Investment Recipes

by AtonRā Partners

On the Menu
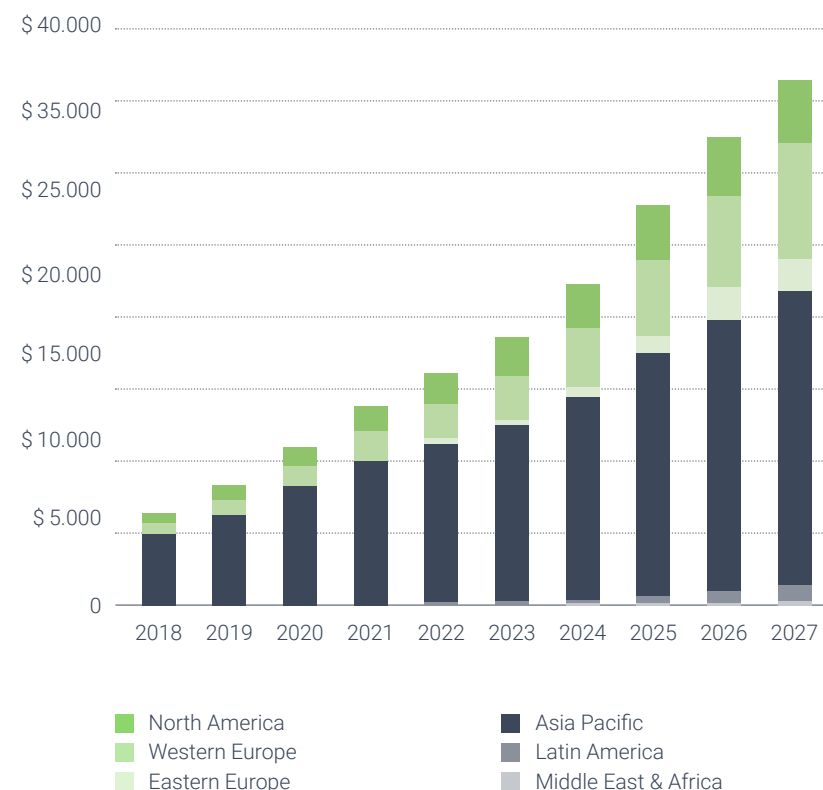
SMART CHARGING OF ELECTRIC VEHICLES

The Rise Of Electric Vehicles' Charging Stations

- As mentioned in the Investment Recipes issued on 25/09/19, electric vehicles (EVs) sales are expected to skyrocket in the coming years.

  - Forecast are from **5mn EVs in 2018 to more than 500mn by 2040**, with a majority of battery electric vehicles (BEVs)

- One of the biggest question mark in EV adoption is the speed at which charging infrastructure will be built.

  - Today there are **5.2mn EV chargers globally** (540'000 are publicly available) and, according to Navigant, the charging equipment market is expected to grow from about $9bn to $36bn by 2026.

- EV chargers are evolving from being only an infrastructural cost to a real asset, capable of extracting new value from EVs.

  - A "smart charger" basically adapts its charging cycles depending on both the power system and vehicle's owner needs.
  - According to the International Renewable Energy Agency, by 2050 EV batteries will represent a total of **14 TWh** of stored energy compared to 9 TWh for stationary batteries.

- •With cars being parked 90–95% of the time, all the energy stored into EVs' batteries represent a great potential for supporting the power grid and capturing new revenue streams.

EVSE SALES & INSTALL GLOBAL REVENUE

Legend:
- North America
- Western Europe
- Eastern Europe
- Asia Pacific
- Latin America
- Middle East & Africa

SUSTAINABLE FUTURE

Smart Charging Options

- The concept of "Smart Charging" includes a set of different technologies, from basic charging methods to more advanced mechanisms providing increasing flexibility to the grid.

  - **Time-of-use pricing** consists of applying cheaper electricity rates during "off-peak" times, incentivizing car owners to adapt their charging time.
  - **Basic control** consists of simply switching on and off the charging depending on grid's condition, and thus enabling basic grid congestion management.
  - **Unidirectional control** (**V1G**) is the real-time variation (increase or decrease) of charging rate for frequency control purpose.
  - **Bidirectional Control**
    - **Vehicle-to-Grid** (**V2G**): the car feeds back electricity to the grid and thus providing "demand response" services to the network.
    - **Vehicle-to-X** (e.g., Home/Building): the vehicle's battery is used here as a power supplier to the home/building.

  - **Dynamic pricing with automated control**: real-time electricity rates as a function of energy demand/ supply and automatic control of battery charging/discharging.

CURRENT CONCEPTS OF SMART CHARGING INCLUDE:
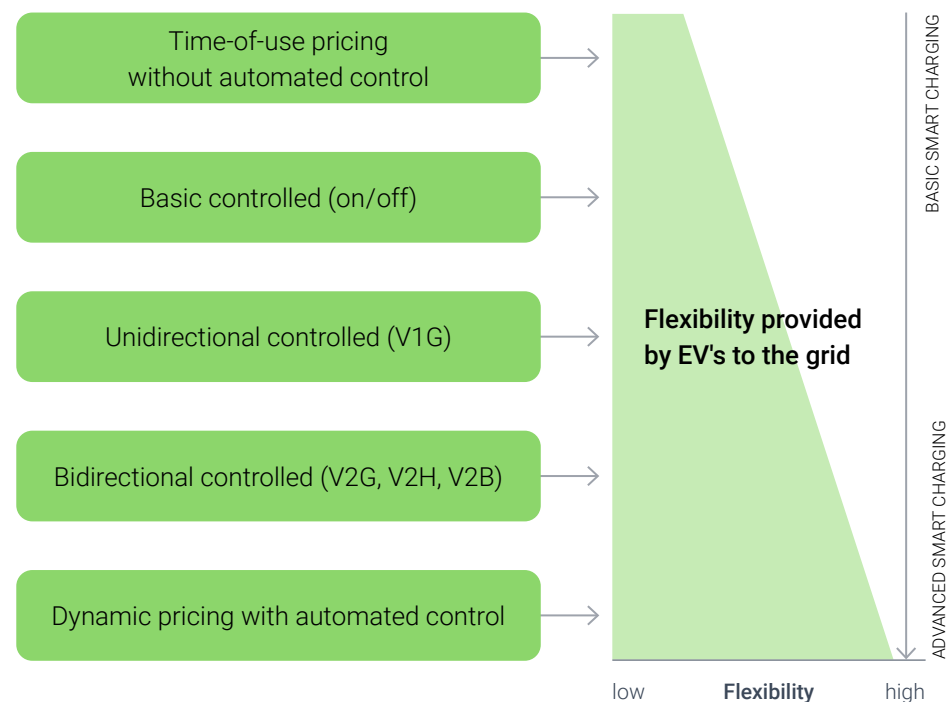
Time-of-use pricing without automated control

Basic controlled (on/off)

Unidirectional controlled (V1G)

Bidirectional controlled (V2G, V2H, V2B)

Dynamic pricing with automated control

BASIC SMART CHARGING

ADVANCED SMART CHARGING

Flexibility provided by EV's to the grid

low   **Flexibility**   high

SUSTAINABLE FUTURE

Capturing New Revenues

- Smart charging offers new sources of revenues along with providing flexibility to the grid.

- **Energy arbitrage** is the most straightforward possible revenue stream.

  - It consists of exploiting dynamic electricity prices by charging the EV at low price (during off-peak times) and selling back the power at higher price (during peak times).

- Another possible source of revenue is by selling services to the Transmission System Operator (**TSO**)

  - **Fast Frequency reserves**: helping the TSO to maintain power frequency stability (50/60 Hz)
  - **Primary reserves**: energy stored in idle EVs can be used as a primary control reserve, available within seconds to balance power in the case of an unfortunate event (e.g. power outage).
  - **Secondary reserves**: depending on the event, EVs stored energy can also be used as a secondary control reserve, available within a few minutes.

- Finally, it is also possible to sell services to the **Distribution System Operator** (**DSO**)

  - **Congestion management**: reduce grid congestions by shifting the charge from peak to off-peak times.
  - **Voltage control**: adapt charging patterns to control the grid voltage and facilitate the integration of distributed generation.

EV REVENUES STREAMS THROUGH
- Services sold via aggregator
  - to the DSO
  - to the TSO
- Direct benefit

Stack revenue streams
- Arbitrage
- Fast frequency reserves
- Primary reserves
- Secondary reserves
- Congestion management via load shifting / peak sharing
- Voltage control

SUSTAINABLE FUTURE

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Early Movers

Some stakeholder in the power industry, along with certain automakers and governments have already started to implement "smart charging" initiatives (see below table).

TYPE OF CHARGING	PROJECTS
Uncontrolle time-of-use tariffs	China, US, Japan, Germany, UK
Basic control	My Electric Avenue project by Scottish and Southern Electricity Networks (SSE LN) and Ea Technology (not listed) Xcel Energy (XEL US) project in Minnesota US for 100 households
Unidirectional control (V1G)	Green eMotion project by the EU, reduced grid reinforcement cost by 50% Sacramento Municipal Utility District (not listed), reduced grid upgrade costs by over 70%
Bidirtectional control (V2G)	Nuvve (not listed), Nissan (NSANY US) and Enel (ENEL IM) project with ISO National Grid (N US) in England and Wales Nuvve (not listed), NewMotion (not listed) and Mitsubishi (8058 JP) project with TSO TenneT (not listed) in the Netherlands
Bidirectional control (V2H)	DENSO (DNZOY US), Toyota (TM US), and Nissan (NSANY US) project of V2H in Japan for 7'000 households. ElaadNL center and Renault (RNO FP) project in Utrecht NE, 1'000 solar-powered smart charging stations
Dynamic pricing with automated control	San Diego Gas & Electric (not listed) providing dynamic hourly pricing (day-ahead bases) to 3'500 charging stations

SOURCES:
IRENA, Electric-Vehicle Smart Charging Innovation Landscape Brief, 2019

SUSTAINABLE FUTURE

Catalysts:

- **Growing Variable Renewable Energy** (**VRE**). The increasing share of variable renewable energy (e.g., Solar and Wind) in the power mix is driving the need for grid flexibility that can be provided by smart charging.

- **Bigger batteries**. The storage capacity of EVs' batteries is set to increase, providing more potential for bidirectional charging applications.

- **Increasing Synergies**. The power industry is increasingly collaborating with e-mobility actors, exploiting positive synergies as business models' innovation becomes a necessity for utilities (read our Investment Recipes issue of 06/11/2019 for more details).

Risks:

- **Slow EV adoption**. Slower-than-expected EV adoption would impact smart chargers' growth since both remain highly correlated.

- **New disrupting technologies**. The emergence of new technologies such as hydrogen cars (not using electric chargers) or wireless charging roads (via inductive charging).

- **Lack of supportive policies**. Smart charging requires the implementation of specific regulatory framework (e.g., on dynamic electricity rates); lack of cooperation between private & public actors could be a threat.

Bottom Line:

- **Smart Charging**, as a sub-component of **smart cities**, will likely emerge together with electric vehicles.
- Car owners using vehicle-to-grid technology will **reduce their EV's cost-of-ownership** by capturing new revenue streams.
- **Variable renewable energies** can benefit from the **grid-flexibility** provided by innovative smart charging technologies.
- Today we are seeing growing interest coming from traditional utilities such as **EDF** (**EDF FP**), or **Enel** (**ENEL IM**) as well as big Oil& Gas majors like **Shell** (**RDSA LN**) or **Total** (**FP FP**) who are either acquiring EVs' charging companies or setting up partnerships to benefit from the new business opportunity.
- In our **Sustainable Future certificate**, we monitor closely the promising sectors of electric transports and smart grid technologies, together accounting for roughly **15% of our asset allocation**.
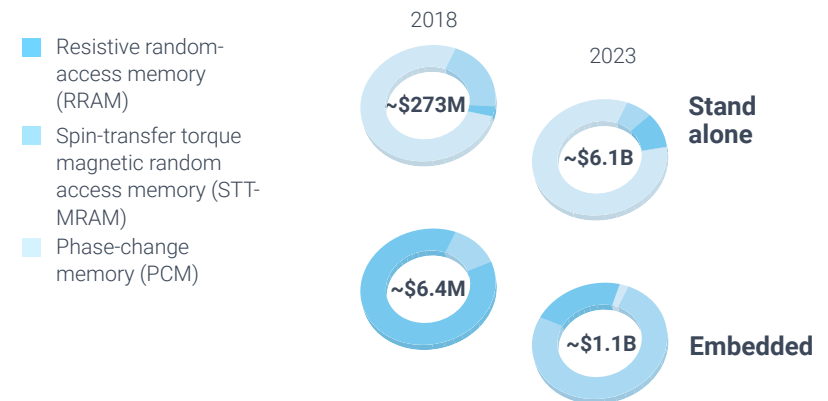
EMERGING MEMORIES – GET READY FOR TAKE OFF

Memory Bottleneck – Time For A Technological Breakthrough

- The development of computers memory has not followed that of processors, creating the so-called **memory bottleneck**: processors crunch data faster than ever, but memory still needs time to allocate and retrieve that data (latency), creating a bottleneck.

- Moreover, while processors are very efficient machines, memories have still a lot of room for improvement: retrieving two numbers cost 1'000 times more in terms of energy than summing up those two number.

- **Latency, energy consumption** and **endurance** are requirements that are becoming very stringent for AI and IoT application, where data need to be retrieved, processed and stored at a pace that was unthinkable before.

- **In-memory** and **near memory computing** have changed the way processor are designed, but have also pushed for researching newer solutions, **emerging memories**.

DRAM IMPROVEMENT (LOG)

■	Latency
■	Capacity
■	Bandwidth

128x
20x
1.3x
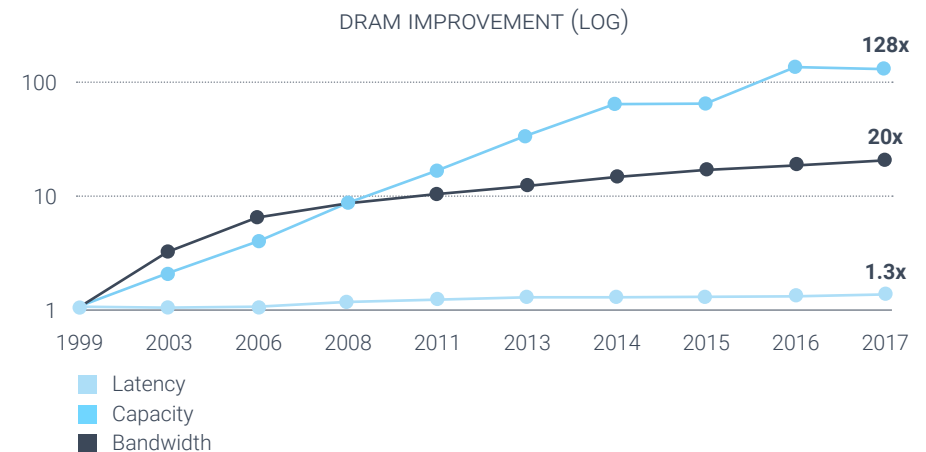
EVOLUTION OF THE EMERGING NON-VOLATILE MEMORY MARKET BREAKDOWN BY TCHNOLOGY FOR STAND-ALONE AND EMBEDDED MEMORIES

- ■ Resistive random-access memory (RRAM)
- ■ Spin-transfer torque magnetic random access memory (STT-MRAM)
- ■ Phase-change memory (PCM)

2018

~$273M

~$6.4M

2023

~$6.1B · **Stand alone**

~$1.1B · **Embedded**

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Emerging Memories: Coming To Market

- Emerging memories are a family of alternative technologies that promise to disrupt the semiconductor memory industry.

- For instance, recently **Baidu** (BIDU:US) has announced that it will use **Intel's** (INTC:US) novel memory, **Optane**, in order to upgrade its in-memory database.

  - In-memory databases make use of main memory for data storage, to reduce both latency and seek time, thus boosting performance.

- Optane is the commercial name for one type of emerging memory, the **phase-change memory** (PCM), a solution that fills the gap between main memory (DRAM) and storage (NAND flash).

  - DRAMs are very fast in writing and reading, but costly and volatile, i.e. they lose stored information when power is cut.
  - Flash memory is cheap and non-volatile, but reading and writing can take up to 10'000 times more than DRAM, so they are mainly used for storage and not for low latency applications.
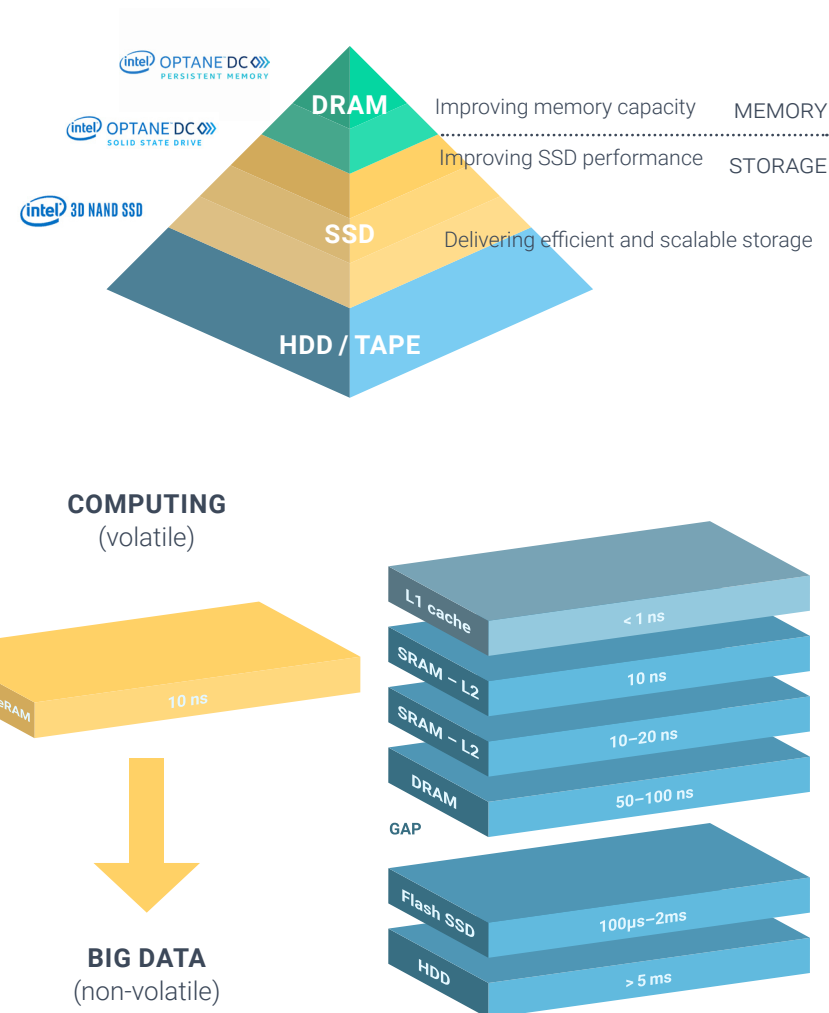
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Applications For Emerging Memories

- **Big Data**, **IoT** and **5G** are bringing about a revolution in terms of how businesses will be conducted and technologies used. 5G on its own will provide larger bandwidth, faster communication, and allow access to billions of distributed sensors that compose the Internet of Thing, and all the data they are generating.

  - The main memory of these sensors will be crucial in the development of the IoT, as power consumption is a key constraint for their deployment.

- The spread of **Artificial intelligence** and its applications will trigger new solutions, among which:

  - Usage of new types of memory, such as **PCM** and **MRAM**
  - New architecture such as **near** or **in-memory computing**.

- **Autonomous Driving** will be one of the biggest opportunity for memory and storage. The ADAS (advanced driver assistance systems) market will surely drive the adoption of larger, in terms of capacity, and faster memories. It is estimated that an autonomous vehicle will generate terabytes of data per hour of driving (see table).
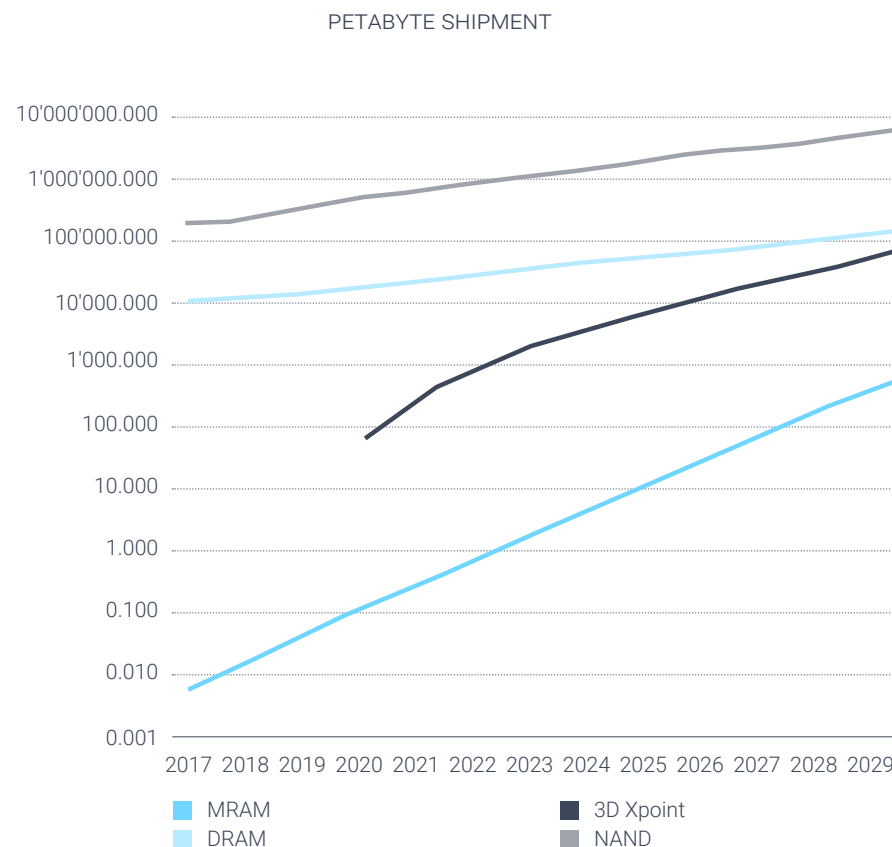
CAR AUTOMATION SENSORS & DATA VOLUMES

SENSOR TYPE	QUANTITY	DATA GENERATED
Radar	US-based, Hong Kong IPO planned	Anti-inflammation using microbiome
LIDAR	Hong Kong	Oncology, HBV, ageing diseases
Camera	Hong Kong	HCV, HIV, HBV
Ultrasonic	Hong Kong	Oncology
Vehicle motion, GNSS, IMU	Hong Kong	Vaccines in 12 disease areas
TOTAL ESTIMATED BANDWIDTH **3Gbit/s (~1.4TB/h) to 40 Gbit/s (~19TB/h)**		

SOURCES:
https://www.tuxera.com/blog/autonomous-and-adas-test-cars-produce-over-11-tb-of-data-per-day

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Different Types, Different Uses

- **Phase-Change Memory** main features lie in between the capacity of a flash memory and the latency of a DRAM, being non-volatile.

  - Intel and **Micron** (MU:US) have started a joint venture in 2006 (IM Flash Technologies) that has developed a PCM memory called 3D Xpoint. Optane is Intel's commercial product. Micron is planning to launch a second generation product in Q4 2019.

- **Resistive RAM** (**ReRAM** or **memristor**) is emerging as ideal solution for cost-sensitive applications (wearables and IoT), low-end processors and consumer products with low memory density requirement.

  - **Rambus** (RMBS:US), **Fujitsu** (6702:JP), **Adesto Technologies** (IOTS:US) and **Crossbar** (not listed) are among the companies with the wider offer.

- **Magnetic RAM** (**MRAM**) main features are speed, non-volatility and power consumption, which is a key issue for IoT devices.

  - Most foundries, like **TSMC** (2330:TT), have teamed up with MRAM players, *e.g.* **Everspin** (MRAM:US), in order to benefit from the take-off of the technology.

- **Ferroelectric RAM** (**FeRAM**) key advantage is the read and write mechanism, similar to DRAM, but more effective. Low power makes FeRAM a better alternative to static RAMs (SRAM), as it delivers better performances and cost savings.

  - **Cypress Semiconductor** (CY:US), **Symetrix** (not listed) and **OKI** (6703:JP) are developing solutions based on this technology.

PETABYTE SHIPMENT

| MRAM | 3D Xpoint |
| DRAM | NAND |

SOURCES:
https://www.forbes.com/sites/tomcoughlin/2019/07/09/20b-emerging-memory-market-by-2029/#48f5172422ef

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Catalysts:

- **IoT**. Connected objects will trigger the adoption of new type of memories, embedded, fast and with low power consumption.

- **Performance needs**. Memory bottleneck seriously limits AI applications. Memory designers and manufacturers are under pressure to develop new memory solutions.

- **Reliability**. Progress in materials science and in fabrication processes are driving down costs and improving reliability.

Risks:

- **Cannibalization**. Big players, among which Intel, **Toshiba Memory** (or Kioxia, not listed), **SK Hynix** (000660:KS), may hinder the competition, as their fire power, from R&D to distribution channels, can slow down or even block market access for certain technologies developed by smaller players.

- **Cost**. Emerging memories are still more pricey than existing solution. As the technology matures and becomes acceptable on technical level, prices will have to fall to competitive levels to trigger wide-scale adoption .

- **Substitutional threats.** Chinese memory players are pushing for low cost DRAM and flash memories. This can diminish the R&D efforts for new solutions, as the cost advantage of old ones shields their competitiveness.

Bottom Line:

- The need for **low latency**, **low power** and **non volatile** memories will strongly push the development of alternative solutions: emerging memories represent a good candidate to solve those issues.
- The hottest technologies of the future require new types of memory, this is why we believe that **AI, Advaced Driver Assistance Systems and IoT will ignite the take-off of emerging memories**.
- **Tech giants** have started to **scout** and **adopt novel solutions**, for instance Baidu that has chosen PCM for its data-centers and the time for emerging memories to finally go mainstream appears ripe.

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A VIEW FROM BARCELONA:
IOT SOLUTIONS WORLD CONGRESS

Last month AtonRa Partners participated to the IoT Solutions World Congress in Barcelona.

The IoT Solutions World Congress is the largest IoT event in the world dedicated to bringing together IoT providers and general industry.

Experts, key players and technology solution providers from the industry presented use cases on key topics. Alongside conferences, companies participated as sponsors and exhibitors. The event encompasses multiple facets of IoT: connected transport, manufacturing, healthcare, energy and utilities, buildings and infrastructure, open industry, cross-sectional IoT technologies, blockchain and artificial intelligence.

Conferences in the event were spread over three main areas: blockchain, artificial intelligence, and a more generic and comprehensive one (multiple practical applications).
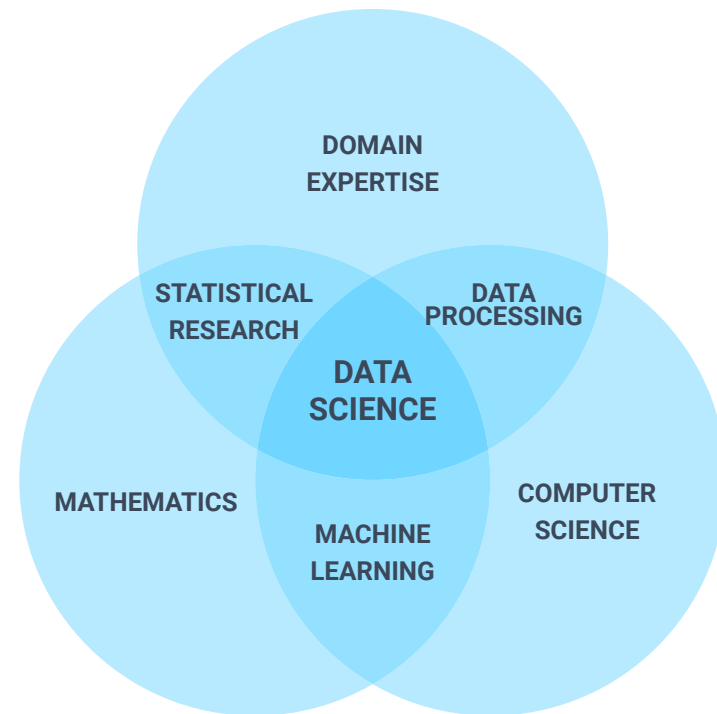
SOURCES:
https://www.google.it/search?q=iot+solutions+congress+barcelona&source=lnms&tbm=isch&sa=
X&ved=0ahUKEwiT0sTv4-vlAhUDqaQKHTpTC2UQ_AUIEygC&biw=1823&bih=871#imgrc=LrLuO4-8jkPAdM:

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Adding Domain Expertise To Big Data

- The last decade first prioritized toward the gathering of huge amount data (Big Data) and the creation of efficient Machine Learning algorithm. Lastly, the last technical step was the creation of powerful framework to feed and handle this immense amount of data.

- The mainstream AI pipeline merge strong concepts of Mathematics and Computer Science. However, speific **Domain knowledge** is missing. Company working with AI emphasized that having sufficient data and a powerful machine does not produce the necessary good result in real life.

- •The goal of adding Domain Expertise to Big Data is to build **AI that works in real-life applications by**:

  - Selecting feature and building a consistent data set with the problem to solve.
  - Choose the proper ML algorithm among the huge library available today.

- Companies are now hiring domain experts and data scientist that **understand** the problem and the data. A talent that combines both skills is highly sought after.
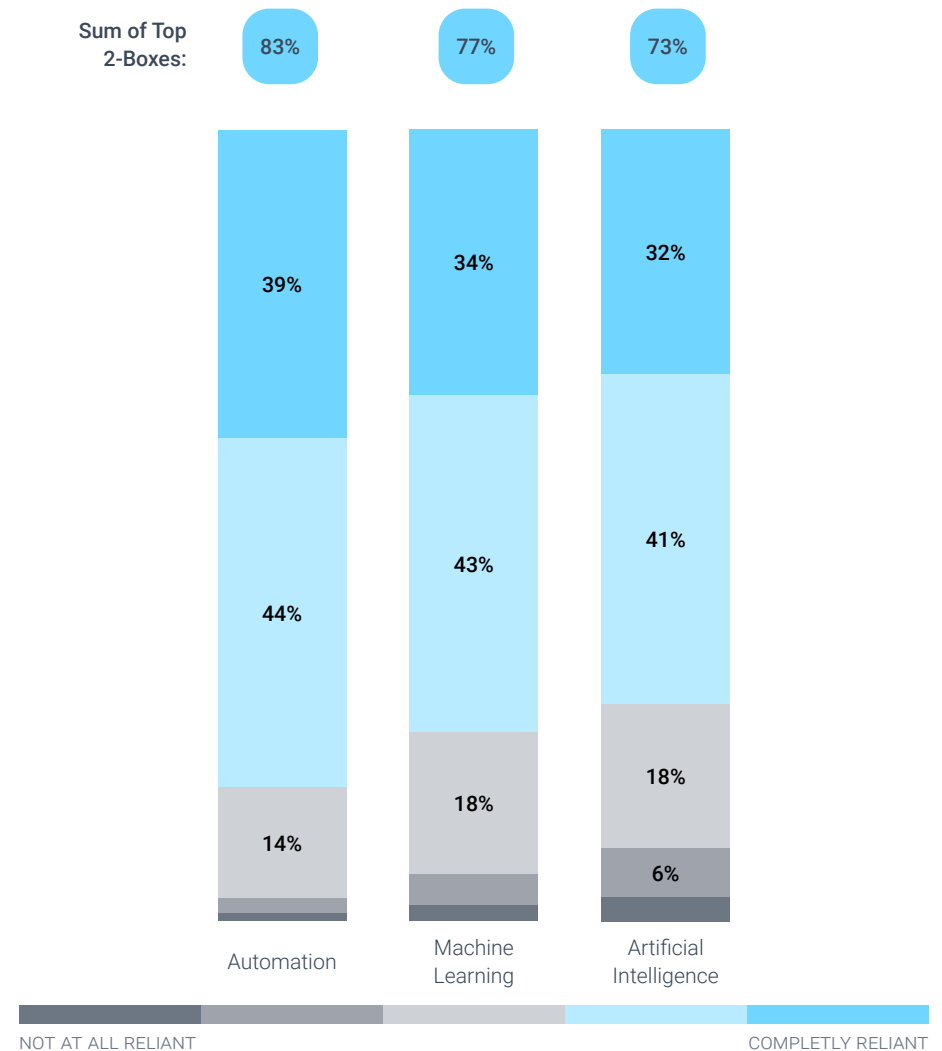
DOMAIN
EXPERTISE

STATISTICAL
RESEARCH

DATA
PROCESSING

DATA
SCIENCE

MATHEMATICS

COMPUTER
SCIENCE

MACHINE
LEARNING

SOURCES:
https://medium.com/@srinivas.sateesh/domain-knowledge-the-real-predictor-for-machine-learning-success-ca4a672676b3

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Applied Machine Learning:
How Company Monetize AI

- The technology stacks allow companies to build customized AI tools where domain knowledge is mandatory.

- **Big AI players don't have the domain expertise to create a tool to fit all problems** leading to a huge market for consulting companies in this sub-sector.

- The perfect example of an AI company using domain knowledge is **Zyfra** (**not listed**).

  - The company answered to a real-life problem by proposing applied ML tools

    - Optimize how much explosive must be used in mining, leading to **savings of $5-10 Million per mine**.
    - Detect when the excavator's teeth is likely to break using computer vision. When it happens (several times a year) the **machines stop for hours which costs over $100K**.

  - An Open API that optimizes the bitumen recipes by tuning the quantity of additive in the mix, reducing bitumen cost by 3.5% on average.

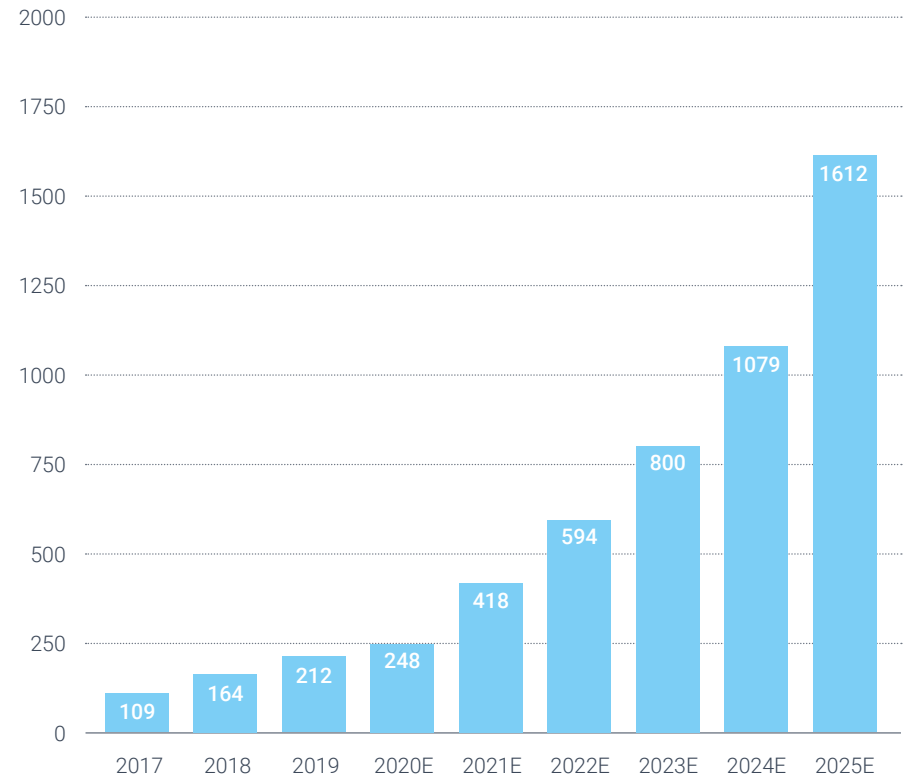ORGANIZATIONS RELY HEAVILY ON AUTOMATION, MACHINE LEARNING, AND ARTIFICIAL INTELLIGENCE

Sum of Top 2-Boxes:

	Automation	Machine Learning	Artificial Intelligence
Sum of Top 2-Boxes	83%	77%	73%
	39%	34%	32%
	44%	43%	41%
	14%	18%	18%
			6%

NOT AT ALL RELIANT   COMPLETLY RELIANT

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IoT: The Focus On The Industrial Internet Of Things (IIoT)

- Global IoT is expected to grow at a **CAGR of 26%**, while the Industrial IoT subsector is seen to reach **$949 Billion by 2025** (**CAGR 29.4%**) according to the numerous talks about applied IIoT solution across the Congress in Barcelona.

- The combination of AI and IoT in the industrial sector make possible the implementation of customized solutions, giving **direct and visible cost benefit in the short therm**. Many companies are logically heavily investing in IIoT solutions for their day to day operations.

- Similar to Machine Learning, the need for strong domain knowledge makes **generic application development not suitable for IIoT**.

  - Paving the way for consulting companies that have the knowledge to implement customized IoT solutions.

- As an example of a really interesting IIoT application: a sensor at the end of the electric grid to detect frequency fluctuation and avoid propagation (caused by alternative electric source generator). Currently this is the only way to avoid electricity burst (i.e. fire) or a blackout given the ever changing electricity grid.

THE FOCUS ON THE INDUSTRIAL INTERNET OF THINGS

Year	Value
2017	109
2018	164
2019	212
2020E	248
2021E	418
2022E	594
2023E	800
2024E	1079
2025E	1612

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The Challenge Of Massive IoT Cybersecurity

- The number of **IoT connected devices is expected to reach 40 billions by the end of 2020**. This is a consequent surface vector attack with many entry point for attacker to gain access to network, confidential information etc...

- For IoT network to be meet security requirement, it needs to be satisfy requirement at four level:

  - **Hardware**: This is the most complicated. The device is usually situated in unsecured place where authenticated access is not possible. Furthremore, the device computing capacity does not allow strong cryptography.
  - The **communication layer**: Using well established protocol, this level is usually secure.
  - The **cloud**: The data goes back and forth between the device and the cloud. A breach in the cloud service will leak sensitive data.
  - The **secure lifestyle management platform**: The most challenging. Its goal is to ship update to remote devices while ensuring security.

- In that purpose, Kaspersky proposes KasperskyOS, a immune operating system, dedicated, fully customable and with security by design. It aims to protect software and data systems from the consequences of the intrusion of malicious code, viruses and hacker attacks.

- There is always a tradeoff between security and privacy, particularly in IoT, where breach in either one can lead to dramatic consequence.

NUMBER OF MALWARE SAMPLES FOR IOT DEVICES
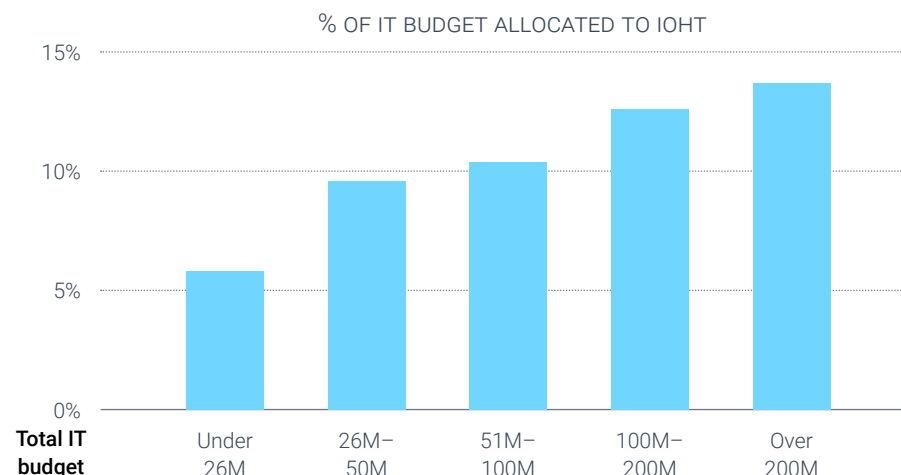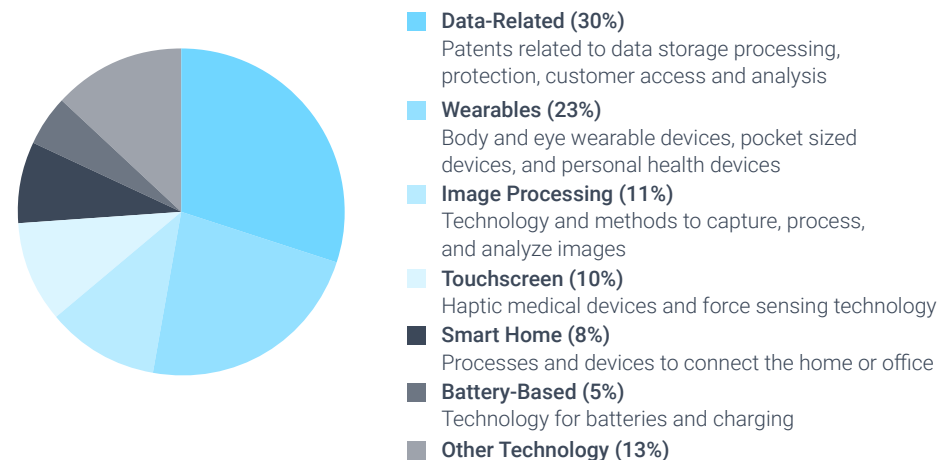IN KASPERSKY LAB'S COLLECTION 2016—2018
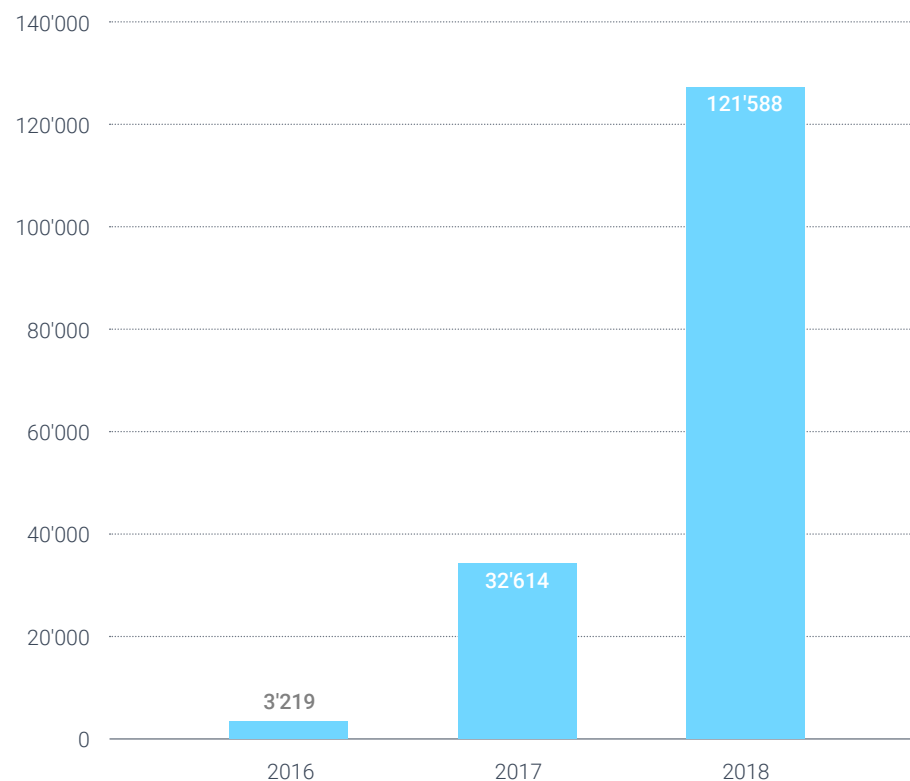
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Unlocking The Value Of Healthcare Data

- **Digital health** companies build their value on data.

  - According to Forbes, health data is valued between **$200** and **$1k** per person.
  - **82%** of smartphones gather health data.
  - Over **30%** of healthcare patents (filed between 2015–2017) are data-related.

- IoT supports the expansion of **data-sharing** among devices. Today there are around 26bn IoT devices worldwide expected to reach **40bn by the end of 2020**.

  - According to Frontier Communications, by 2020, **40%** of all IoT devices will be adopted by healthcare organizations.

- The IoT potential in the healthcare sector is endless: smart hospitals, smart home care, smart pills, Electronic Health Records, etc.

  - As the **IT budget** in healthcare organizations **increases**, so do the IoT investments.

- The global **healthcare IoT market** is expected to reach **$534.3bn** by **2025** growing at a **CAGR** of **20%.**

- **A successful IoT investment** in healthcare is based on a few simple elements:

  - A device, when feasible, should be built upon **standards**.
  - The lower the n**umber and distance** of connected devices the lower the security issues to solve.
  - A low **margin of error** and cost of making mistakes increases chances of regulatory approval.
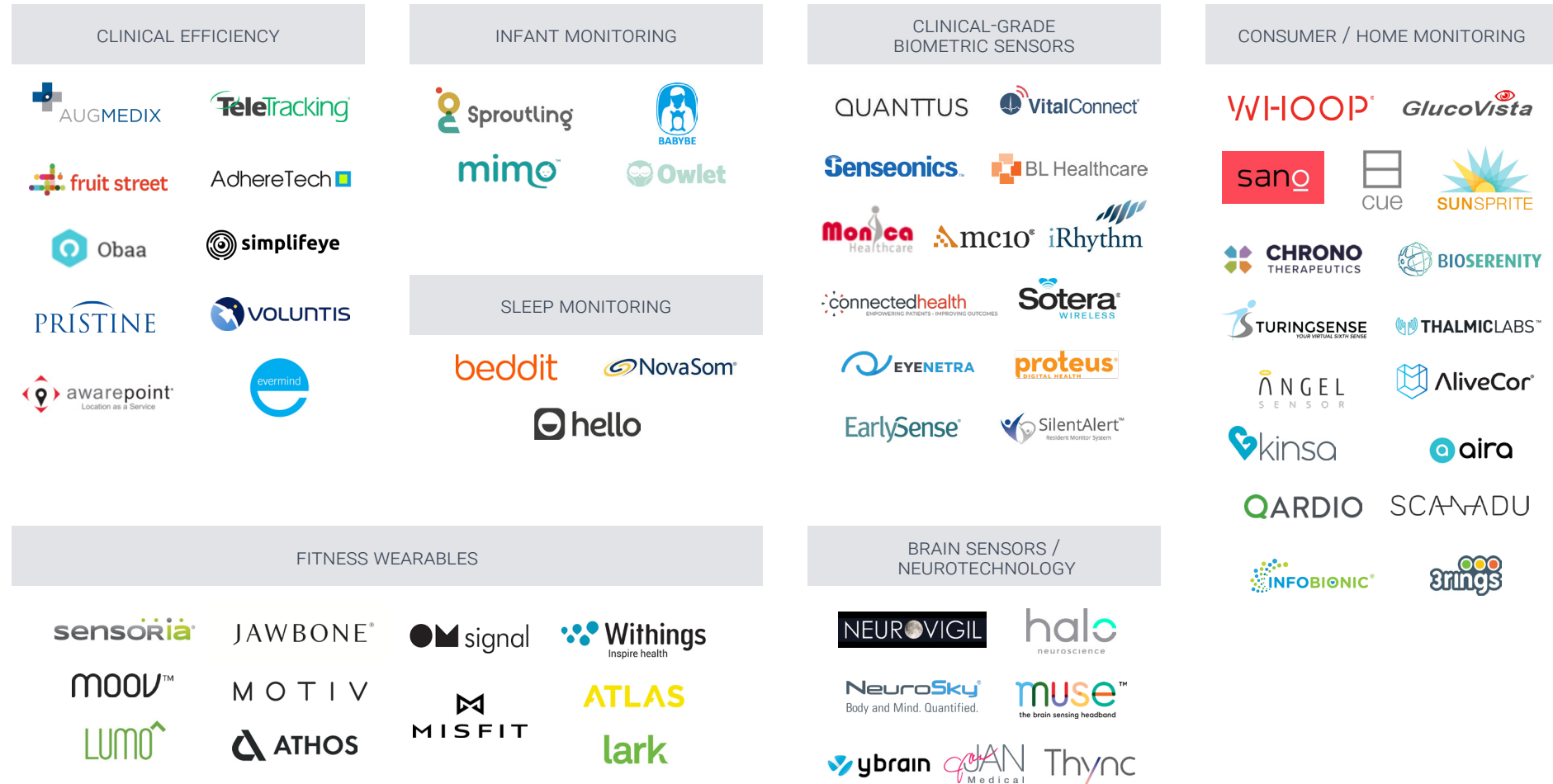
HEALTH CARE PATENTS FILED BY TECH COMPANIES 2015–2017

- **Data-Related (30%)**
  Patents related to data storage processing, protection, customer access and analysis
- **Wearables (23%)**
  Body and eye wearable devices, pocket sized devices, and personal health devices
- **Image Processing (11%)**
  Technology and methods to capture, process, and analyze images
- **Touchscreen (10%)**
  Haptic medical devices and force sensing technology
- **Smart Home (8%)**
  Processes and devices to connect the home or office
- **Battery-Based (5%)**
  Technology for batteries and charging
- **Other Technology (13%)**

% OF IT BUDGET ALLOCATED TO IOHT

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The Healthcare IoT Market Map

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Scaling Knowledge From Data

- AI is the tool that allows to gather **valuable insights** from the huge amount of data that is collected.

  - AI accuracy (one of the most important requirements in healthcare applications) is bound to increase over time, as its models improve based on the data that is feeded to them.

- The global **Healthcare AI market** is expected to reach **$7bn** by 2021 at a CAGR of **40%.**

  - According to the McKinsey Global Institute, **15−20%** of the healthcare market could be impacted by AI.
  - **Robot assisted surgery** and **virtual nursing assistance** will be the healthcare applications to focus on in the short term.
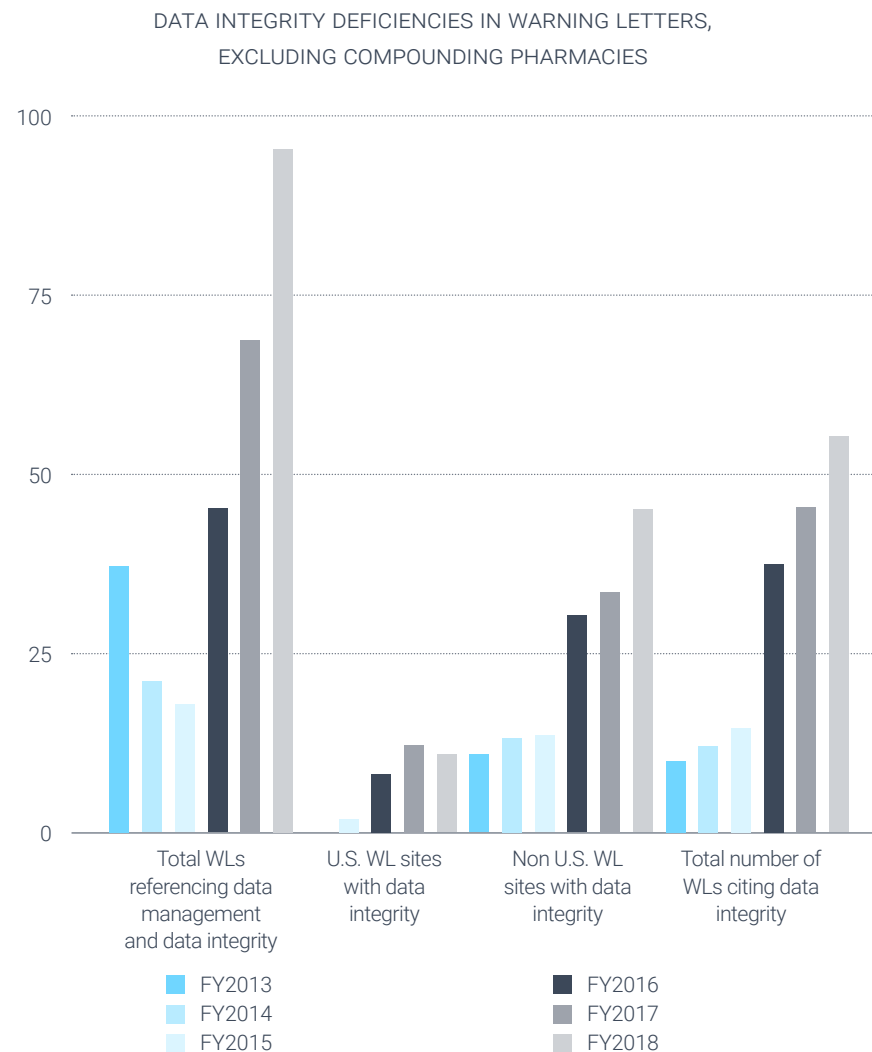

1950's
1960's
1970's
1980's
1990's
2000's
2010's

ARTIFICIAL INTELLIGENCE

Early artificial intelligence stirs excitement.

MACHINE LEARNING

Machine learning begins to flourish.

DEEP LEARNING

Deep learning breakthroughs drive AI boom.

SOURCES:
https://www.datasciencecentral.com/profiles/blogs/artificial-intelligence-vs-machine-learning-vs-deep-learning

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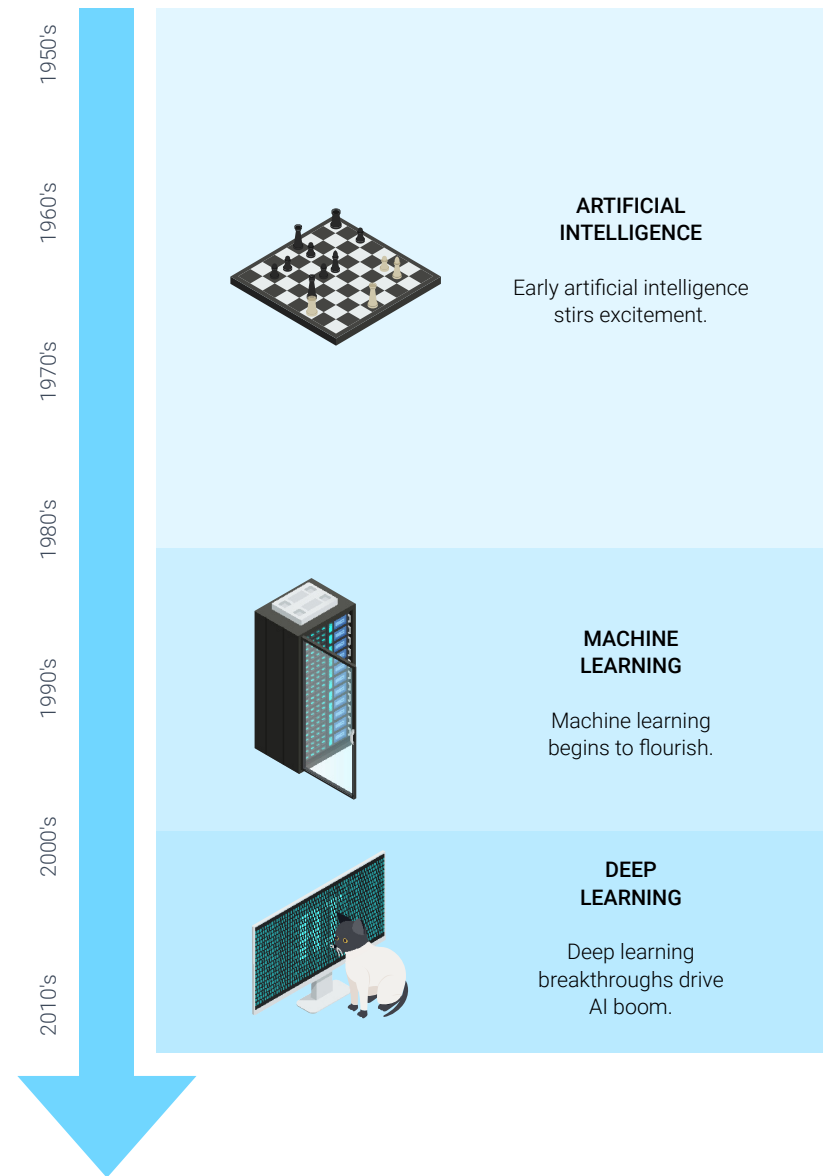
Blockchain: Knowing The Journey Of Healthcare Data

- Blockchain is a technology allowing to **trade and trace any asset of value**, digitally.

  - Blockchain secures the transmission of data, without requiring a centralized **third party**.

- Every year the healthcare sector receives more and more warning letters from FDA based on **data integrity problems**.

  - These letters require manufacturers to review their medical devices for violations regarding data security issues.

- Blockchain is now moving out of the « proof of concept » and is starting to give real value to digital health companies and their business.

  - **83%** of healthcare companies think Blockchain could give them an edge.
  - One of the most popular healthcare applications includes the **Electronic Health Records**: sharing clinical data among healthcare providers, insurances and regulators.

- **Permissioned Blockchain**: Blockchain for healthcare applications should require permission to participate to transactions, making the algorithms of protection less complex while also increasing the number of transactions per second.

DATA INTEGRITY DEFICIENCIES IN WARNING LETTERS, EXCLUDING COMPOUNDING PHARMACIES

Legend:
- FY2013
- FY2014
- FY2015
- FY2016
- FY2017
- FY2018

X-axis categories: Total WLs referencing data management and data integrity | U.S. WL sites with data integrity | Non U.S. WL sites with data integrity | Total number of WLs citing data integrity

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Catalysts:

- **IoT scale effect**. The improvement in communications connectivity and power supply will drive IoT adoption even further.

- **Economic and social benefit**. IoT and AI applications can help reduce costs but also improve standards of living.

- **New Regulations accelerate AI, blockchain and IoT**.

  - Since data scandals such as Facebook-Cambridge Analytica, regulatory bodies are encouraging user-centric ownership of information.
  - On February 2019, President Trump signed an executive order to spur the development and regulation of AI (New York Times).
  - In 2018 FDA has proposed a new framework which accelerates the approval of AI-based medical devices (Software as a Medical Device).

Risks:

- **Quick Implementation is key**. The pressure on Time To market for any IoT or ML application is challenging. It should not be more than 6 months.

- **A tradeoff between Privacy and efficiency**. Most IoT application uses personal data to provide insight. Satisfy the regulation and public opinion while ensuring efficiency is complicated. Companies need to invest in security. New solutions using Blockchain technology are emerging.

- **Bias in data**. Machine is unbiased but data are not. Data analytics aimed to remove it but it is people than the label and chooses data. Ethical and social responsibilities will be at the center of any AI application.

Bottom Line:

- IoT adoption will grow consistently over the next years. However, Industrial IoT will see the most interesting application. **Coupled with AI, it will unlock limitless possibilities.**

- Overall, the IoT Congress Barcelona proposes really interesting talk about the **cutting-edge applications** and their underlying **technology** in the domain of **IIoT**, **AI** and **blockchain**.

- **Personal data** is becoming the new **currency** of the digital world. Health data in particular, seems to be the **most valuable** one.

- However, **security concerns still linger**. Security protocols are able, to some extent, to protect devices from breaches but, as the number of **connected devices increases**, so do security issues.

AI & ROBOTICS

THE CHINESE BIOPHARMA MARKET: A NEW INNOVATION CYCLE!

A Booming Market

- China is the **second-largest drug market in the world** and key drivers are trending in the right direction.

  - The **population** is aging: by 2020, 200mn people will be over 65 in China.
  - The **middle class** is growing, and the standard of living is improving.
  - **Obesity rates** in China are rising rapidly due to changes in dietary habits leading to a higher incidence of diabetes or cancers.

- Biologics (biotech products) only account for 12% of the Chinese total drugs market versus 25% in the US.

  - China still relies heavily **on imports of US drugs** to meet the demand.

- The China biotech market is expected to grow at a five years **CAGR of 17% by 2021**, making it the world's fastest-growing biologics market.

  - The market is expected to reach **¥300bn** (**$43bn**) **in 2021** from **¥152bn** (**$21.7bn**) **in 2016**.
  - The US remains **the largest market** valued at **$170bn in 2017**, but is expected to grow by only about 8% over the next five years.

SOURCES:
Frost & Sullivan
Evaluate Pharma
Grandviewresearch.com
GLOBOCAN 2012: Estimated Cancer Incidence Mortality and Prevalence Worldwide in 2012, WHO, June 2017
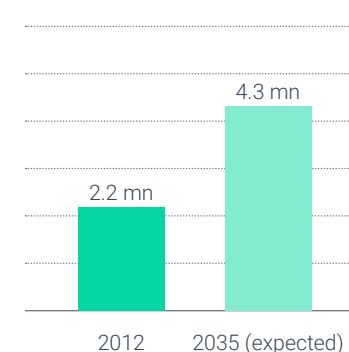https://www.scmp.com/sites/default/files/2014/05/30/5e8ef3511defc2f9b7963c0d172d047.jpg

CHINA SNAPSHOT – PREVALENCE %
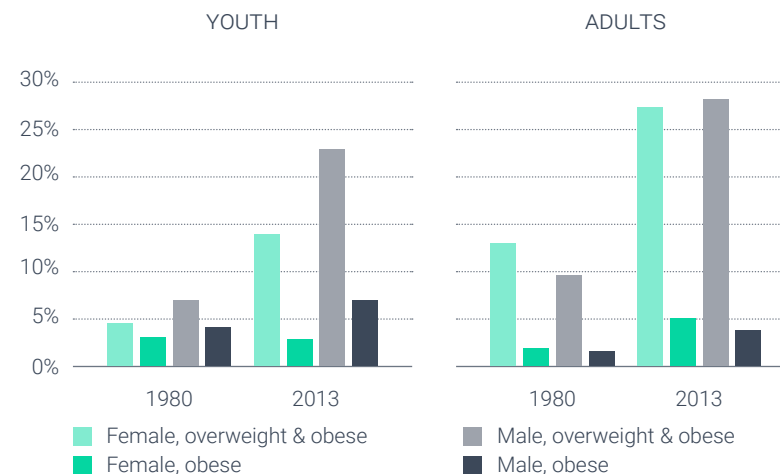
CHINA: NEW CANCER INCIDENCES / NEW CANCER DEATHS
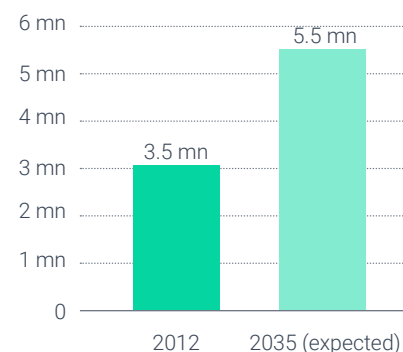
Government's Incentives Are Boosting Innovation

- China launched **a wave of new reforms** to boost the development of the biopharmaceutical sector.

  - In 2015, President Jinping presented the "**Made in China 2025**" plan. The biopharmaceutical sector is one of the ten industries in which China wants to encourage innovation and increased R&D.
  - The Ministry of Science and Technology also unveiled **a five-year plan** (**2015–2020**) to increase the size of the biopharmaceutical sector to more than 4% of GDP.
  - President Jinping introduced 15 reforms through the "**Healthy China 2030**" plan to improve healthcare access and mortality rates on major diseases.

- The **China FDA** (**CFDA**) has implemented several reforms to modernize the clinical trial process and speed-up the approval of innovative drugs.

  - Following the reform, thirty-five new biologic drugs were launched between January and October 2017 vs. around 5 in previous years.
  - CAR-T cells therapies benefit from an orphan designation and tax deductions in China.
  - **China's National Reimbursement Drug List** (**NRDL**) added more than 340 drugs on the national insurance list, including the most expensive drugs.

- As a result, significant new investment capital has flown into the sector.

  - The value of Chinese biopharma IPOs reached an all-time high of $2.8bn in 2017.

MAIN OBJECTIVES OF HEALTHY CHINA ACTION (2019–2030)

Prevent and control major diseases

- ■ Target by 2022
- ■ Target by 2030

Cardiovascular and cerebrovascular diseases mortality:

209.7 / 100 000 and below

190.7 / 100 000 and below

Cancer – overall five-year survival rate:
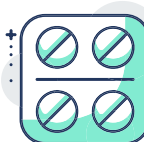
no lower than **43.3%**

no lower than **46.6%**

Chronic respiratory disease – mortality in people aged 70 and under

9 / 100 000 and below by 2022

8.1 / 100 000 and below by 2030

Diabetes – standard management rate of patients:

60% and above

70% and above

Infectious and endemic diseases

At the township (town, street) level, the vaccination coverage of the National Immunization Program Vaccines for children of appropriate age should remain above 90%.

BIOTECHNOLOGY

Chinese Biopharma Landscape

| COMPANY	LISTED	THERAPEUTIC AREA
AOBiome (Not listed)	US-based, Hong Kong IPO planned	Anti-inflammation using microbiome
Ascentage Pharma (6855 HK)	Hong Kong	Oncology, HBV, ageing diseases
Ascletis (1672 HK)	Hong Kong	HCV, HIV, HBV
BeiGen (6160 HK; BGNE US)	Hong Kong	Oncology
CanSino Bio (6185 HK)	Hong Kong	Vaccines in 12 disease areas
Chin-Med (0570 HK)	Hong Kong	Oncology, autoimmune diseases
Cstone Pharmaceutical (2616 HK)	Hong Kong	Oncology
Henlius (2696 HK)	Hong Kong	Biosimilars
Hua Medicine (2552 HK)	Hong Kong	Diabetes
Innovent Biologics (1801 HK)	Hong Kong	Oncology, metabolic diseases
Junshi (1877 HK)	Hong Kong	Oncology, autoimmune, metabolic diseases
MabPharma (2181 HK)	Hong Kong	Oncology, autoimmune diseases
MicuRx (Not listed)	Filed an IPO on the Hong Kong stock exchange	Antibiotic resistance
Sino Biopharmaceutical (1177 HK)	Hong Kong	Ophthalmia, as well as modernized Chinese medicine and chemical medicine for the treatment of hepatitis
Stealth Biotherapeutic (MITO US)	US-based, Hong Kong IPO planned	Dry AMD, mitochondiral dysfunction
Wuxi Biologics (2269 HK)	Hong Kong	CDMO (Contract Development and Manufacturing Organization)
ZaiLab (ZLAB US)	Hong Kong	Oncology, autoimmune, infectious diseases
Zensun (HKG: 0185)	Hong Kong	Cardiovascular, metabolic diseases, Alzheimer's disease

BIOTECHNOLOGY

Digitization And Big Data Capabilities: A Competitive Advantage

- The Chinese biotech and pharma sector benefits from several advantages: **AI, big data and digitization**.

- 58% of the population now uses the Internet (**800mn internet users compared to 275mn in the United States**) and more than 95% are mobile users.

  - This large user base is a **huge source of medical data** and mobile applications are a way to reach more potential patients.
  - The Chinses "big data" market is expected to reach **¥1tn** (**$146bn**) in 2020 from **¥280bn** in 2015 (**30% CAGR**), exceeding the U.S. market. The healthcare part is expected to be around 9%.
  - By 2020, the government aims to build a "large data system" with an interconnected public health information platform.

- The Chinese AI healthcare market is the second-largest in the world, projected to grow at a **CAGR of 45% over 2017–2024 compared to 35% in the U.S.**.

  - In 2018, Alihealth, owned by **Alibaba** (**BABA US**), presented its AI diagnostic software to interpret CT scans.
  - Since 2019, **Tencent** (**0700 HK**) also has its own AI medical image reading tech called Miying.
  - In 2016, **Baidu** (**BIDU US**) developed a healthcare AI bot, a medical "brain", called Melody.
  - **BGI Genomics** (**300676 SHE**), which participated to the Whole Genome Project, is the biggest genetics lab in the world. The company used AI technology with genome sequencing to help the development of new medicine.

SOURCES:
China Internet Network Information Center (CNNIC)
https://www.yicaiglobal.com/news/china-aims-usd146-billion-big-data-market-2020

BIOTECHNOLOGY
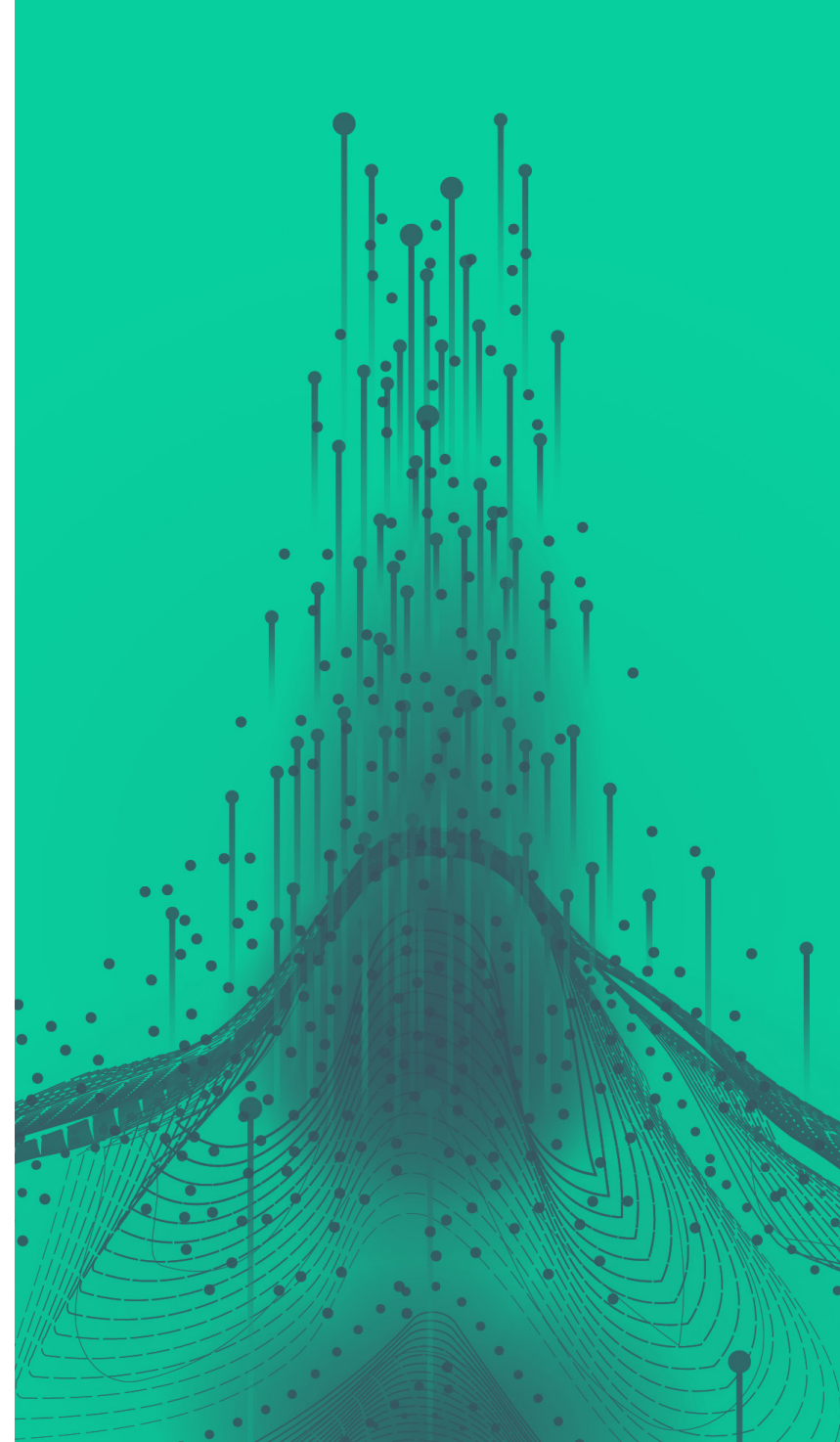
Catalysts:

- **IPOs**. Chinese biotech and pharma companies are gaining exposure through IPOs either abroad or on the Hong Kong/ Shanghai stock exchanges. Suzhou Zelgen Biopharmaceutical (Not listed) is one of the most exciting IPO to come.

- **China FDA (CFDA) new regulatory frame**. Many reforms were issued to encourage innovation .

- **Talent attraction**. Chinese talents who were trained and worked previously in the US biotech industry are coming back to China; they are called "Haigui" (sea turtles). For example, BeiGene (6160 HK) acquired an experienced oncology commercial team from Celgene (CELG US)

- **"Healthy China 2030" plan**. The government is committed to ensuring better healthcare access for the Chinese population.

Risks:

- **Pricing pressure**. Biologics will have to be listed by the NRDL (National Reimbursement Drug List), which has significant bargaining power. It may lead to a decrease in biologics' prices in the future.

- **Safety and ethical standards**. China has adopted only recently "The International Council for Harmonization of Technical Requirements for Pharmaceuticals for Human Use" guidelines. Guidelines on safety, quality and ethical standards may take time to be implemented, especially on a more provincial level, with administrative issues slowing down innovation.

Bottom line:

- We believe that the Chinese biopharma sector is entering an **important innovation cycle**, thanks to supportive government reforms. The China FDA (CFDA) removed many clinical trial requirements and introduced a priority review designation to speed approvals. As a result, many Chinese and USA innovative drugs were approved, including Keytruda by Merck (MRK US), Repatha by Amgen (AMGN US), or Spinraza by Biogen (BIIB US).

- **China also has a very competitive advantage: the sector can rely on important big data and its AI capabilities to stimulate fast-growing areas such as genomics and AI applications in healthcare.**

- **In our biotechnology certificate, we currently have a direct exposure to the Chinese biopharma sector, albeit limited. We are closely following the sector and may add more Chinese biopharma companies in the future.**
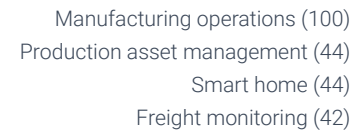
BIOTECHNOLOGY

CHARTS FOR THOUGHTS

IoT – When Will The Focus Switch?

- The four charts on this page depict a simple picture of current IoT status: connected sensors help **reduce costs by monitoring operations**.

  - No wonder their widest application is in highly repetitive and item rich verticals, such as industrial manufacturing and retail.
  - It remains a very narrow application of IoT, and doesn't fully leverage the huge synergies coming from the data generated by IoT devices.

- As most innovative technologies, they are initially deployed where an ROI can be achieved fastest.

  - The uncertainty around the new technology requires **fast results** – companies are unwilling to wait "long" time to test if it works or not.

- But the tipping point, where a small incremental change leads to a substantial effect, will be (soon) reached when investments will focus on obtaining the highest ROI.

  - Once the technology is considered as established, companies will be less "nervous" in laying investments on it.

- The signal will be when the **focus shifts to increasing revenues** rather than reducing costs.

Organisations deploying IoT in operations at full scale, by industry (%)

- Industrial Manufacturing (62%)
- Retail (46%)
- Industrial Manufacturing (38%)
- Consumer Products (36%)
- Energy & Utilities (35%)
- Automotive (17%)

Predicted spend on IoT use cases in 2019, across industries ($ billion)

- Manufacturing operations (100)
- Production asset management (44)
- Smart home (44)
- Freight monitoring (42)

Top IoT drivers for enterprise organisations, across industries (%)

- Reduce overall costs (44%)
- Improve business processes (37%)
- Improve employee productivity (33%)
- Increase competiveness (33%)
- Improve customer experience (30%)
- Grow revenues from existing customers (30%)
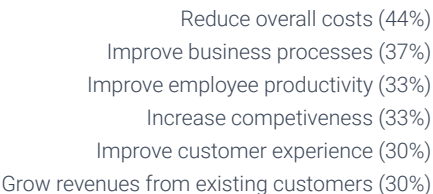
How do you utilise your connected devices? (%)

- Monitoring (71%)
- Status, alarms and alerting (69%)
- Predictive maintenance (56%)
- Direct control operations (53%)

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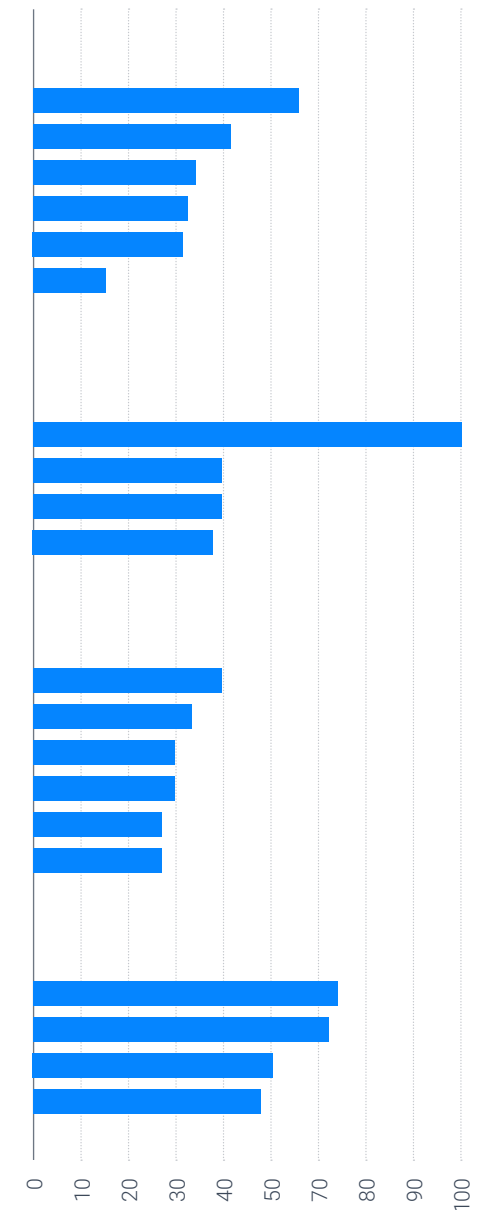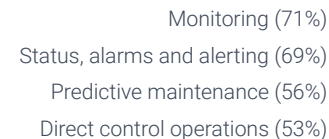
CASUAL FRIDAY
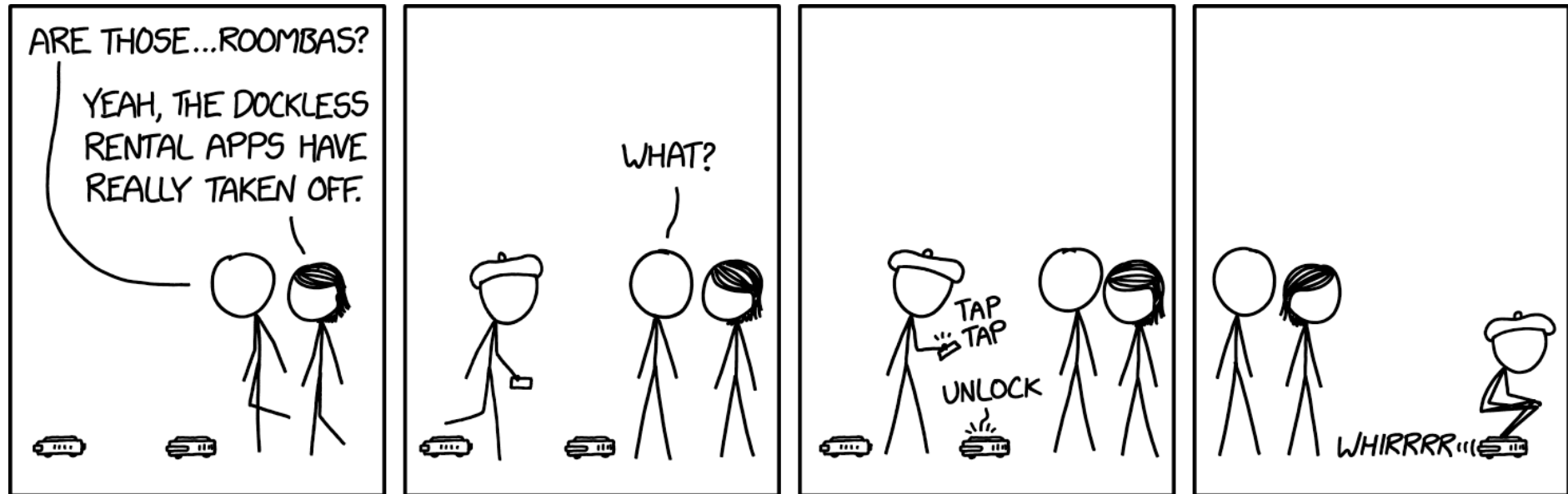
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AtonRâ Partners is an asset management company, founded in 2004 with head office in Geneva, incorporated under Swiss law, duly approved by the Swiss Financial Market Supervisory Authority (FINMA) under the Swiss Collective Investment Schemes Act. AtonRâ Partners is a conviction-driven asset manager combining industrial and scientific research with financial analysis. AtonRâ Partners focuses on long-term trends powerful enough to be turned into thematic equity portfolios.

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