

Artificial Intelligence for the Future Economy

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The Big Picture

The Big Picture

Old models are not working, new models are coming thick and fast, and we're having to adjust and to keep up, because of **technology and globalisation**. And the **disruption will happen over and over again**, relentlessly. - Prime Minister Lee Hsien Loong, National Day Rally 2016



“As we mature as an economy, we must compete on the quality and novelty of our ideas, and our ability to create value. We need to build a strong **innovation and enterprise** engine...”

- Finance Minister Heng Swee Keat, Budget 2017

“A*STAR’s research have always been geared towards **meeting the needs of industry and society**. They always have been mission-oriented. ...More and more innovations are now occurring at the interstices of disciplines. Companies must increasingly **draw upon multi-disciplinary capabilities to develop new solutions**, and they need to do that with greater speed.”

- Minister for Trade and Industry (Industry) Mr S. Iswaran, Committee of Supply Debate 2017



Building momentum and the CFE

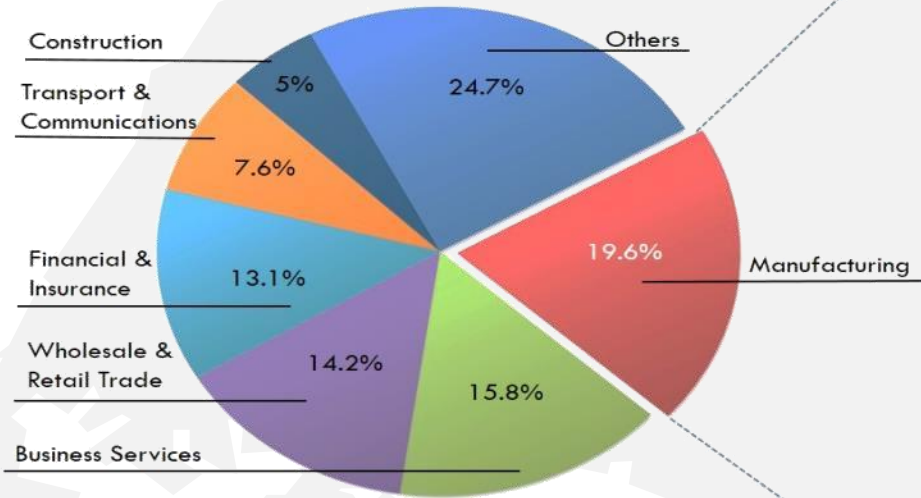
7 Strategies Identified by the Committee on the Future Economy

FUTURE ECONOMY

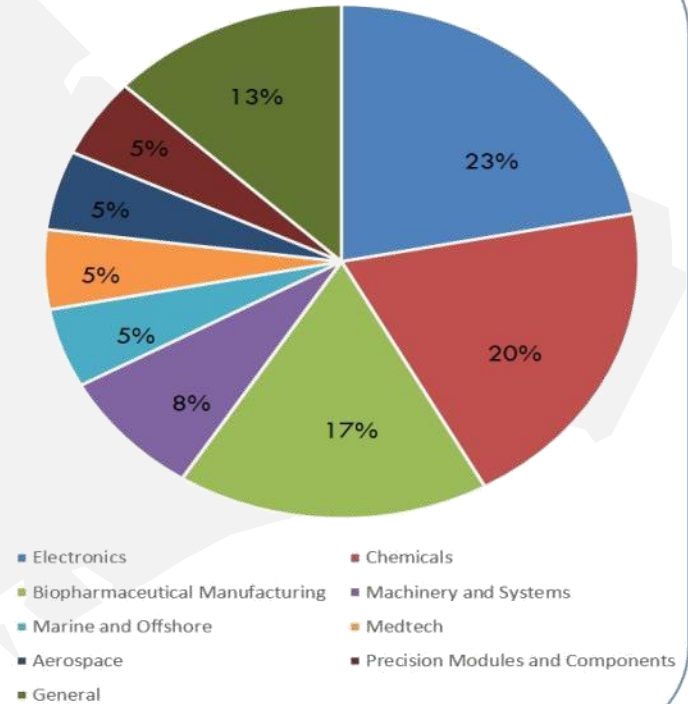


Manufacturing is a key pillar of Singapore's economy

2016 GDP: S\$410 billion



MANUFACTURING VALUE ADDED



Source: Department of Statistics (DOS), Economic Development Board (EDB)

Maintain competitiveness of manufacturing sectors

Committee on the Future Economy Recommendation



Singapore manufacturing to be at 20% GDP over medium term

FUTURE OF MANUFACTURING

Leverage technology to boost existing sectors and to capture new growth opportunities



Customised across existing verticals

Cross-Cutting Technologies

*Autonomous Robots, **Big Data and Analytics**, **Additive manufacturing**, **Artificial Intelligence**, Industrial Internet of Things, Simulation, Cloud Computing, Cybersecurity, Advanced Materials etc.*

Future Workforce:

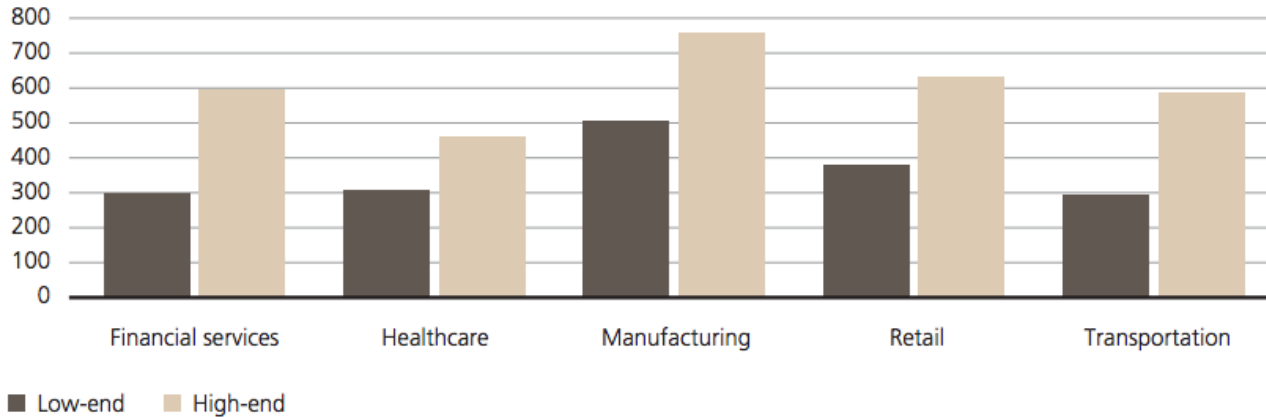
Smart tools, new skills, high degree of automation

Capturing Opportunities in AI

Economic impact in Asian

AI's estimated economic impact on five major Asian industries in 2030

Figures in USD bn



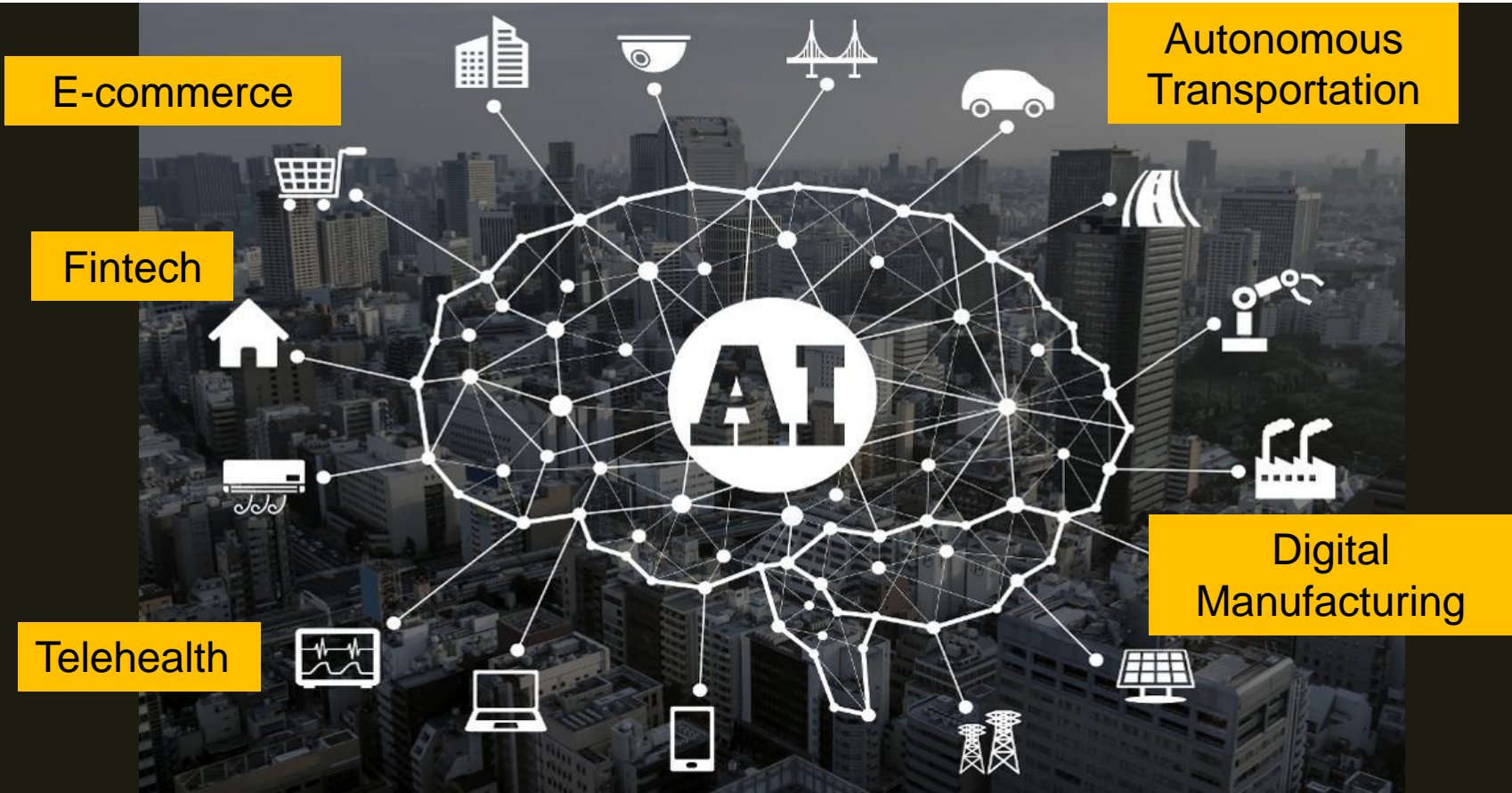
Note: The numbers reflect range of high/low growth estimates off of current World Bank industry size.

Source: World bank, UBS estimates as of January 2017

By **2030**, AI could create economic value of between **US\$1.8 trillion and US\$3 trillion** (S\$2.4 trillion to S\$4 trillion) a year in Asia.

It is forecasted that AI could potentially affect and transform **30 million to 50 million jobs in Asia.**

AI – The disruptive Technology



Current Successes of AI

- Go and Chess (DeepMind AlphaGo, IBM Deep Blue)
- Autonomous vehicles (Google, Uber, nuTonomy)
- Speech-to-text; translation (Google, Nuance)
- Trivia/Q&A (IBM Watson for Jeopardy)
- Voice assistants (Siri, Alexa/Echo, Google Home)
- Medical/legal assistance (DeepMind, Watson)
- Object recognition (ImageNet Challenge)



Missing Gaps

- Current AI systems are like black boxes
- Lack commonsense
- Don't know what people's underlying needs are
- Don't know how to connect with people as unique individuals
- Don't know what social and cultural norms are



**Singapore in a sweet spot
to ride AI wave**

Smart Nation

Innovators

World-Class Universities

Entrepreneurs

Technology Talent

SAVE THE ENVIRONMENT AND LOWER YOUR BILLS

SMART HDB HOME

- Monitor your overall household energy and water usage
- Receive real-time usage updates
- Receive tips and insights to reduce energy and water usage
- Accesses energy-saving resources
- Provides emergency contact and maintenance support and service
- Enables lock-out of your household

Building a SMART CITY

A slew of initiatives are taking place islandwide, the goal of which is to sharpen the Government's response to city issues and hence improve people's day-to-day lives.

TOURIST PLANNING

What: A modelling system to simulate a city's built environment and its impact on the natural environment, traffic, resources and costs.

Who: ECIS, Electricite de France, Veolia

Use: Among other things, show how different land use affects amenities and transport networks, how to design new housing blocks to get 'ideal wind' flow, where best to build cycling paths.

Status: Research collaboration / prototype stage

WATER QUALITY AND SAVING

What: A network of wireless sensors that monitors water quality and detects leaks in real time.

Who: PUB, Singapore S&T Alliance For Research and Technology, Veolia

Use: Allows PUB to repair leaks faster and reduce water loss.

Status: About 300 sensors installed by end 2015

IMPROVING PUBLIC TRANSPORT

What: Analyzing CCTV video feeds and anonymous location-based data from mobile subscribers to learn commuter travel patterns.

Who: Land Transport Authority, S&T, StarHub, B&E

Use: Help agencies respond better to unplanned incidents on the train and bus network, such as breakdowns or emergencies.

Status: Research collaboration

SMILING LANE DISTRICT - SMART CITY

What: A government vision for the area is to use smart technologies such as directionally sensitive cameras to improve road safety for motorists.

Who: Economic Development Board, Ministry of Home Affairs, ACS International, Airbus Defence and Space, NCS, NCS Asia Pacific

Use: Could help commuters respond to accidents more quickly and one-help.

Status: Test bed completed

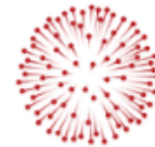
PROTECTING THE SEA

What: Eight buoys along coastline with sensors will give the Chinese and Japanese Gardens later this year. Expected to be used at Jurong East MRT next year.

Who: National Environment Agency (NEA)

Use: Early detection of oil or chemical spills.

Status: In place



Smart Nation
SINGAPORE

Enabling SMEs

“The **digital economy** is not just for one particular segment. We have 23 industry transformation roadmaps, and **an important part of this transformation are the SMEs**. They account for a large proportion of our workforce and GDP,” - *IMDA CEO Tan Kiat How*



Then



Now

ST ILLUSTRATION: MANNY FRANCISCO



Tech Labs (Model Factories)

Develop, test and demonstrate advanced FoM technologies through **Model Factories** which can be located in both **public** and **private** premises such as SMEs



Tech Access

Provide access to public-sector research infrastructure (equipment and tools)



Tech Depot

Create suite of plug and play technologies that are easy-to-use and cater to different system competency levels of companies

How can Singapore harness AI?

Transforming how we live, work and play

Advanced Robotics

Robotic and automation technologies like boost productivity as part of government's efforts to shift towards higher value manufacturing (HVM). It has a number of open positions in industry. In Singapore, robotics is expected to contribute the economic shift to support.

Agency for Science, Technology and Research

MODEL FACTORY @ ARTC

The latest disruptive technologies – such as 3D printing, robotics and simulation – will be better integrated through the Internet of Things and Data Analytics to boost manufacturing productivity. The factory will be made even more efficient with green manufacturing solutions, drone surveillance, as well as smart control rooms and storage management systems.

Industrial 3D Printing

Business is being opened in 3D printing. This technology creates precise parts more efficiently than traditional 3D printing. It is a great green 3D printing from conventional. It is building things in space from industrial such as plastic or metal – allows rapid prototyping of complex, customized and precision designs. The precise addition of material also reduces waste in a mixed manufacturing facility.



WongP first Singapore law firm to embrace AI

by Michelle Oah
michelleoah.com
09042802407

Singapore is the first in Asia to embrace AI in legal services. The firm will use Lawmatics' self-learned machine learning techniques, which can automatically sort, classify and identify a data mass – pinpointing even subtle differences between contracts – so that lawyers can be concerned early on in a transaction.

WongP's partnership quality and past track record across large volumes of contract matters that WongP's lawyers can focus their services on key decisions from the outset.

Technology is changing the way law is practiced and it is only a matter of time before AI technology will be a core component of our firm's future growth, said WongP's managing partner, Ng Weikang.

Lawmatics' solution will not only have but better ability to conduct due diligence and other contract review, analyse more affidavits and affidavits, effectively.

It is to replace legal services for WongP's clients.

The firm has determined that AI technology can facilitate and improve the way a lawyer does his or her job, the intention is not for the technology to replace the lawyer, either now or in the longer term.

The firm took time to determine what would work best for its lawyers in the short, given the state of the legal technology over the past few years.

Says Ng Weikang, "We tested a few small AI products before we settled on using Lawmatics. The trial process amongst our M&A lawyers revealed two things.

"First, that there is a lot of legal-adjacent technology and AI, and the products don't always do what the marketing folks say they will do. And, second, our lawyers are not going to be replaced by machines any time away. The current products are not perfect and human intervention is a proper review to do."

But, despite the fact that much of the current technology promises challenges in terms of usage and operation, the different trials were the same: it would take a few weeks to become an add-on tool.

Such a view reflects Singapore's adoption of AI to improve legal things but control over functions that are the local market.

It is a matter of time, says Ng Weikang, "The new wave of legal services, produced by legal tech startups and international law firms like Axiom, Robot and how it will expand the most significant emerging technology in the provision of legal services, will not have the same of the benefits as previous to deliver to cost and efficiency for law firms, alternative service providers and their clients."

Ng Weikang, "Our success as lawyers has been grounded on doing things differently and challenging some of the norms of how law has been practised."

PHOTO: MICHELLE OAH FOR ETOP

FUTURE PORT

The Tuas mega port, slated to open in phases from 2021, will incorporate smart and green technologies into its operations. Some of these will be tested at the MPA Living Lab. The Straits Times looks at the journey of a container through the port of the future.

Drone

- Drones can be used to fulfil the check-in/drop-off.
- They can also be sent in to inspect vessels for damage, among other checks.

Vehicle to Infrastructure Communications

Floating platforms

- Currently, if a berth is not available, the vessel waits at anchorage in the sea.
- The Maritime and Port Authority of Singapore (MPA) is now exploring the use of multi-purpose floating platforms so that while waiting, immigration checks, refuelling and top-up of supplies can be done. More ships moored to the platforms will free up space at the



Smart Mobility 2030

Healthcare Landscape of the Future

MGH HOLDINGS

Strategic vision of patients moving seamlessly across the healthcare system, receiving coordinated patient-centric care at the most appropriate settings.

Enabled by **National Electronic Health Record (NEHR)**



Education

AI National Programme



Minister for communications and information Dr. Yaacob Ibrahim announces AI.SG at Innovfest Unbound. Photo credit: Innovfest Unbound

NRF to invest up to S\$150 million over the next five years in AI Singapore



Focus Areas:

Finance, City management solutions and Healthcare

Stakeholders:

NATIONAL RESEARCH FOUNDATION
PRIME MINISTER'S OFFICE
SINGAPORE



SMART NATION
&
DIGITAL GOVERNMENT OFFICE



AI Research Partners:



SMART NATION | FINTECH | HEALTHCARE



INVEST IN DEEP CAPABILITIES FOR SCIENTIFIC INNOVATIONS AND BREAKTHROUGHS

- Invest in AI technologies for the future.
- Conduct fundamental research on scientific and engineering methods and models.
- Gather top minds for multidisciplinary approaches to AI innovations and to nurture AI talent.



ADDRESS MAJOR CHALLENGES IN AI THAT AFFECT SOCIETY AND INDUSTRY

- Identify and focus attention on well-defined Grand Challenges.
- Promote bold ideas and innovative approaches to solving them.
- Examine and formulate ethics and governance policies on AI for the public good.



BROADEN THE USE AND ADOPTION OF MACHINE LEARNING WITHIN THE INDUSTRY

- Drive the Singapore Smart Nation endeavor.
- Launch 100 AI-Experiments for end-users, facilitate access to AI talent, create shared AI tools and resources.
- Foster interactions in AI ecosystems to accelerate industry innovations.

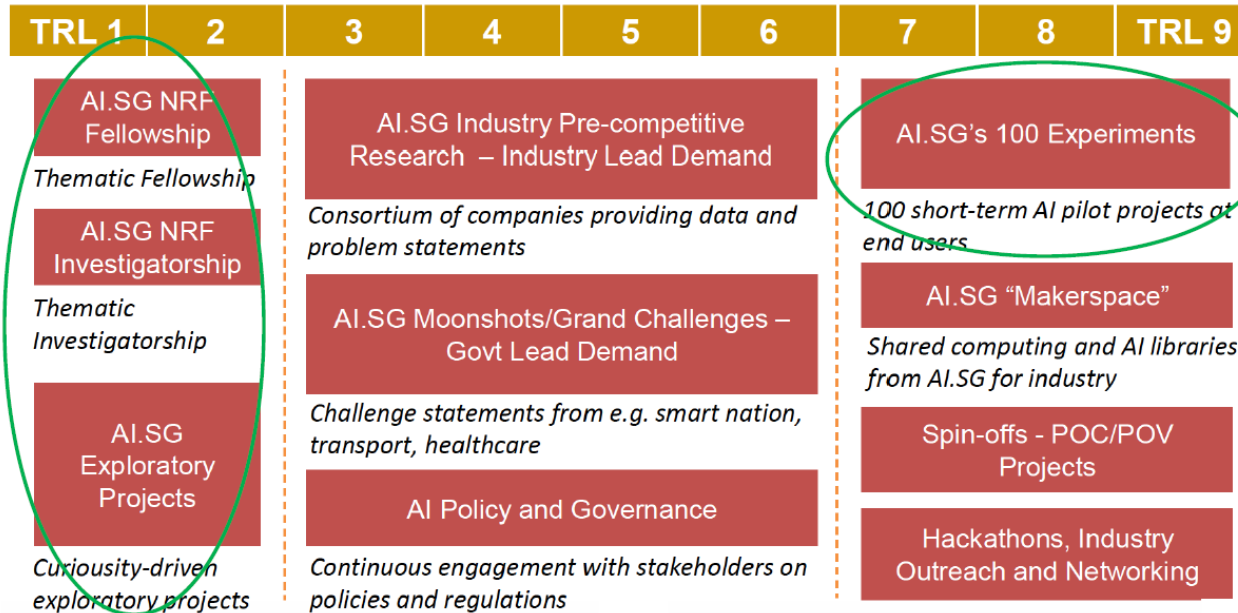
AI Singapore - Activities



Invest in
the next
wave

Aim for
Moonshots

Increase
industry
adoption



AI.Platform@NSCC



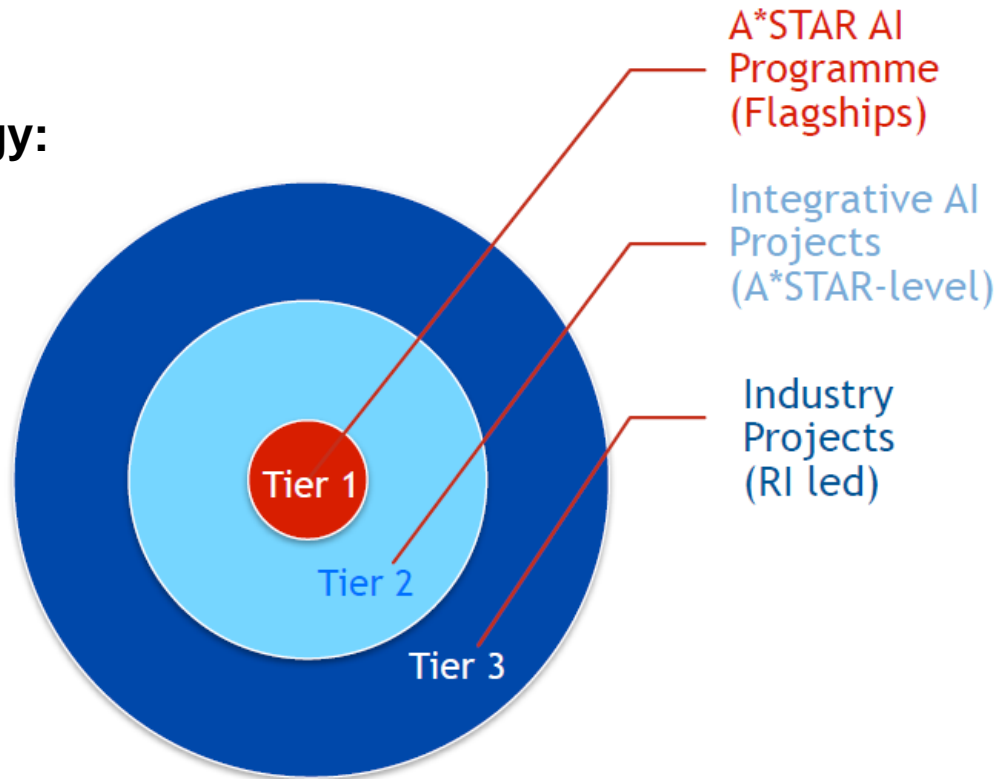
Oct 2017 - Chipmaker NVIDIA and Singapore's National Supercomputing Centre (NSCC) signed a new agreement that will see the setting up of the first shared AI platform to bolster capabilities among academic, research and industry stakeholders.

Called **AI.Platform@NSCC**, the platform will provide AI training, technical expertise and computing services to AISG, which brings together all Singapore-based research and tertiary institutions, including the four local universities and research institutions in the Agency for Science, Technology and Research (A*STAR).

Artificial Intelligence @ A*STAR

A*STAR Wide Integrated Approach

3-Tier Strategy:



Human-centric AI for AME

- Human-Robot/Machine Interaction
- Decision Aiding
- AI augmented business processes
- Job-matching
- Personalised Skills Training



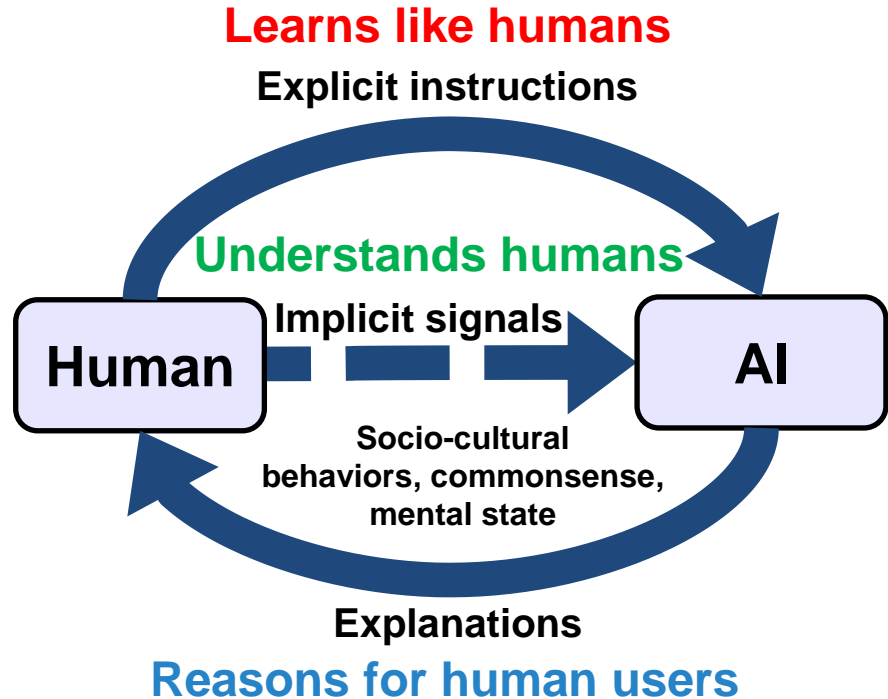
Work with AI.SG partners in other domains



Smart Cities	Healthcare	Finance	Logistics
<ul style="list-style-type: none"> • Transport planning • Infrastructure management • Safety & security • Green IT • eGov 	<ul style="list-style-type: none"> • Healthcare analytics • Personalised medicine • Eldercare • Mobile health • Omics 	<ul style="list-style-type: none"> • Risk modeling and prediction • Fraud detection • Credit risk assessment • Digital insurance 	<ul style="list-style-type: none"> • Adaptive scheduling & routing • Resource optimisation • Fleet management • Supply chain management

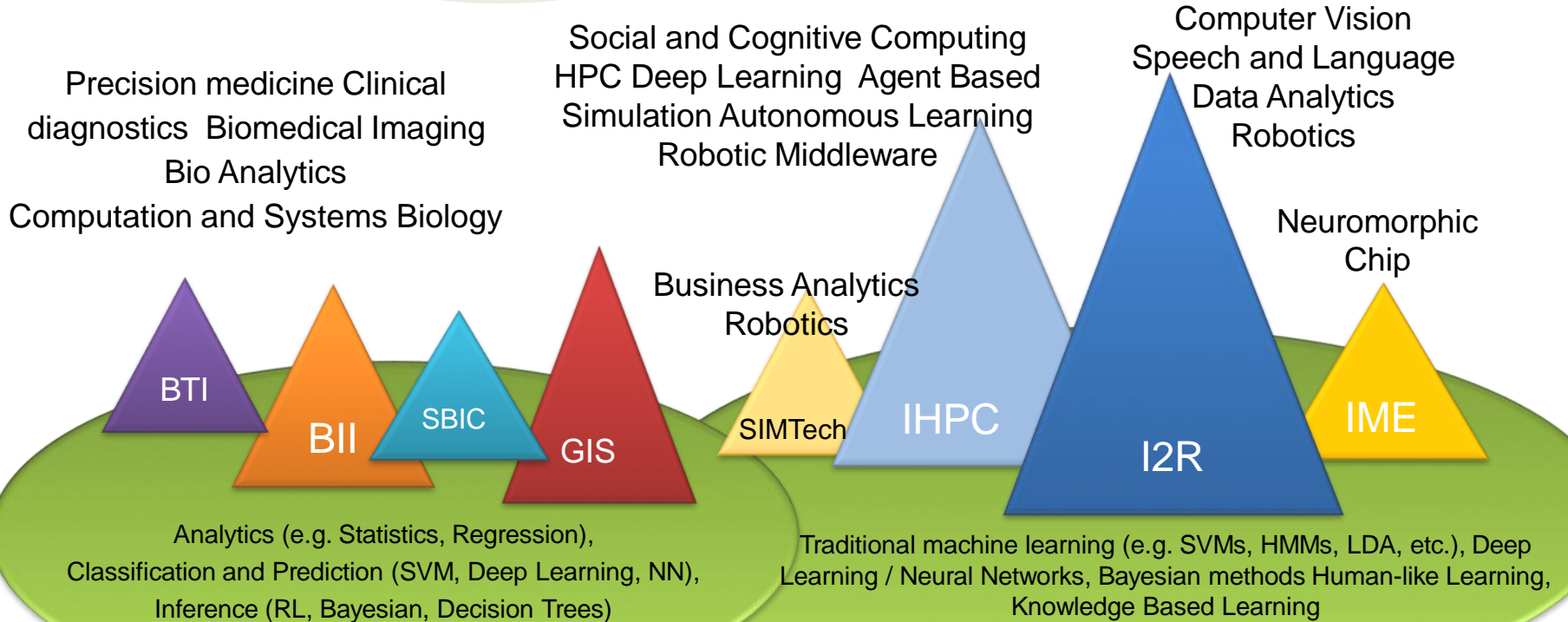
Artificial Intelligence @ A*STAR

Cognitive
Human-like
Empathetic
Explainable
Machine-learning



A*STAR AI Landscape+

+AI in a broad sense, e.g. including analytics and neuromorphic hardware



AI Initiatives



Human-Centric AI
Singaporean and Asian Culture

Speech & Language

Video & Image

Data Analytics

Social Cognitive Computing

Deep Learning / Machine Learning

Good Old Fashion AI (GOFAI)

AI in Manufacturing

- 1. Machine learning for Predictive Maintenance**
 - Real-time, low latency, intelligent preventive/predictive maintenance
 - Machine health diagnostics and prognostics
 - On-board analytics
 - IoT Applications
- 2. Remaining useful life prediction**
 - Regression using deep learning techniques
- 3. Maintenance Schedule Optimization**



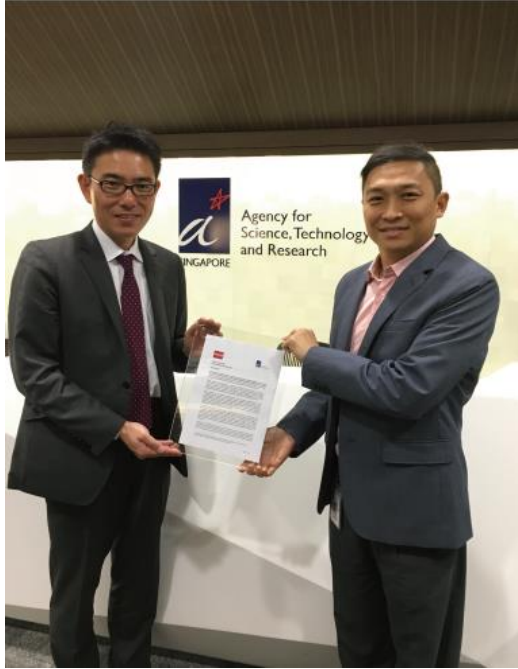
Co-bots in Manufacturing



PBA Group, a local engineering company, is transforming the way factory floors and retail stores operate with the use of robots.

Through partnerships with SPRING and A*STAR, they transformed their family business with automation, using robots to help humans at work.

AI Chip for predictive maintenance



ROHM Semiconductor, a leading semiconductor manufacturer, and A*STAR's Institute of Microelectronics (IME), a world renowned research institute under the Agency for Science, Technology and Research (A*STAR) today announced the joint development of an artificial intelligence (AI) chip to boost efficiency in predictive maintenance for smart factories.

Mr Koji Taniuchi, Fundamental Research and Development Division, General Manager at ROHM (left) and Dr Tan Yong Tsong, Executive Director of IME, at a meeting at A*STAR

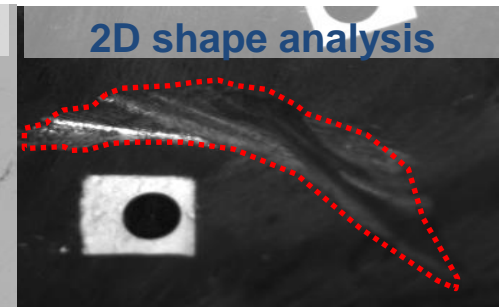
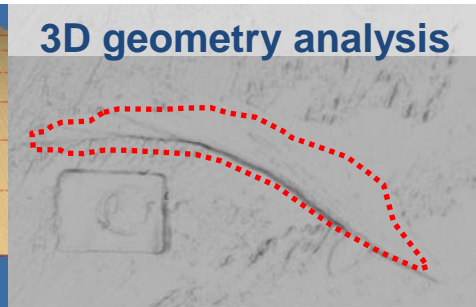
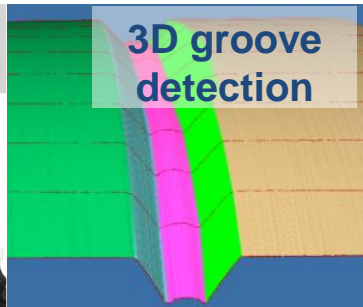
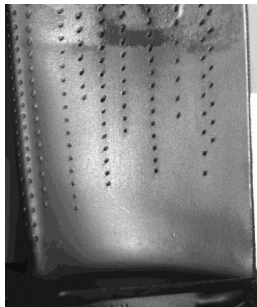
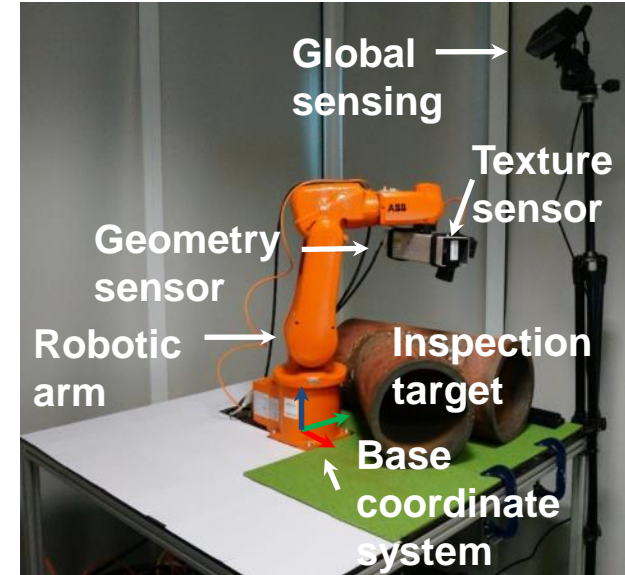
AI in Robotics

Enabling computers to understand what people want



Capabilities for 3D Modelling & Analysis

- Robotic inspection: better reachability and more stable positioning of sensors
- Enabling remote, efficient & full-coverage scanning and checking
- Consistent inspection: suitable for factory operations with high-throughput production
- Advanced image analytics and robotic vision techniques ensure automatic high quality evaluation
- E-documentation for data management, retrieval and sharing



AI in Healthcare

Task : Detect Landmarks on Medical Images



Tumor Region Detection



Artificial intelligence could soon be indispensable to healthcare, diagnosing conditions such as eye disease and cancer from medical scans (Credit: Getty Images)

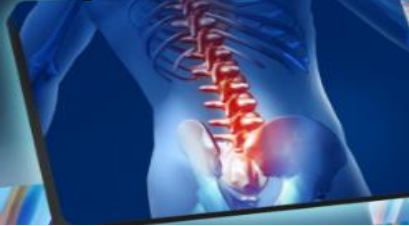
Approach:

Deep Fully Convolutional Networks (FCN) Using Human Organ Medical Images

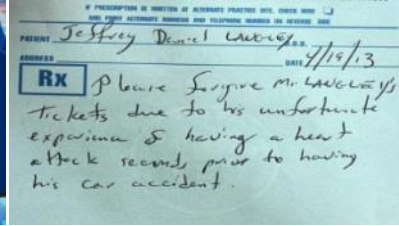
Capabilities on biomedical applications

AI/Machine Learning for analysis of **heterogeneous biomedical data** (multimodal data fusion, multivariate interactions)

Images



Medical Text



Quantified Self



Claims/Admin Data



Biological network analyses (high-dimensional graphs, dynamic networks)

Data-driven **process optimization for healthcare** delivery (black box optimization based on machine learning)

Optimize

Predict Outcomes



Personalize Care

Allocate Resources

Project Highlights

Emotion sentiment analysis platform



Multimodal robot learning from human demonstration



[Robot Kuka](#)

Automated defect assessment



The Future of AI

Across the World

'Partnership on AI' formed by Google, Facebook, Amazon, IBM and Microsoft

Two big Silicon Valley names are missing from the alliance, which aims to set societal and ethical best practice for artificial intelligence research

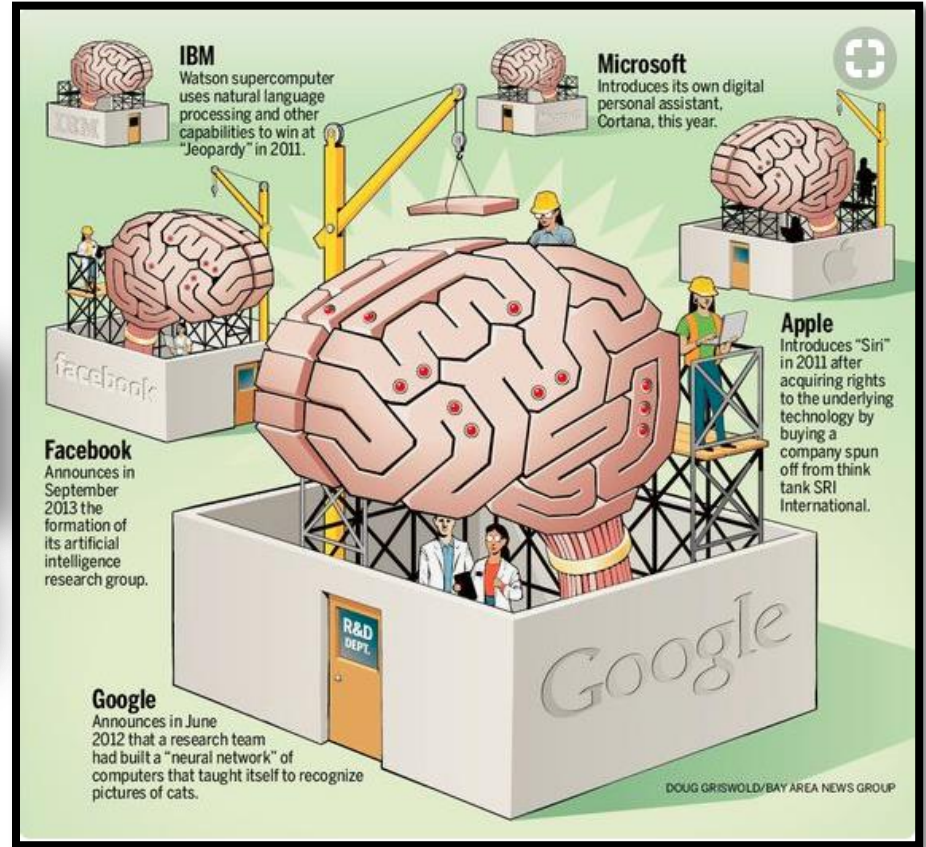
Artificial Intelligence

IBM Just Committed \$240 Million to the Future of Artificial Intelligence

© Getty Images

Amazon to open visually focused AI research hub in Germany

Posted Oct 23, 2017 by [Natasha Lomas \(@riptari\)](#)





CREATING GROWTH, ENHANCING LIVES

Thank you