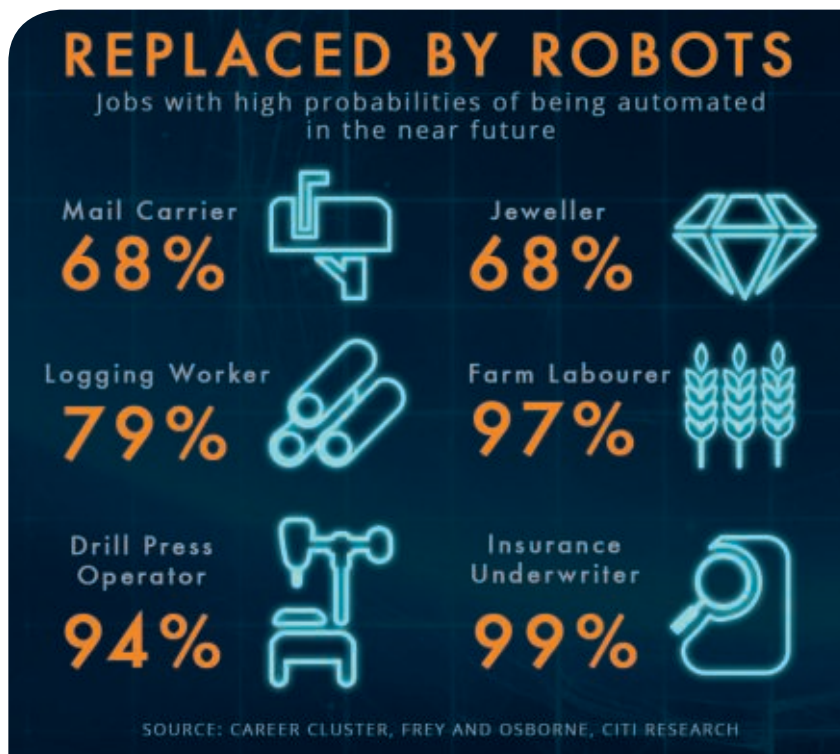
Which is precisely why two years later, SoftBank opened a cell phone store in Tokyo and staffed its front office entirely with Peppers. The six robots would attend to customers, recommend the best phones and handle order processing using a tablet. It's no surprise then that later in May 2016, the world was filled with about 10,000 Peppers; each taking on a varying nature of tasks.

That example would fall in line with everything you may have heard about Industry 4.0 and how robots are coming for your job. It's a complex subject, one that has experts with polarising opinions. Where Facebook founder Mark Zuckerberg and Microsoft co-founder Bill Gates refuse to acknowledge that the technology is something we should be worried about, Elon Musk – a man whose businesses hold AI in great esteem – believes that it is "the greatest risk we face as a civilization" and has called for swift government regulation on the subject. In September this year, Musk even went so far as to tweet, "China, Russia, soon all countries with strong computer science. Competition for AI superiority at national level most likely cause of WW3."

WHAT RESEARCHERS SAY

Is any of this true or sheer sensationalism in a world rife with false news?

According to the *Workforce of the Future* report by PricewaterhouseCoopers (PwC), the second largest professional services firm in the world, automated bots could take nearly four in 10 (38 per cent) jobs in the US, and take 30 per cent of jobs in the United Kingdom, 35 >



Above right: China has about 30 robots for every 10,000 factory workers, compared with 437 in South Korea and 152 in the United States.

Right: Japan's Twenty-One robot works as a carer and is capable of a number of physical tasks.

per cent in Germany, and 21 per cent in Japan. The report further states that by 2030, robots would account for 40 per cent of all US jobs. However, this report was based on a survey of 10,000 people. That's a rather small sample size, especially if you're going to extrapolate that to the US as a whole. The problem with most reports on the subject is that not enough research has gone into the subject matter.

In fact, only two studies have actually researched the impact of robots on jobs thoroughly. The second study, an analysis of more than 20 years of labour automation in Germany, found no evidence that robots caused permanent job losses in the country as a whole. The first – a US study published earlier this year – painted a much gloomier picture. Researchers at the Massachusetts Institute of Technology and Boston University found that workplace automation squeezes wages and takes away between three and six jobs per robot.

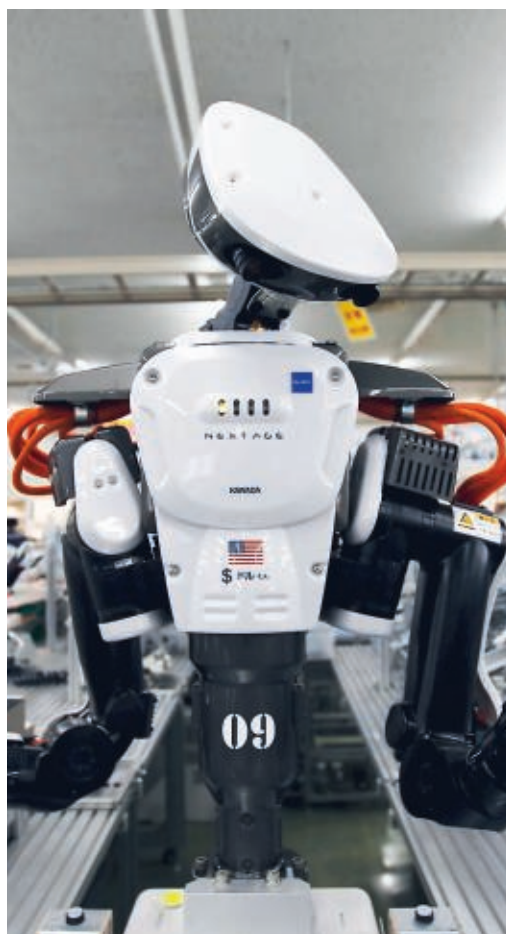
As you'd expect the findings aren't all good news, but they also aren't as bad as the reports would have you believe. Germany, Europe's largest economy and a manufacturing powerhouse, went from having two industrial robots per thousand people in 1994 to almost eight in 2014. That essentially means it has quadrupled the number of installed industrial robots in the last 20 years, yet the Germans did this without causing human redundancies.

How do we know this? Researchers from the Universities of Würzburg, Mannheim, and the Düsseldorf



Heinrich-Heine University examined 20 years of employment data to figure out how much of an effect the rise of the robots had on the German labour market. Despite the significant growth in the use of robots, they hadn't made any dent in aggregate German employment. "Once industry structures and demographics are taken into account, we find effects close to zero," the researchers said in the report.

"It's not like jobs were destroyed, in the sense that a manufacturing robot is installed and then the workers are



fired because of the robots – that never really happened in Germany,” explained study co-author Jens Südekum, from the Düsseldorf Institute for Competition Economics. “What happened instead is that in industries where they had more robots, they just created fewer jobs for entrants. Typically, around 25 per cent of young labour market workers went into manufacturing and the rest did something else, and now more workers have immediately started in the service sector – so in a sense, the robots blocked the entry into manufacturing jobs.”

The study also found that those in jobs where they were more exposed to automation were significantly more likely to keep their jobs, though some ended up doing different roles from before. The big downside for some medium-skilled workers, who did manual, routine work, was that it meant taking pay cuts.

THE WAY AHEAD

So why the large disparity between the German and US markets? The biggest factor that helped Germans from losing their jobs was the country's famously powerful unions and work councils, which have been keen to accept flexible wages on behalf of workers in order to maintain



high employment levels. The US workers, however, mostly don't have that kind of backing.

In the US, more than two million people were employed as accountants, bookkeepers, and auditors in 2015. Until now, these types of information-oriented professions have resisted automation as they require managing unstructured data emanating from the real world, making judgments, and dealing with actual people. What's different now is that artificial intelligence's perceptive capabilities have improved. Machines can now handle images, sounds, and text in a way that enables them to ingest and analyse data at high volume, without making costly mistakes. Between accounting professionals and truck drivers alone, about 4.5 million human jobs could be ceded to robots over the next few years.

Dennis Whitney, Senior Vice President of the Institute of Management Accountants (IMA), believes education could help people being replaced altogether. Specifically education in those fields that will be in high demand such as computer programming, data analytics, applied mathematics and statistics. This includes all high-level accounting jobs represented by the IMA that are focused on planning, analysis and risk management. “We have to look at AI as a source of analysis and information and retune ourselves so we can get those higher-level jobs that require judgement and recommendations,” Whitney said. “Governments need to intervene and take care of their citizens too. The AI takeover is coming quick – less than ten years away – which is why governments need a plan in place. Things like reduced cost of training, a proper healthcare plan and minimum wage could go a long way to make all of this easier.”

Therein lies the truth. AI or robotics is not here to take away every job, but it will take away blue-collar jobs. Most people aren't equipped to deal with the digital revolution alone, which is why government intervention is necessary and education on all levels needs to be adjusted to deal with Industry 4.0. Industrial revolutions brings disruption, what matters is how we tackle that disruption. ♪

Above: Kawasaki Heavy Industries uses robot machinery to pack lunches and make pizzas.

Left: A humanoid robot works with employees on an assembly line at a factory.





THE BIRTH OF THE PC

The Altair 8800 microcomputer that was released in 1975 is regarded as the world's first personal computer.

On 1 April 2010, a doctor named Henry 'Ed' Roberts passed away in the US town of Cochran in rural Georgia. He had been practicing in quiet obscurity since 1977.

Outside of his immediate family and friends, few people would have batted an eyelid at the news of his death. Bill Gates and Paul Allen, the joint founders of Microsoft, changed that.

"Ed was willing to take a chance on us – two young guys interested in computers long before they were commonplace – and we have always been grateful to him," they wrote in a joint statement on the day of his death. "The day our first untested software worked on his Altair was the start of a lot of great things."

In a previous life, Roberts had been an engineer and entrepreneur and had founded Micro Instrumentation and Telemetry Systems (MITS) in 1970, mostly to sell electronic calculator kits. At the time, he probably had little idea how far reaching the impact of his work would be – an impact that would later lead him to be called the 'father of the personal computer'.

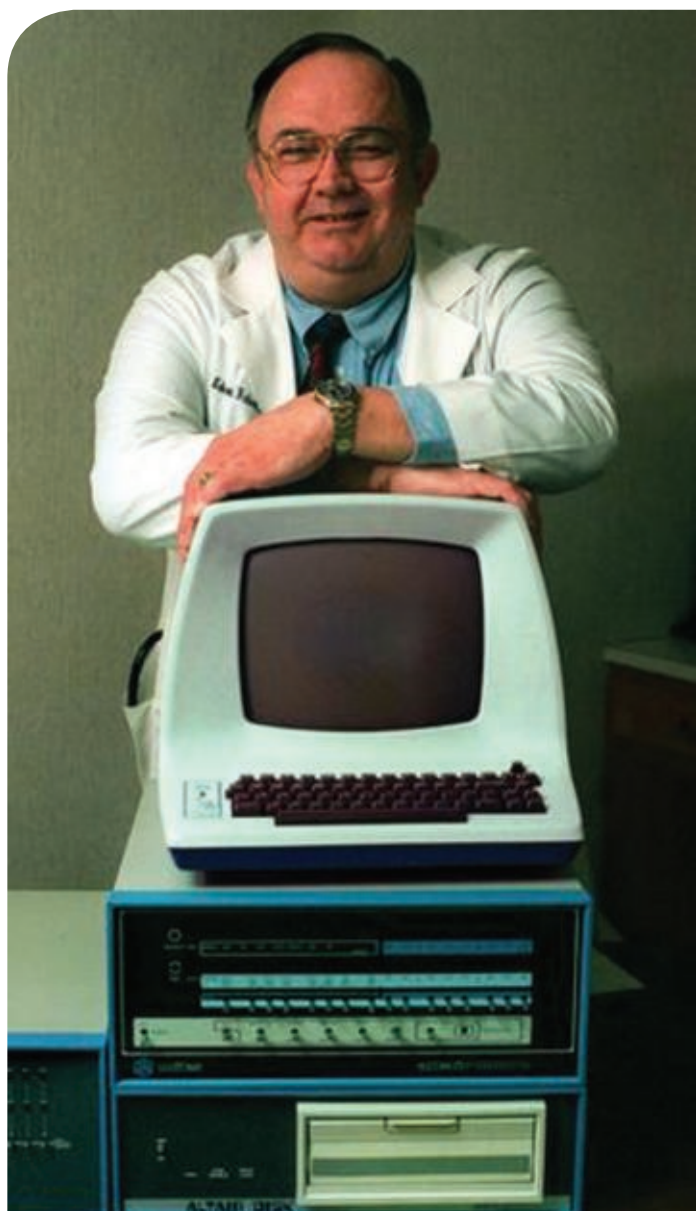
"Roberts ran a company in the early 1970s called MITS, making various electronic kits for hobbyists and builders of model rockets," says Dag Spicer, senior curator at the Computer History Museum in California. "His company was doing very well selling inexpensive calculators when he got caught with too much inventory and his company nearly went bankrupt.

"He developed the Altair 8800 microcomputer as a way to pay off his debts. It sold many times what he initially thought and can be said to have been the seminal event in introducing the idea of a microprocessor and personal computer to the world via the January 1975 issue of *Popular Electronics*, which featured the Altair on its cover."

The Altair 8800 is widely credited as being the world's first personal computer and Gates and Allen wrote a BASIC interpreter for it the same year it was released. It was Microsoft's first product (as Micro-Soft) and was distributed by MITS under contract.

"BASIC as a programming language is typically easier to master than other high level languages such as C or Fortran (that were available at the time)," says Gerasimos Barlas, a professor in the computer science and engineering department at the American University of Sharjah. "However, it is not regarded as a choice for professionals.

"The partnership of Gates and Allen would lead to greater things later on, but their rise to prominence was mainly due to factors external to their own work, as for many years MSDOS and its ecosystem was regarded as inferior to many competitor offerings. It was only because IBM did not want to invest resources in building the software for their first PC, and Apple was too expensive and closed to be a real threat." >



Above: Henry 'Ed' Roberts created the Altair 8800, which is widely regarded as being the world's first personal computer.

Above right: Steve Wozniak and Steve Jobs founded Apple in 1976.

Understandably, Gates and Allen were grateful for the opportunity to work with Roberts, having realised that the price of computers would eventually drop to the point where selling software for them would be a profitable business.

"Ed was truly a pioneer in the personal computer revolution, and didn't always get the recognition he deserved," they wrote. "He was an intense man with a great sense of humour, and he always cared deeply about the people who worked for him, including us. We will always have many fond memories of working with Ed in Albuquerque, in the MITS office right on Route 66 – where so many exciting things happened that none of us could have imagined back then."



While computing had been improving steadily since the development of the first transistor in 1947, the key innovation that enabled the production of the Altair 8800 was the invention of the microprocessor, or the 'computer-on-a-chip.'

"One of the earliest commercially available microprocessors, the Intel 4004 (1971), had about 4,000 transistors and was initially targeted at calculators and applications like traffic lights and industrial controls," says Spicer. "It was a follow-on to the 4004 – the Intel 8008 – that enabled the first generation of 'microcomputers', as they were called then. The term 'personal computer' came later in 1981 with the IBM PC.

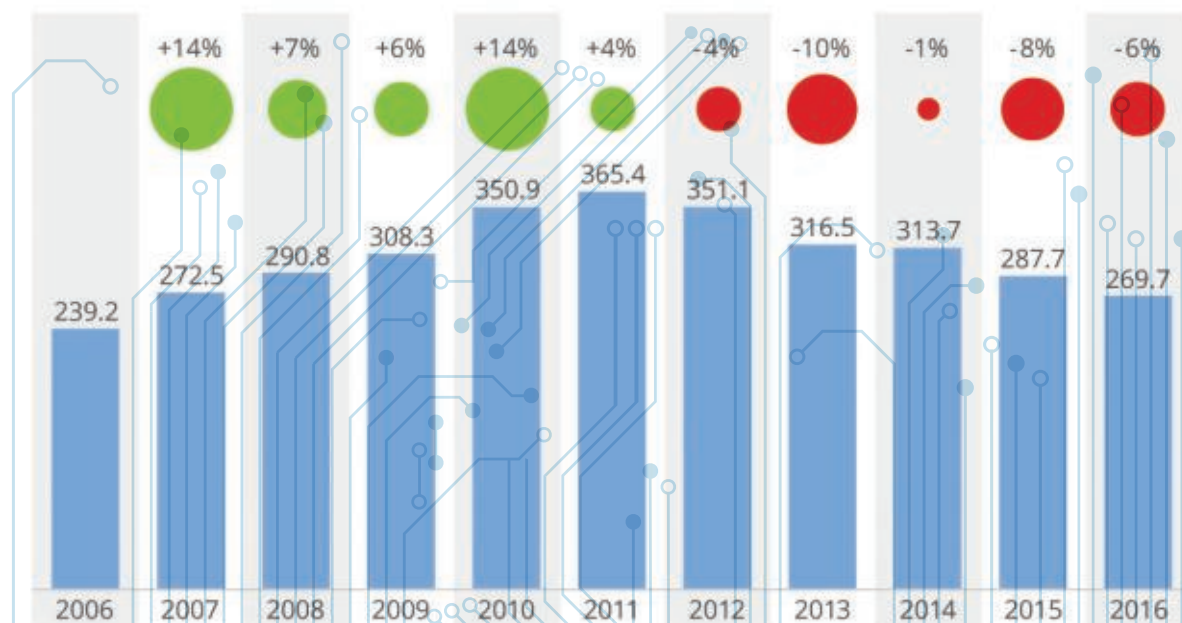
"Secondly came the invention of hard disk drives for personal computers in 1980 with the Seagate ST-506, a 5MB drive that cost \$1,500. Generally speaking, all parts of the PC (motherboard, video card, memory) also benefitted from Moore's Law, leading to continual improvements in performance, capacity, speed, and price as time went on."

The microprocessor made computers accessible to a mass audience for the first time. Before its invention computers had been the exclusive privilege of large academic, financial and military institutions, but with the Altair 8800, followed by the introduction of the Apple II (Apple had been founded by Steve Jobs, Steve Wozniak, and Ronald Wayne in April 1976), the Commodore PET 2001 and Radio Shack's TRS-80 in 1977, computers were becoming more accessible.

"The Apple II was Apple's most important product, being produced in one version or another for an

FIVE YEARS PAST PEAK PC

Worldwide PC shipments from 2006 to 2016 (in million units)



astonishing 17 years,” says Spicer. “Apple II sales single-handedly kept Apple in business during several disastrous times in the company’s history.”

There were other events that shaped computing in the early 70s, says Barlas, including the design of the Unix operating system, the creation of C (a programming language), and the invention of the GUI (graphical user interface) by Xerox.

Early computers, however, were very limited in what they could do. This was mainly due to a lack of good software, says Spicer, but also because of primitive hardware. It took until the late 1990s for computers to be powerful enough to play music or videos or surf the web.

“They could do minimal work compared to modern machines, not because of their slow speed, but also because they were equipped with very little memory,” says Barlas. “Apple I had 4kB, which is roughly two million times smaller than what laptops typically have today. These early machines were little more than programmable calculators.”

“As a user, we learned to accept the limitations and work within them,” adds Spicer. “What other choice was there? Developers were a relatively new class of person. After extensive pirating of his Altair BASIC program, Bill Gates wrote a famous ‘Letter to Hobbyists’ in which he claimed that software has value and should be paid for. That newfound attitude among developers plus the arrival of a common platform to



develop for (the IBM PC) provided the conditions for software developers to grow and prosper. The ISV (Independent Software Vendor) industry was born, a massive ecosystem supporting the IBM PC and its descendants.”

Although Commodore in the US and Spectrum in the UK helped take the personal computer to a wider audience from 1980 onwards, it was the IBM PC that

Above: Paul Allen and Bill Gates wrote the software for the Altair 8800.



Above: A display of computers at the Computer History Museum in California.

proved to be the most influential and had the greatest long-term impact.

"The IBM PC made the computer mainstream," says Spicer. "But there are certainly legions of computer users who used machines before (and after) the IBM PC. It's just that no other machine had the explosive influence of the PC on business and consumers."

The IBM PC was released in 1981 and was created by a team of engineers and designers under the direction of Don Estridge, who worked at the IBM Entry Systems Division in Boca Raton, Florida. Such was its importance that *TIME* magazine released its now famous 'Machine of the Year' cover instead of the usual 'Man of the Year' on 3 January 1983.

"I think what they had in mind was that with the arrival of the IBM PC in August 1981, the computer industry had begun to mature," says Spicer of *TIME*'s famous issue. "Being able to unify around a common reference platform like the IBM PC gave hardware and software vendors alike a foundation upon which to develop their products. Without such an agreed-upon standard, there would not be the economies of scale that came to define the PC."

"In retrospect, what the 21-page 'Machine of the Year' cover package captures isn't the beginning of

the PC so much as the end of the beginning," wrote technology writer and editor Harry McCracken on the 30th anniversary of *TIME*'s issue. "The industry still had room for a bevy of hobbyist-oriented, sometimes downright rudimentary computers from Apple, Atari, Commodore, Osborne, Radio Shack, Texas Instruments, Timex and others. None of them had futuristic features like a graphical user interface and a mouse; most ran their own operating systems and weren't compatible with anything else on the market."

"Here and there, though, the issue hints at the changes which would really get underway in 1983."

Changes that would eventually separate the winners from the losers. Commodore, for example, with sales of \$49 million in 1983, was one of the world's largest personal computer manufacturers and yet would go bankrupt in 1994.

"The issue was fragmentation. Too many platforms that required dedicated development and a lack of openness," says Barlas. "The IBM PC on the other hand was cloned by everyone and offered expansion capabilities that were previously unmatched. Microsoft grew on the wave of PC growth and its control of the OS allowed it to kill competition off in the early 90s."†



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