

# The Rise of the Machines: Digital Transformation 4IR in Motion

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Royal Elephant Hotel, Centurion, 14 March 2019

Define tomorrow.

UNISA



# INTRODUCTION



# Introduction

The majority of the world's population now lives in cities, and this number is growing fast. It is estimated that **one million people move into the world's cities each week**. With this enormous influx of population, new ideas are needed to **manage complexity, increase efficiency, reduce expense and improve quality of life**.

A city may only be “smart” if its citizens collectively take up the challenge of **innovating intelligently and sustainably**, with the aim of creating more **liveable, viable and equitable cities**.

**As our planet gets more urban, our cities need to get smarter!**

**Artificial Intelligence (AI)** has been described as the ‘fourth industrial revolution’. It will transform all of **our jobs** and **lives** over the next 10 years.

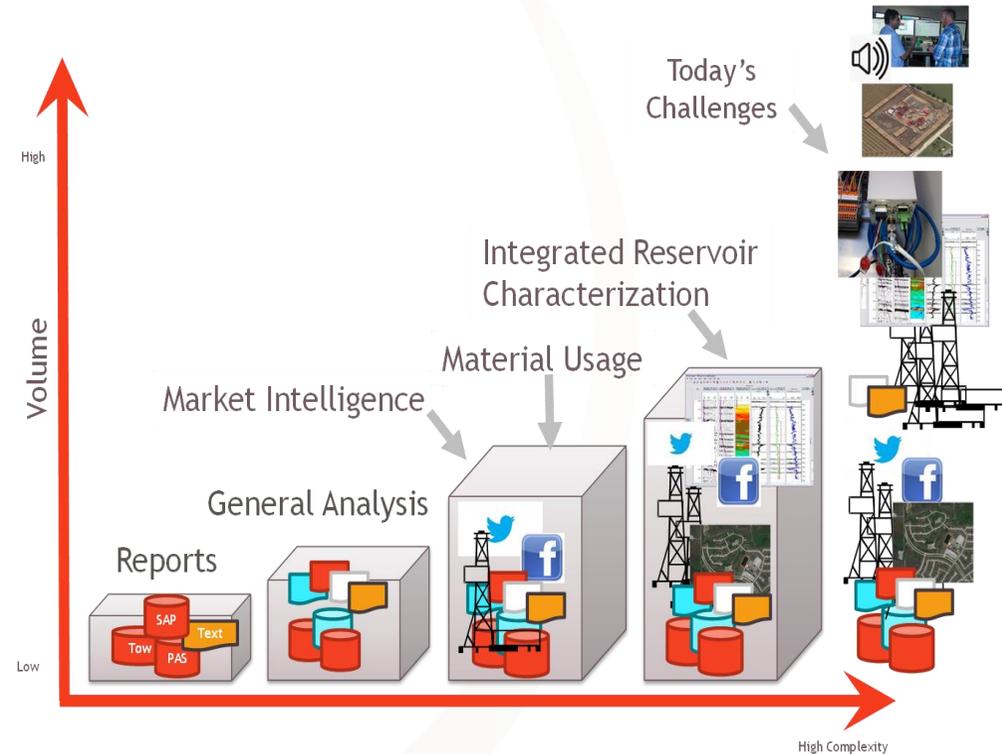
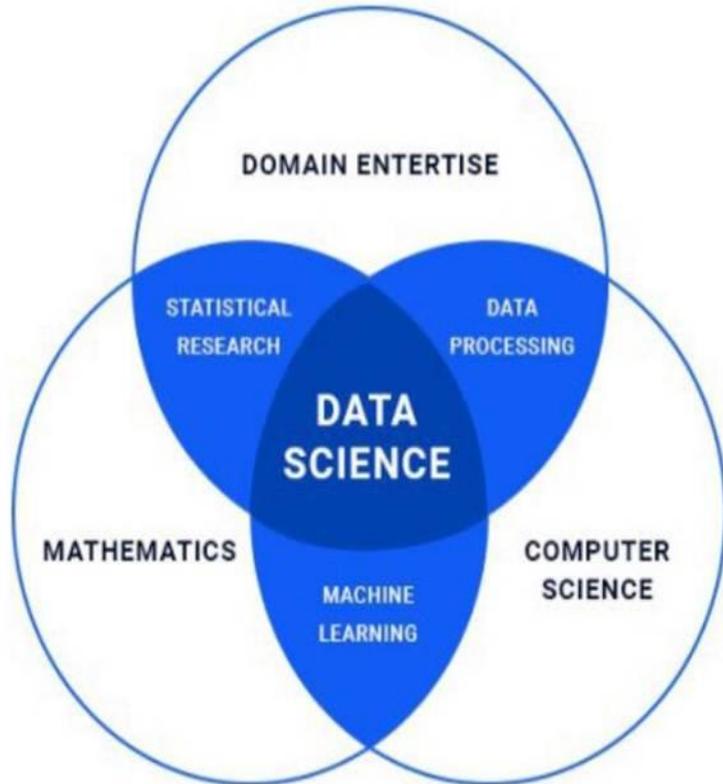
AI’s roots are in the ‘expert systems’ of the ‘70s and ‘80s, computers that were programmed with a human’s ‘expert’ knowledge in order to allow decision-making based on the available facts.

**Evolution of machine learning systems.** No longer are machines just capturing ‘explicit’ knowledge they are now developing a ‘tacit’ knowledge – the intuitive, know-how embedded in the human mind.

**Fuelling machine learning with data** (unlocking our phones with a glance or a touch, suggesting music we like to listen to, and teaching cars to drive themselves).

# Data Science in Johannesburg

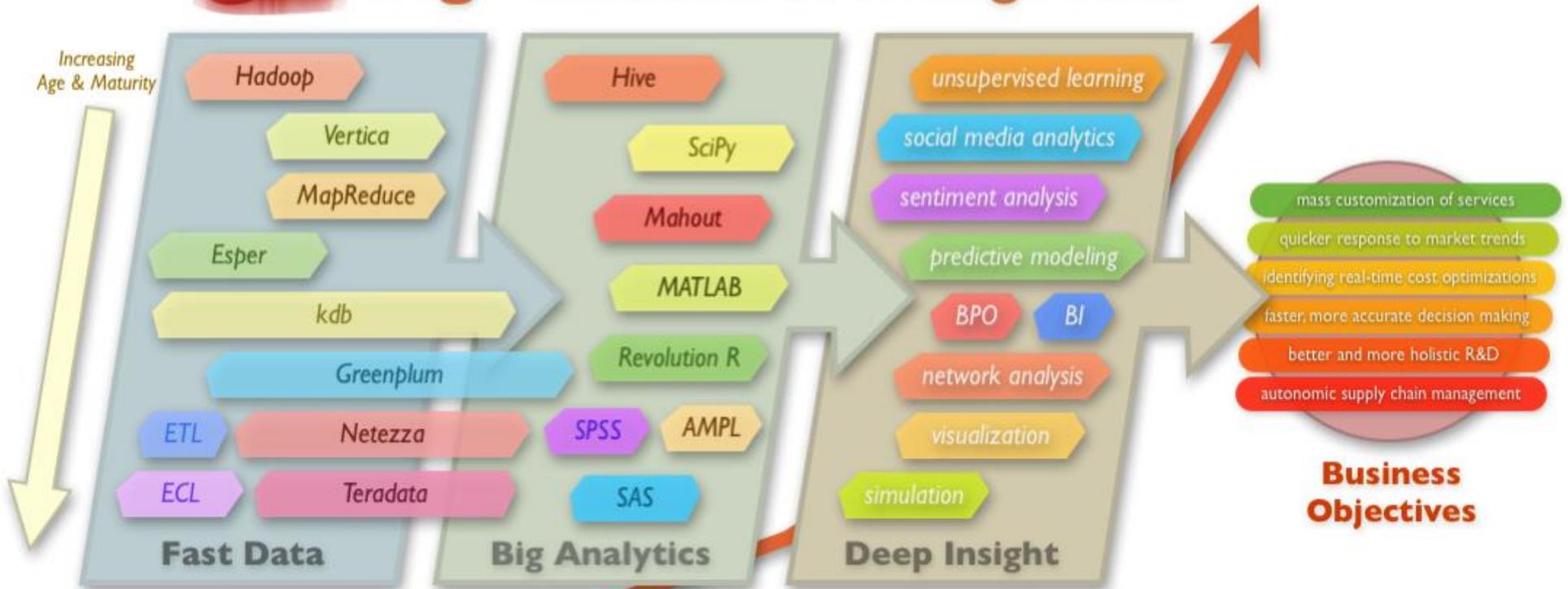
## Challenges and Technology Growing Rapidly



# Big Data Technology



## Big Data: The Moving Parts



- mass customization of services
- quicker response to market trends
- identifying real-time cost optimizations
- faster, more accurate decision making
- better and more holistic R&D
- autonomic supply chain management

### Business Objectives

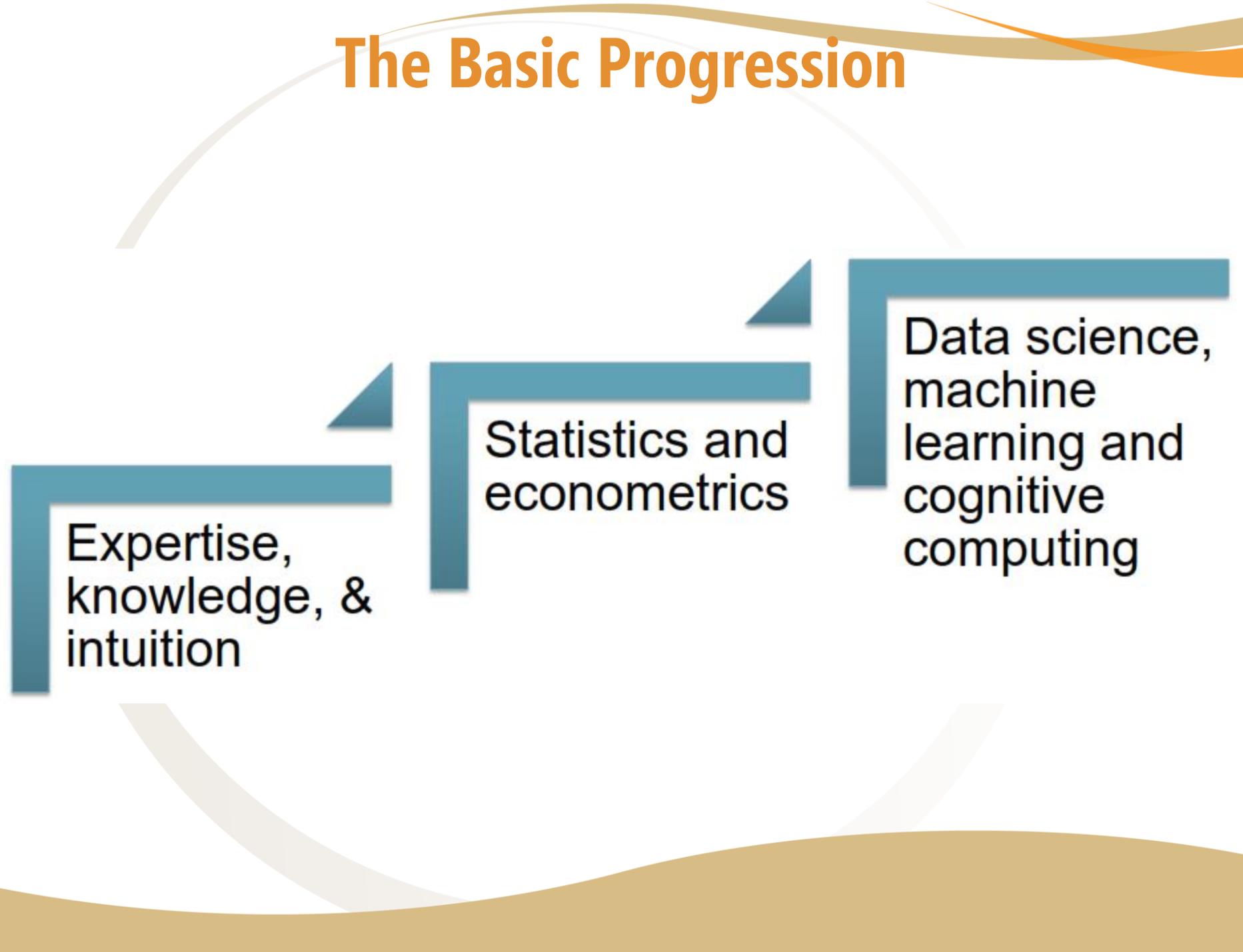
From <http://blogs.zdnet.com/Hinchcliffe>

the growth of data will be exponential for the foreseeable future



the amount of data stored by the average company today

# The Basic Progression

A staircase diagram with three steps, each represented by a blue L-shaped block. The steps ascend from left to right. The first step is labeled 'Expertise, knowledge, & intuition'. The second step is labeled 'Statistics and econometrics'. The third step is labeled 'Data science, machine learning and cognitive computing'. The background features a light beige wavy line at the top and a darker beige wavy line at the bottom, with a thin grey arc connecting the top of the first step to the top of the third step.

Expertise,  
knowledge, &  
intuition

Statistics and  
econometrics

Data science,  
machine  
learning and  
cognitive  
computing

# Industrial Demands



# Killer Robots, the End of Humanity, and All That

## What is a good AI researcher to do?

### The Telegraph

'Killer Robots' could be outlawed

'Killer Robots' could be made illegal if campaigners in Geneva succeed in persuading a UN committee, meeting on Thursday and Friday, to open an investigation into their development



### TECH TIMES

PERSONAL TECH BIZ TECH FUTURE TECH SCIENCE LIFE T-LOUNGE

TAG Robots , Robotics , Unemployment

### Robots Could Replace Half Of All Jobs In 20 Years

By Timothy Torres, Tech Times | March 24, 6:56 PM

Like Follow Share(119) Tweet(17) Reddit 2 Comments SUBSCRIBE



Robots will replace 47 percent of all jobs by the year 2035 if we're to believe University of Oxford associate professor Michael Osborne. (Photo : Paramount)

If we're to believe University of Oxford associate professor Michael Osborne, then robots will replace 47 percent of all jobs by the year 2035.

If you want to stay employed by then, you better think about a career shift into software development, higher level management or the information sector. Those professions are only at a 10 percent risk of replacement by robots, according to Osborne. By contrast, lower-skilled jobs in the accommodation and food service industries are at a 87 percent risk, transportation and warehousing are at a 75 percent risk and real estate at 67 percent. The researcher warns that driverless cars, burger-flipping robots and other automatons taking over low-skilled jobs is the way of the future.

### Artificial Intelligence could spell the end of the human race

BY PAUL CROKE · JUNE 9, 2015 · NO COMMENTS

f t e d g Like 50 8+



What do we do?

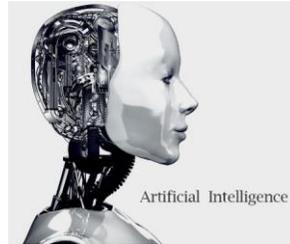
**DON'T  
PANIC**

# AI Digital Quake

10 MSs' → \$4 T market cap



Mobile/Cloud  
first → AI first



China \$337B



AI top 6 trends

Gartner “perceptual smart  
machine age” top 3 trends



AI tools, hardware,  
open source (OpenAI)

FSR summit, \$91.7 Trillion, AI key

# Daily AI News

- AI assesses breast cancer risk 30 times faster

<http://www.forbes.com/sites/janetwburns/2016/08/29/artificial-intelligence-can-help-doctors-assess-breast-cancer-risk-thirty-times-faster/#7b717af556e2>

- GE, reborn as a software startup using AI

[http://www.nytimes.com/2016/08/28/technology/ge-the-124-year-old-software-start-up.html?\\_r=0](http://www.nytimes.com/2016/08/28/technology/ge-the-124-year-old-software-start-up.html?_r=0)

- World leading 2025 China AI industry

[http://www.chinadaily.com.cn/business/tech/2016-08/27/content\\_26615174.htm](http://www.chinadaily.com.cn/business/tech/2016-08/27/content_26615174.htm)

➤ Global AI Market 2015: 127B; 2016: 165B; 2018: 200B

- Audrey--NASA's New Self-Learning AI Could Save First Responders

<http://motherboard.vice.com/read/this-nasa-ai-will-sense-danger-save-firefighters-and-learn-from-mistakes>

- Voice recognition 3x faster than typing

[http://www.npr.org/sections/alltechconsidered/2016/08/24/491156218/voice-recognition-software-finally-beats-humans-at-typing-study-finds?utm\\_medium=RSS&utm\\_campaign=storiesfromnpr](http://www.npr.org/sections/alltechconsidered/2016/08/24/491156218/voice-recognition-software-finally-beats-humans-at-typing-study-finds?utm_medium=RSS&utm_campaign=storiesfromnpr)

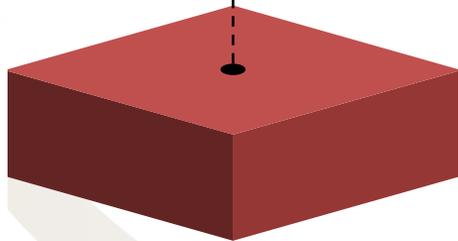
- The world's first self-driving taxi picking up passengers in Singapore on 1st September 2017  
<http://www.cbc.ca/news/technology/driverless-taxi-nutonomy-1.3735375>
- AI bias <http://motherboard.vice.com/read/its-our-fault-that-ai-thinks-white-names-are-more-pleasant-than-black-names>
- Norwegian Telco creates AI and Big Data lab  
<https://www.telecomtvtracker.com/insights/telenor-supports-norwegian-entrepreneurship-and-artificial-intelligence-research-6448/>
- Telefonica and BigML using AI to select start-ups  
[https://www.telefonica.com/es/web/press-office/-/telefonica-open-future\\_-and-bigml-create-preseries-a-joint-venture-for-early-stage-investment](https://www.telefonica.com/es/web/press-office/-/telefonica-open-future_-and-bigml-create-preseries-a-joint-venture-for-early-stage-investment)
- Deep Knowledge Ventures appoints AI like a Board member to make investment decision  
<http://www.itbusiness.ca/blog/hong-kong-vc-firm-appoints-ai-to-board-of-directors/48815>
- Satellite images and machine learning mapping poverty <http://bit.ly/2bxEv3w>

# Data Volumes Driving AI

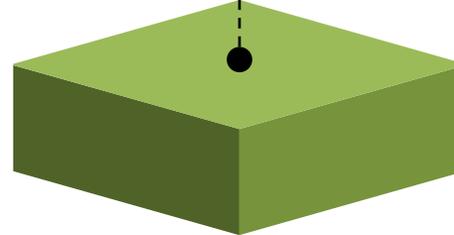
Only AI has the power to analyze this data to solve grand challenges and problems guiding our future.



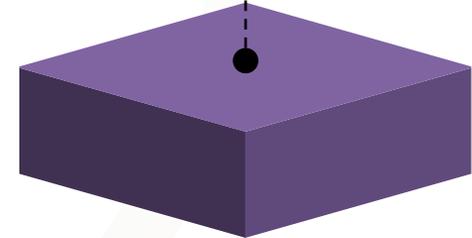
44 ZB 2020,  
50 x 2010



2015/16 entire  
human history



26 billion IoT  
devices 2020

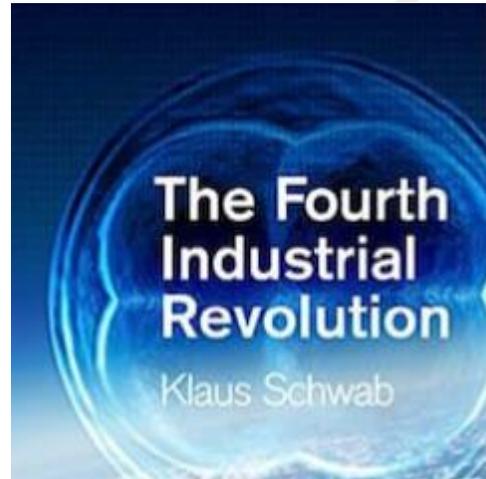


# The 4<sup>th</sup> Industrial Revolution (4IR)

## The Fourth Industrial Revolution

by Prof Klaus Schwab - World Economic Forum

Subject UBS paper



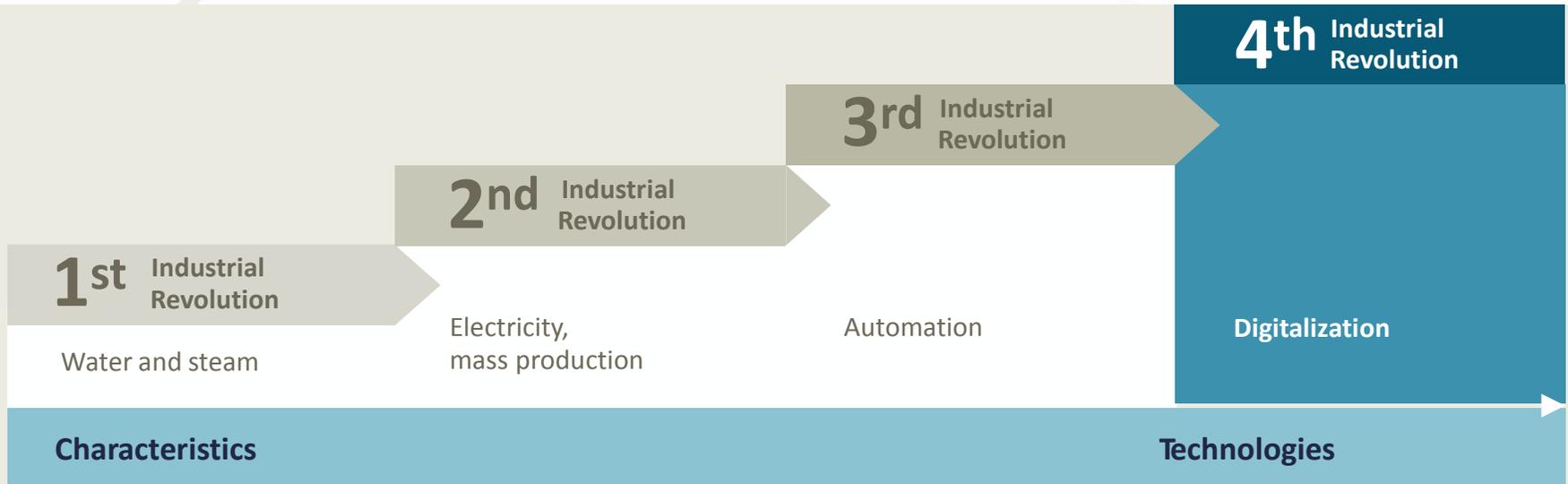
**Cyber-physical systems (CPS)  
driven by AI and robots**



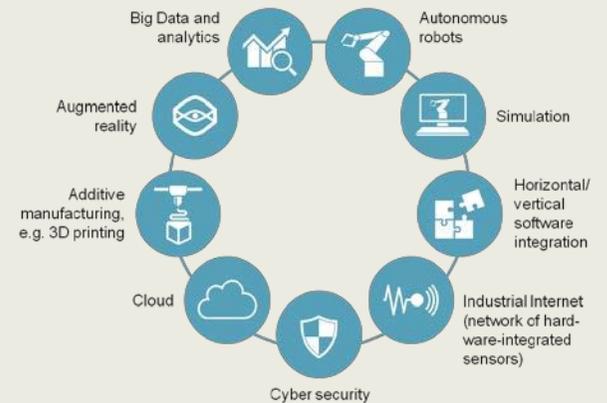
**EXTREME automation,  
connectivity**



# Defining IR4



- Humans, devices and systems are connected along the entire value chain
- All relevant information are available in real-time – across suppliers, manufacturers and customers
- Parts of the value chain can constantly be optimized with respect to different criteria, e.g. cost, resource utilization, customer needs



# The 4IR and Future Society

**Tipping Points  
expected to occur  
by 2025**

10% of people wearing clothes and reading glasses  
connected to the internet

1 trillion sensors connected to the internet

The first robotic pharmacist in the US

The first 3D-printed car in production,  
The first transplant of a 3D-printed liver

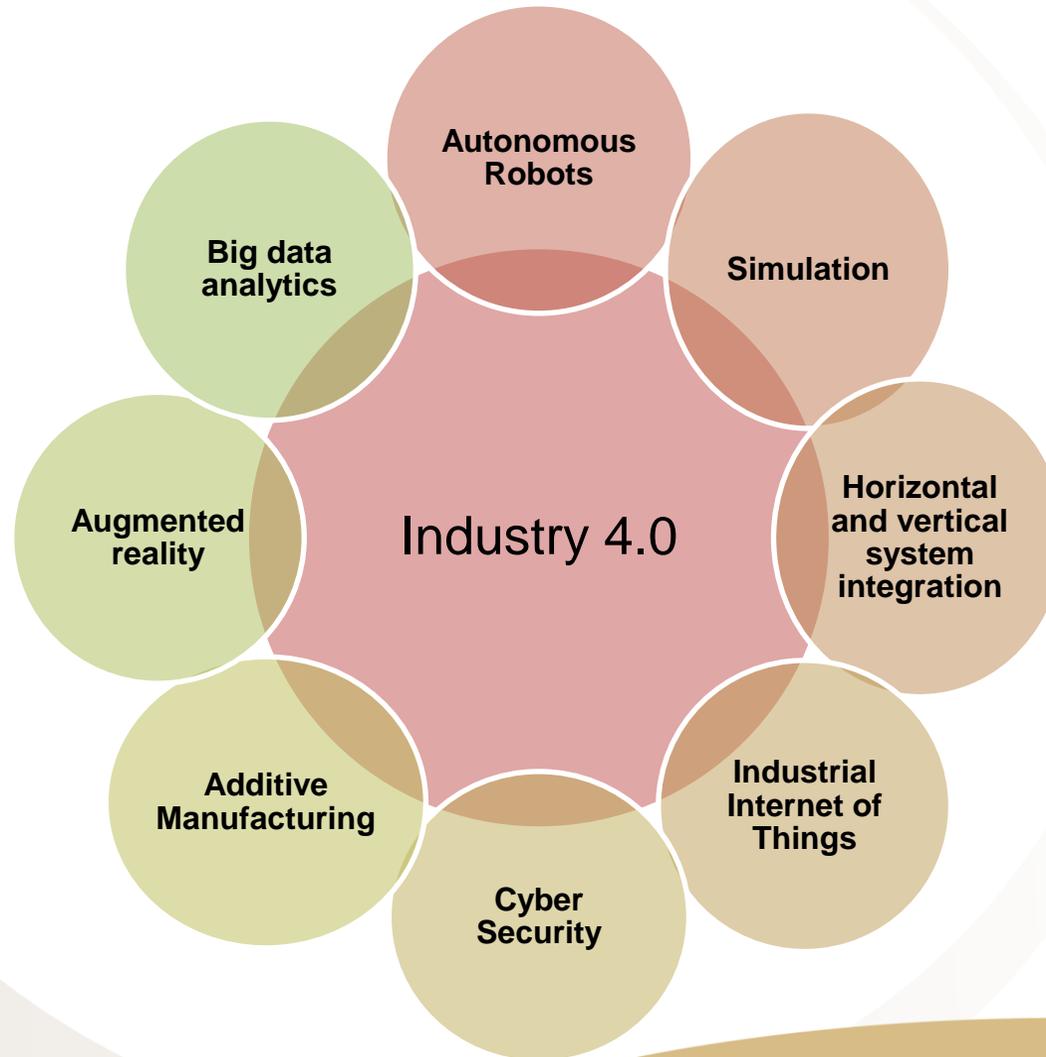
Driverless cars equaling 10% of all cars on US roads

90% of the population using smart phones

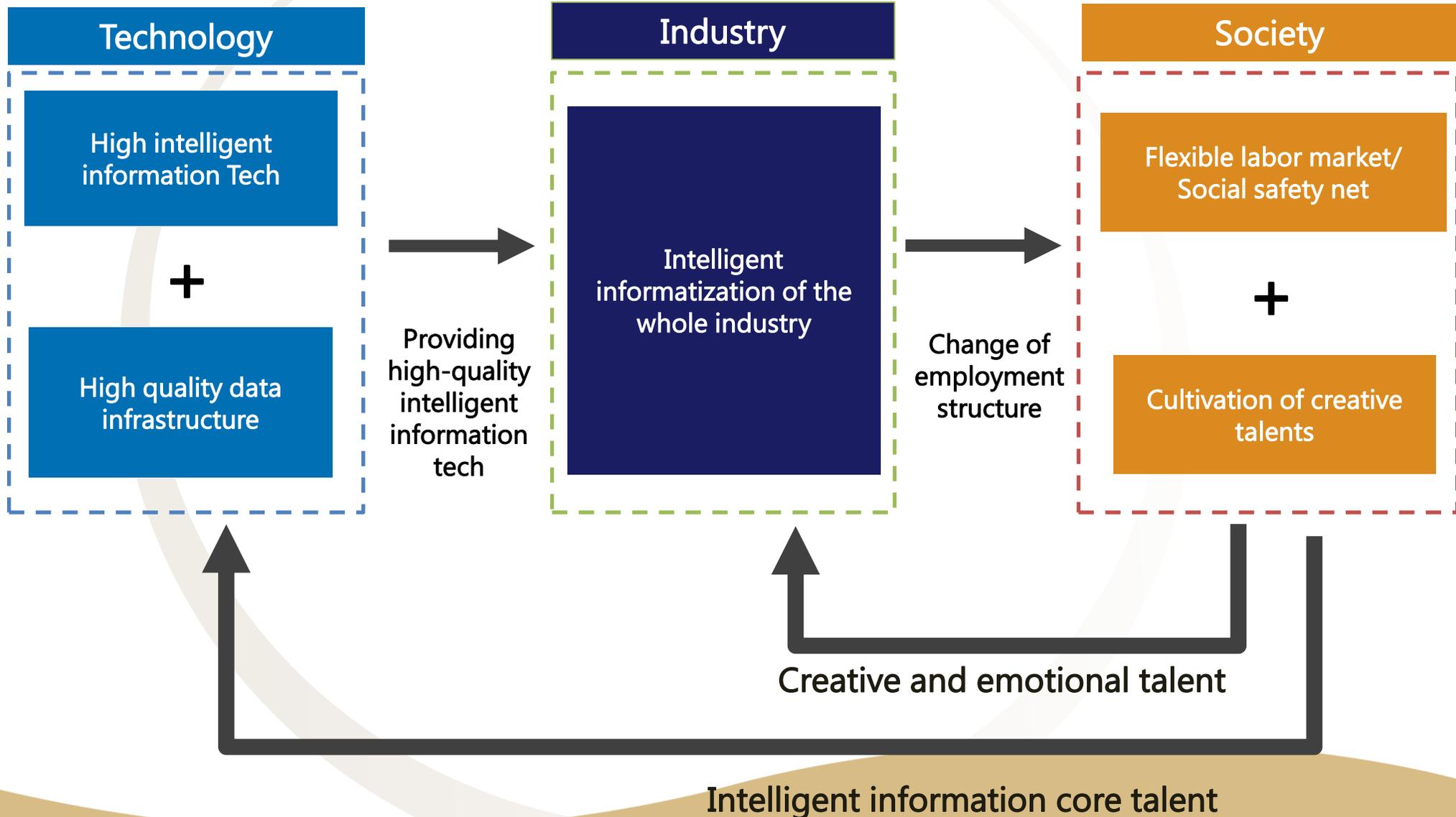
Globally more trips/journeys via car sharing than  
in private cars

The first city with more than 50,000 people and  
no traffic lights

# Building the Blocks

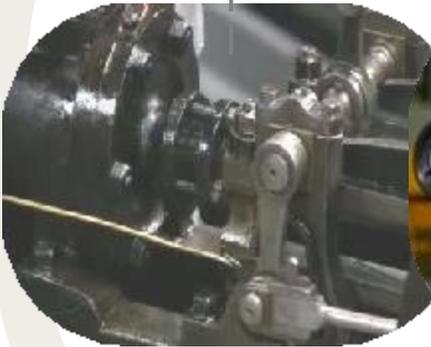


# Key Success Factors in IR4



# IR4 – An Example

1. Mechanic



3. Automatic



2. Electric



4. Autonomous - CPS



# IR4 – Another Example



**PEOPLE**  
arrange, control, interlink...



**TRUCKS**  
deliver goods autonomously



**CONTAINER**  
organize their supply chain  
and global networks



CLOUD



**SHELFS**  
organize their replenishment



**BINS**  
display what to pick



**AGVs and TRUCKS**  
interact like a swarm

# AI Impact



**Economic, cultural, social,  
... endless disruption**

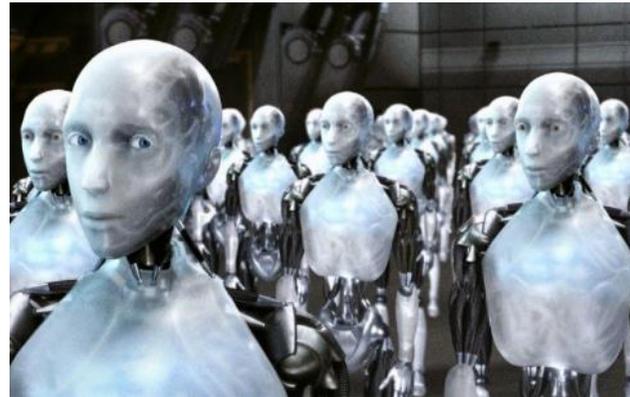
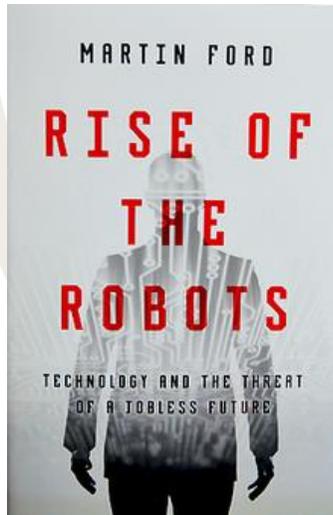


**Labour - McKinsey 58%  
of jobs automated**

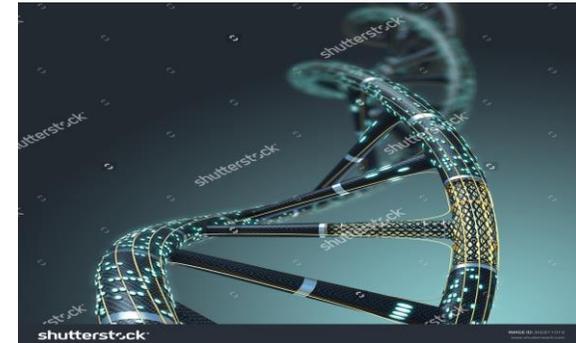


**Michael I. Jordan, AI...  
the revolution hasn't  
happened yet**

**Martin  
Ford,  
Rise of  
the  
Robots**



**Elon Musk, AI...  
existential threat**



**Stephen Hawking, AI...  
to end mankind**

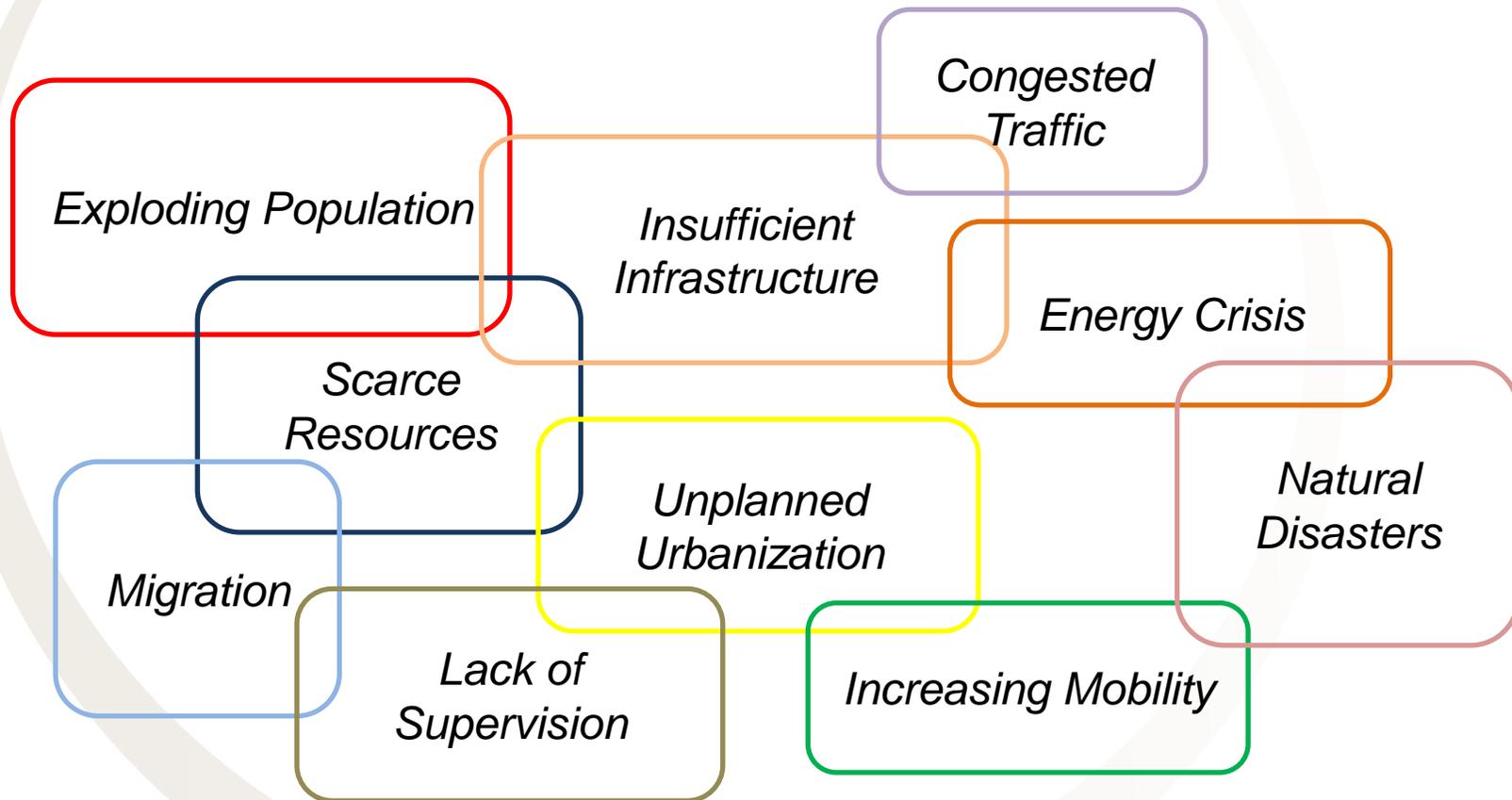
# Kissing a lot of frogs to find a gorgeous princess...



- **“The worldwide demand for vehicles will not exceed a million – if only because of a lack of chauffeurs.”**  
[Gottlieb Daimler, 1901]
- **“I think there is a world market for maybe five computers.”**  
[Thomas Watson, CEO IBM, 1943]
- **“There is no reason anyone would want a computer in their home...”**  
[Ken Olson, President of DEC, 1977]
- **“640K ought to be enough for anybody”**  
[Bill Gates 1981]
- **“People will never do without the experience to browse through a catalogue”**  
[Mail order company to the chances of e-commerce, 2000]

# Urbanization

More manageable and innovative cities needed considering issues of urbanization



# Application of Big Data Analytics



**Smart Cities** aren't some far-off dream of the future

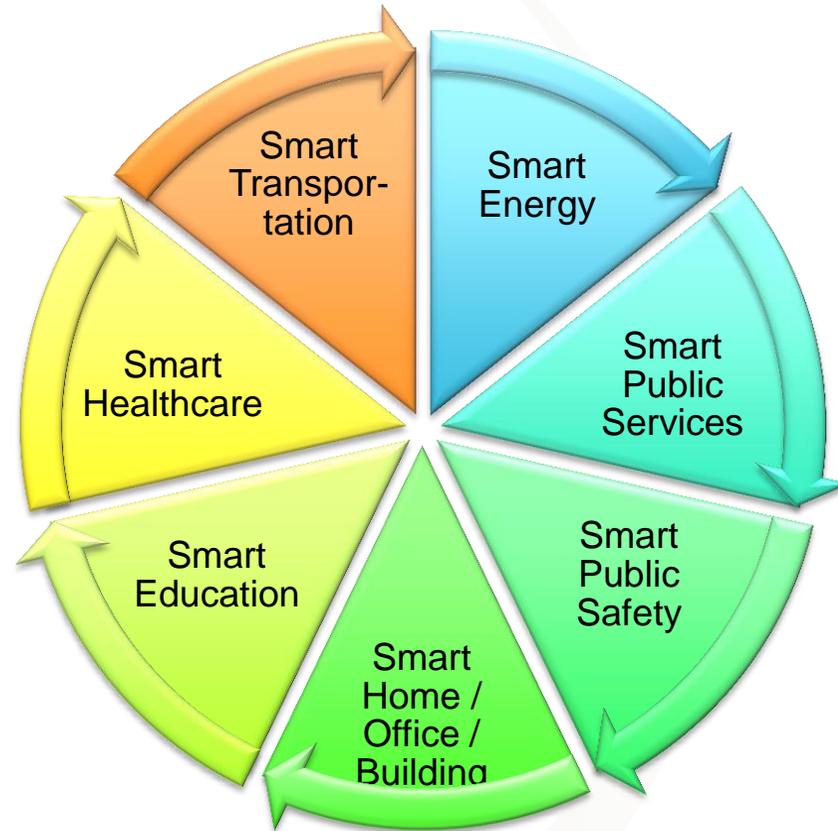
Interconnection of cities – **Internet of Things**

**Intelligent Systems** the root of Big Data; enable acquiring this data securely & performing analytics and filtering (real-time systems?)

Introduction	Healthcare	Education
Traffic	Airports	Rail
Energy & Utilities	Social Services	Public Safety
Retail	Communications	Economic Development

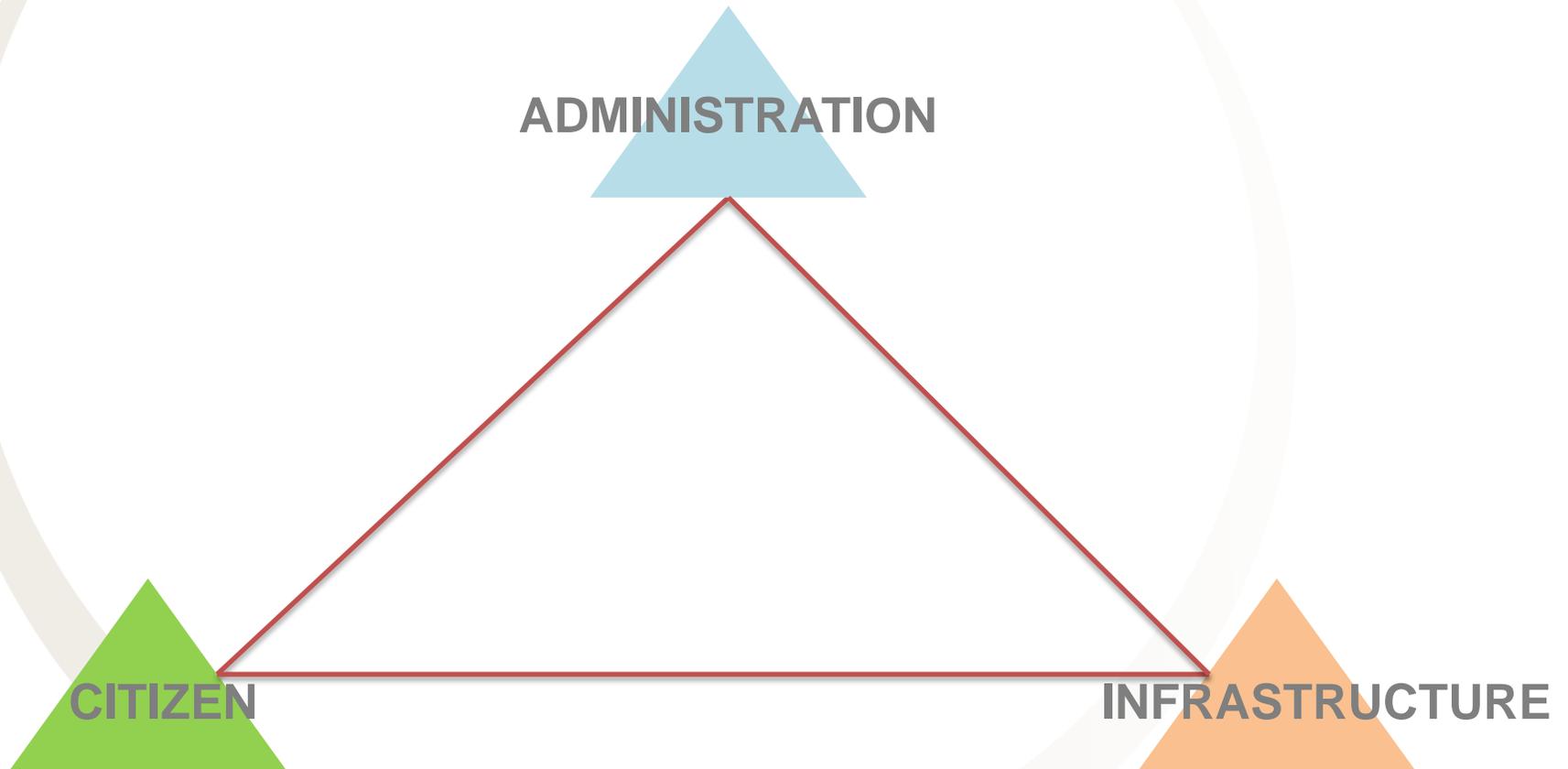
# Smart Cities

**Smart city – the  
harmony and  
transformation itself  
– touches and  
transforms our  
cities from end to  
end**



# Transformation of Cities

Transformation possible by harmonic integration of << ADMINISTRATION >>, << CITIZEN >>, and << INFRASTRUCTURE >>



# Smart Cities: Unique Features

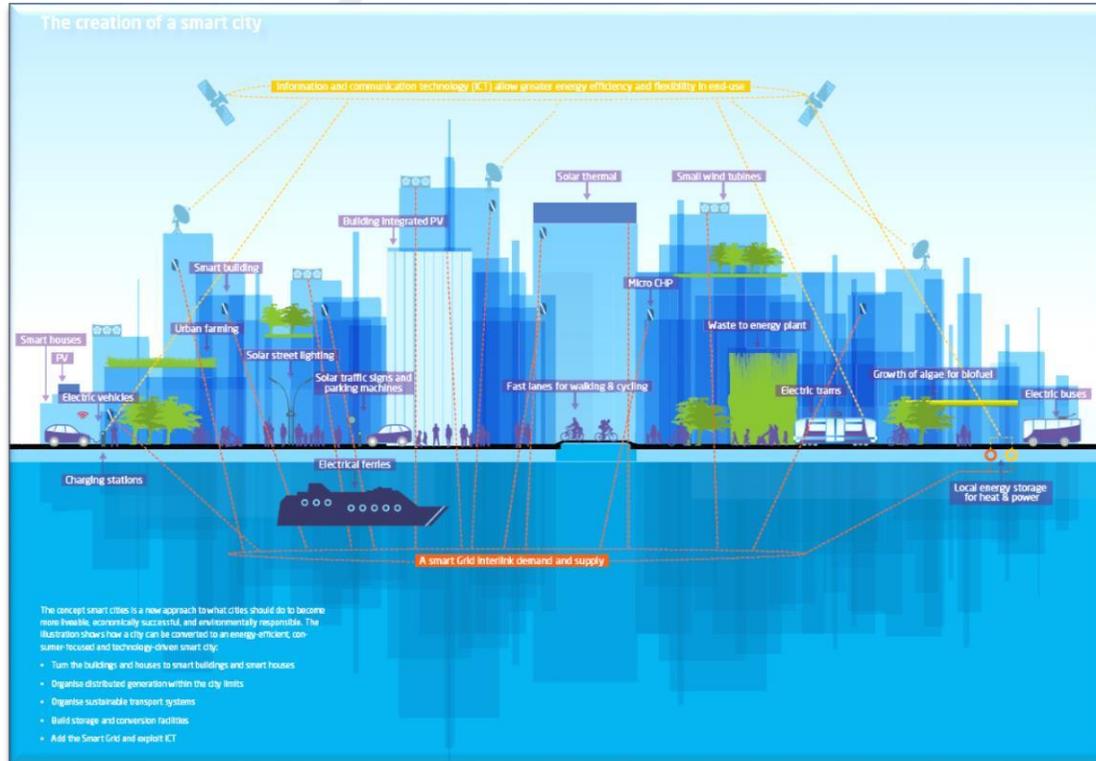


- **HOLISTIC**
- **TECHNOLOGY**
- **INFORMATICS**
- **TELECOMS**
- **MULTIDISCIPL.**
- **CITIZENS**
- **MANAGERS**



# Many Views: Potential Targets

THINK BIG



THINK SMALL

# Many Views: Applications and Infrastructure



## FOCUS ON SERVICES

### SENSORS AND CITIES

**SMARTER OPERATIONS:**  
Sensors can measure, track and locate a wide variety of factors in the urban environment. Data from sensors can be analyzed and used to run systems more efficiently and effectively, improving services for citizens while reducing the cost of government operations.

**BIG BUSINESS:**  
By 2020, cities are expected to spend \$20 billion on sensor technology.

**SENSOR-BASED APPLICATIONS INCLUDE:**

- traffic congestion
- transit
- parking
- environmental monitoring
- waste collection
- water systems
- crime and public safety

**CITIES WITH SENSOR-BASED SOLUTIONS:**

Chicago  
Montreal  
Rio de Janeiro, Brazil  
Santander, Spain  
Singapore

**ECONOMIC POWER:**  
The 100 biggest metro areas in the U.S. produce 75% of the nation's GDP.

**POPULATION CENTERS:**  
By 2030, six out of 10 people in the world will live in cities; the number will reach seven out of 10 by 2050.

**SHRINKING WORKFORCE:**  
U.S. cities have cut more than 500,000 jobs from their payrolls. City revenue declined every year between 2006 and 2012.

# Many Views: IT & Intelligence



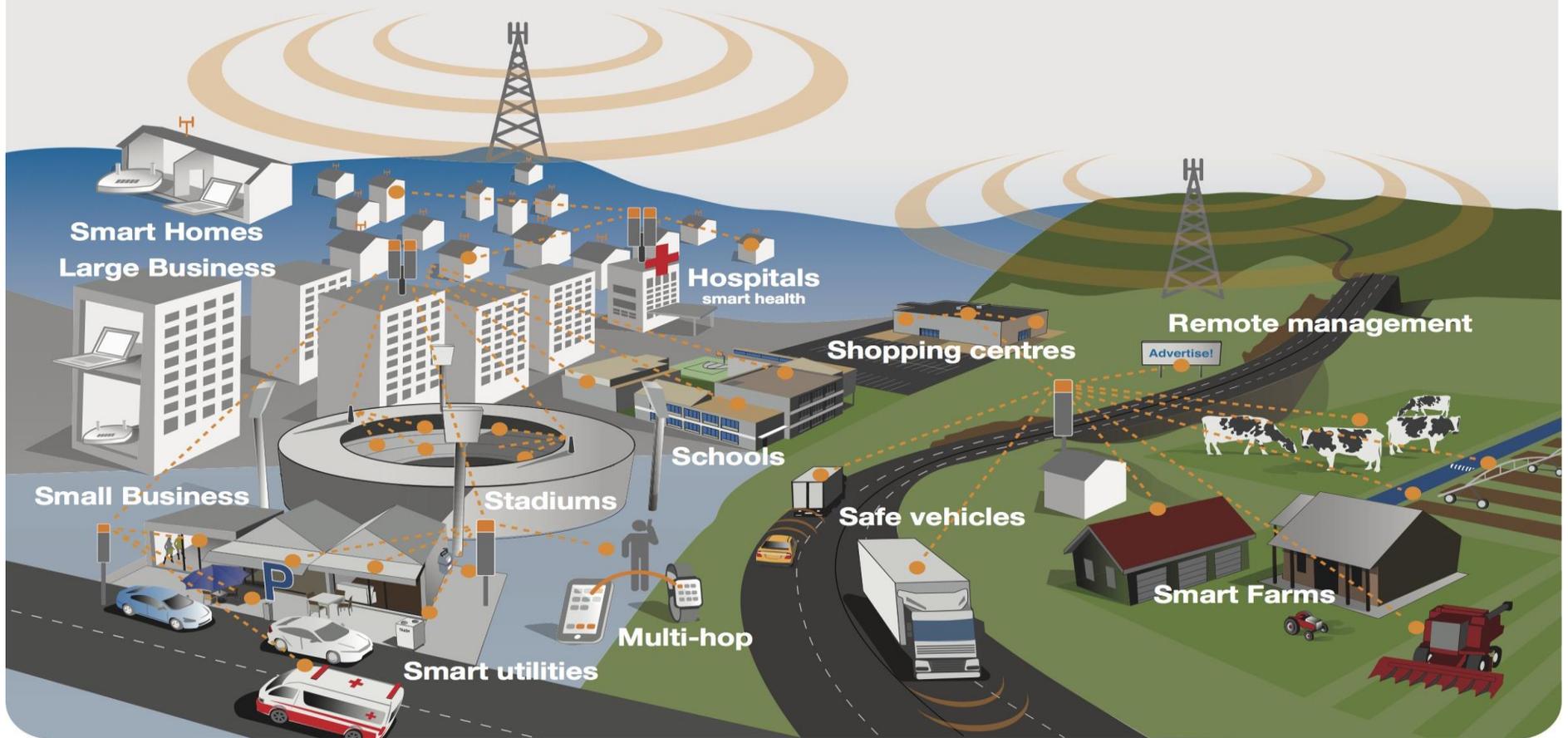
# Combination of Technology

Smart city concept is founded on a set of solutions which are combination of today's stand-alone technologies



# Key Enabler – 5G

## THE CONNECTED COMMUNITY



5G wireless network: 280 times faster than LTE and 70 times faster than 4G.

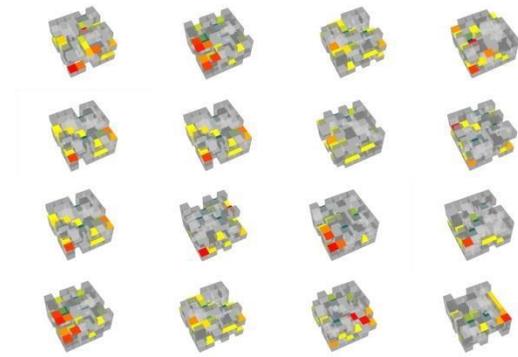
# Smart Cities: Challenges



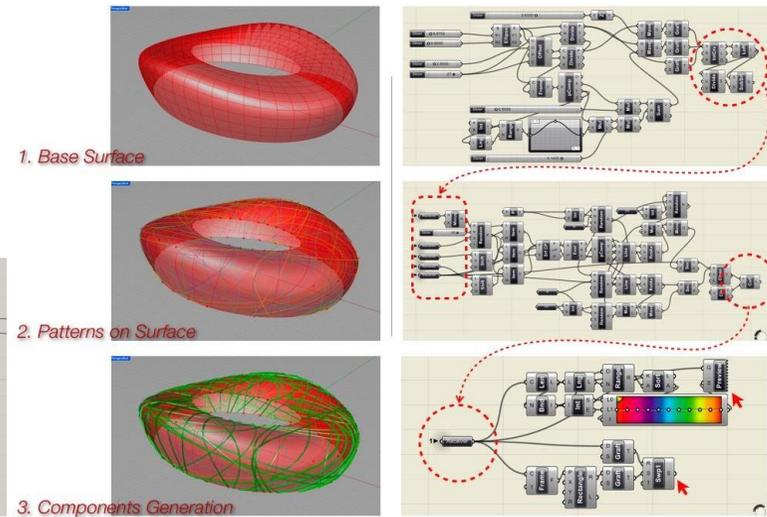
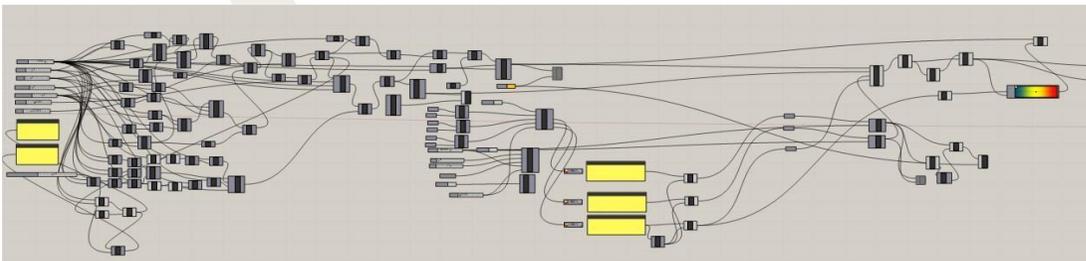
- Large scale, every is really big
- Time consuming and real time
- Dynamic, everything changes in time
- Uncertainty in all tasks and phases
- Complex relations, interdependences
- Several goals at the same time
- Human preferences and interfaces
- Lots of restrictions (legal, technical...)
- Mobile plus desktop applications



# Smart Building Construction



- Safer, sustainable, modern design principles
- Complex simulations needed
- Optimization and machine learning needed

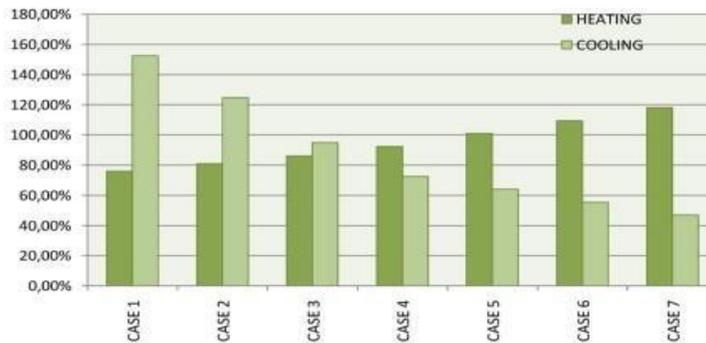


# Smart Building Construction: Techniques & Technologies

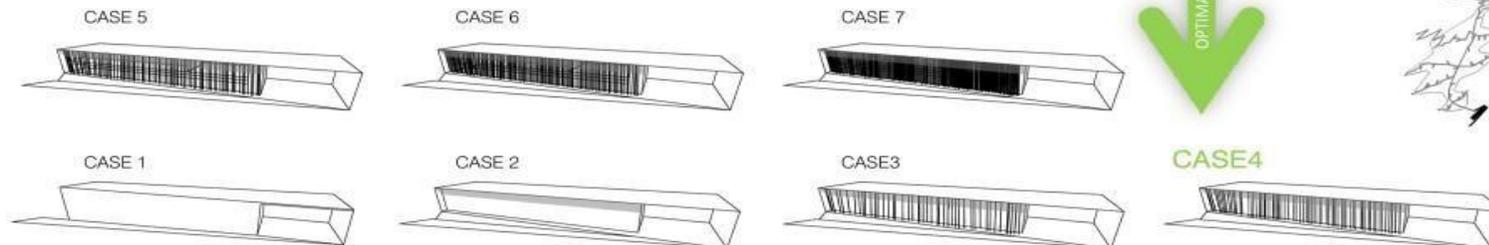
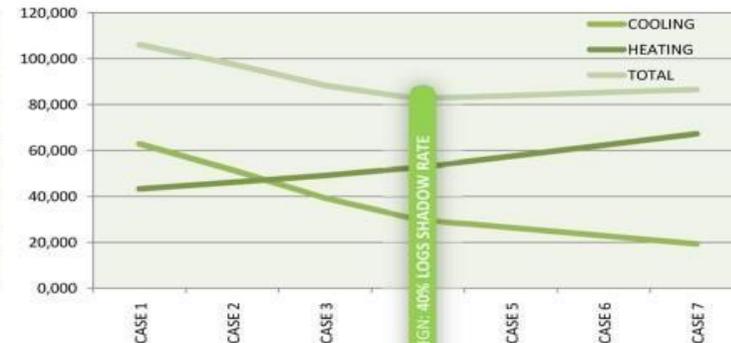
ENERGY DEMAND ANALYSIS (kWh/sqm)

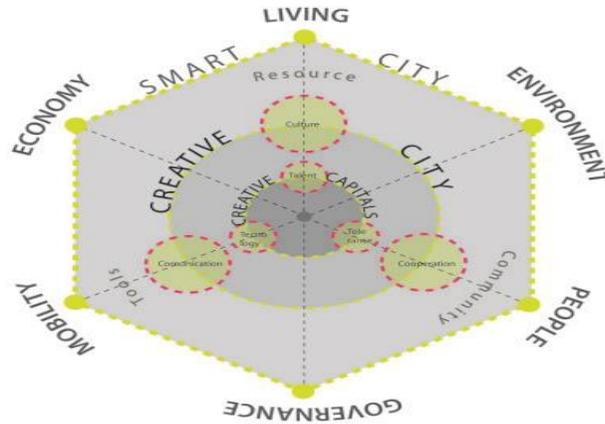
	PROJECT			REFERENCE			%			LIMIT
	HEATING	COOLING	TOTAL	HEATING	COOLING	TOTAL	HEATING	COOLING	TOTAL	
<b>CASE 1</b>	NO SHADOWS	43,290	62,920	106,210	57,006	41,282	98,288	75,94%	152,42%	100,00%
<b>CASE 2</b>	NO LOGS JUST PROJECTINGS	46,129	51,458	97,587	57,006	41,282	98,288	80,92%	124,65%	100,00%
<b>CASE 3</b>	25% LOGS SHADOW RATE	49,110	39,164	88,274	57,006	41,282	98,288	86,15%	94,87%	100,00%
<b>CASE 4</b>	40% LOGS SHADOW RATE	52,634	29,917	82,551	57,006	41,282	98,288	92,33%	72,47%	100,00%
<b>CASE 5</b>	50% LOGS SHADOW RATE	57,493	26,406	83,899	57,006	41,282	98,288	100,85%	63,97%	100,00%
<b>CASE 6</b>	75% LOGS SHADOW RATE	62,352	22,896	85,248	57,006	41,282	98,288	109,38%	55,46%	100,00%
<b>CASE 7</b>	100% LOGS SHADOW RATE	67,211	19,385	86,596	57,006	41,282	98,288	117,90%	46,96%	100,00%

% PROJECT VS REFERENCE BUILDING



ENERGY DEMAND Wh/(sqm-year)

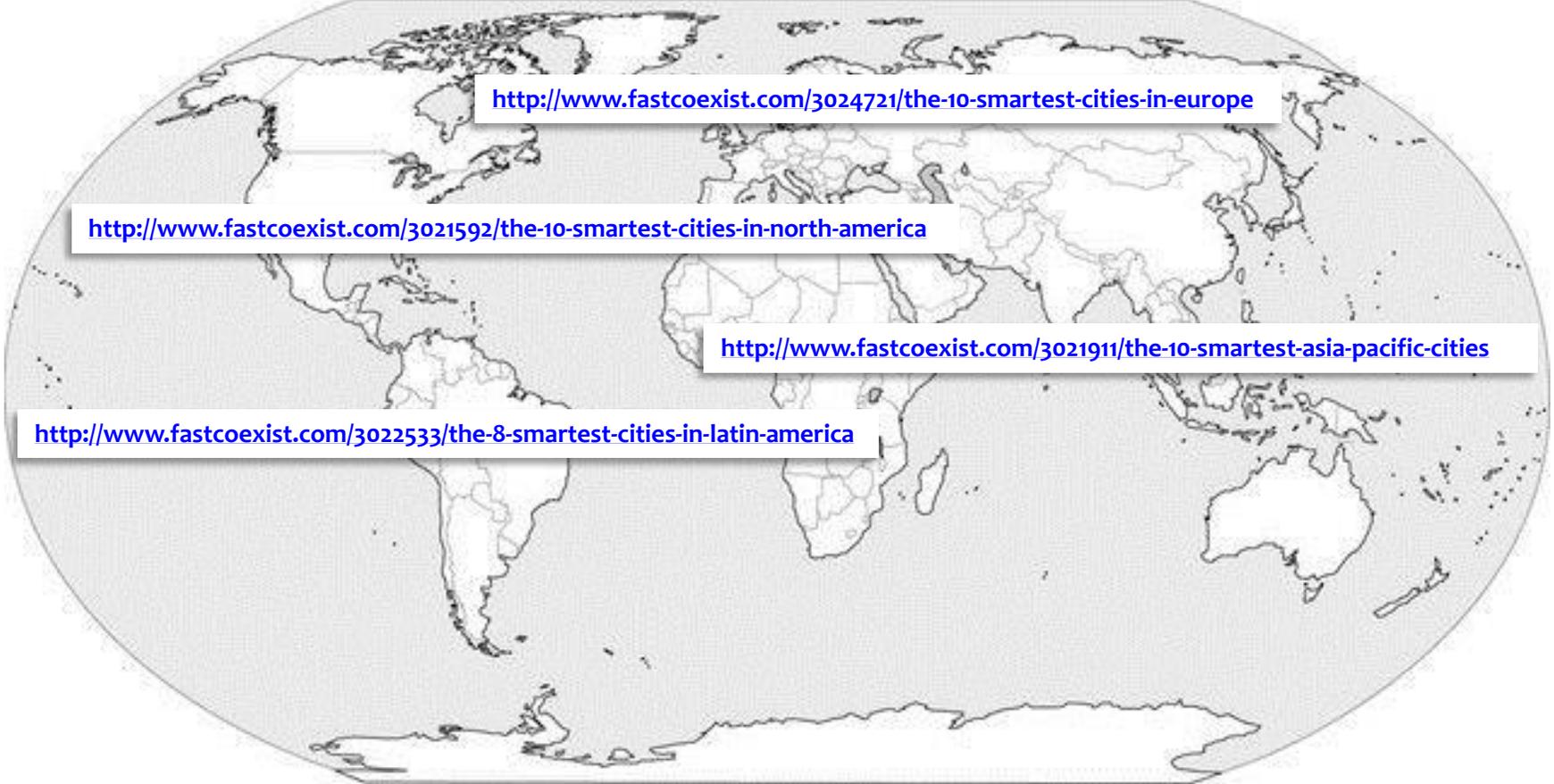




# THE CASE OF AFRICA



# Ranking of Smart Cities



<http://www.fastcoexist.com/3024721/the-10-smartest-cities-in-europe>

<http://www.fastcoexist.com/3021592/the-10-smartest-cities-in-north-america>

<http://www.fastcoexist.com/3021911/the-10-smartest-asia-pacific-cities>

<http://www.fastcoexist.com/3022533/the-8-smartest-cities-in-latin-america>

<http://eponline.com/articles/2015/02/18/the-top-5-global-smart-cities-of-2015.aspx>

# Background (African Cities)

City	Population (million)
Lagos, Nigeria	21.0
Cairo, Egypt	20.4
Kinshasa, DR Congo	13.3
Luanda, Angola	6.5
Nairobi, Kenya	6.5
Mogadishu, Somalia	6.0
Abidjan, Ivory Coast	4.7
Alexandra, Egypt	4.7
Addis Ababa, Ethiopia	4.6
Johannesburg, South Africa	4.4
Dar es Salaam, Tanzania	4.4
Casablanca, Morocco	4.3
Accra, Ghana	4.1
Durban, South Africa	3.4
Kano, Nigeria	2.8



The **World Atlas** lists the **populations of 150 largest cities** in the world. Out of these, **15 are located in sub-Saharan Africa** (figures in million people):

It's not difficult to figure out the **main challenges** African cities face. If you have lived there, you can name them in a few seconds:

- **Inadequate physical infrastructures**
- **Too widespread populations**
- **Unemployment**
- **Slums**
- **Poor quality social services**
- **Vulnerability to disasters and climate change...**



**WAY FORWARD**

# Way Forward

- African corporations and government institutions cannot afford to miss the lucrative opportunity in Big Data.
- For companies with significant Big Data infrastructure and resources, **their values are rising at exponential rates.**
- For progress in Big Data to be realised, **the skills gap in Africa may need to be filled.** Leading economies struggle to fill the skills gap for Big Data professionals. Such a gap in Africa may prove to be even harder to fill, with significantly fewer students opting for education tailored for Big Data.

- **Culture that supports** Big Data must be adopted. This is a very difficult task.
  - Organisations in African nations must create a culture that respects the collation and utilisation of data on computer systems.
- **New innovative methods of data collection** and analysis in the rapidly growing telecommunications industry may be one of the first necessary steps needed to make a transition into major Big Data in Africa.
- **Cell phone metadata and geospatial images** are two types of Big Data currently being developed and are likely holding the most promise for Africa.

- An **efficient distribution of resources** by African governments may be needed to ensure that Big Data has its place in Africa's economies. With over half of the predicted \$3TRN available to be earned through Big Data in countries outside Europe and the United States, the race for supremacy will only become more intense.
- Are Math skills enough to be a Data Scientist?
  - Wide panoply of skills: **statistical theory, programming, the ability to build data models and ability to work with systems that can process large amounts of data.**
  - **Communication skills** to give talks with clients to help them understand the needs at the beginning of a project and present results at the end.

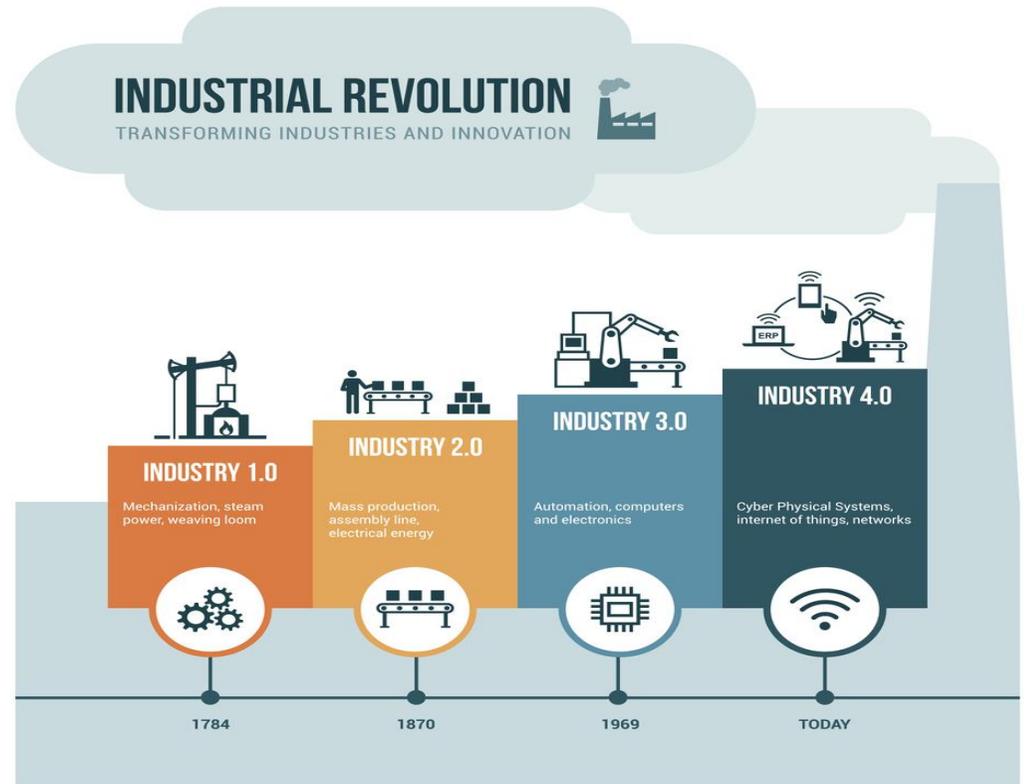


# Where are we headed?

## 4IR



**Physical**  
+  
**Digital**  
+  
**Biological**



# Risks of Big Data

- **We will be so overwhelmed**
  - Need the right people and solve the right problems
- **Costs escalate too fast**
  - Isn't necessary to capture 100%
- **Many sources of Big Data is privacy**
  - Self-regulation
  - Legal regulation

# Potential for Big Data in Africa

**Is Big Data key in unlocking Africa's development prospects?**

- Africa trails Asia, Europe and US in terms of technology but **the gap is closing**
  - Our economic woes have inspired us to harness certain technologies with more zeal and in more innovative ways
- Key countries in the Big Data markets are, among others, Kenya, Nigeria, **South Africa**, Uganda, and Zimbabwe
  - Kenya developed an SMS based system to alert government on new infections and response in Sierra Leone (peak of Ebola epidemic)

- Data analytics (often coupled with the term “predictive modelling”) rapidly growing discipline of using data gathered in the past to predict what will happen in the future
  - Some **hedge funds** have taken the lead, analysing tweets as signals for investment in the stock market which they sell to traders
  - Development of indices across over 100 countries which can be used to monitor minute-by-minute the **emotional state** of a nation

# Changes of Educational Environment in 4IR

**Shock of low birth rate and aging**

**Changes in the industry / occupational structure**

**Coexistence of AI and human**

**Deep polarization**

**Large transformation of knowledge ecosystem**

**Ability-driven society**



# The 4IR: How can Schools respond to the Rise of Robots?

- Up to **800 million global workers** will be replaced by robots and AI by 2030  
A **rethink of education** is needed to keep humans employed
  - Should colleges be concerned about the robotic takeover?
- It seems that everywhere you look these days there are articles about **Big Data Analytics** and **AI**.
- How can **we best prepare our learners for the new careers** that are being ushered in by these technologies? How do colleges **need to change**, and should we be concerned?
- Industry **should sponsor a major programme** of students to pursue courses in AI, with an initial cohort of, say, 300 students”.
- Creating an additional 200 places **dedicated to AI at leading colleges**
- Availability of funding to test the use of AI and innovative education technology in **online courses**.

# How can Schools adapt?

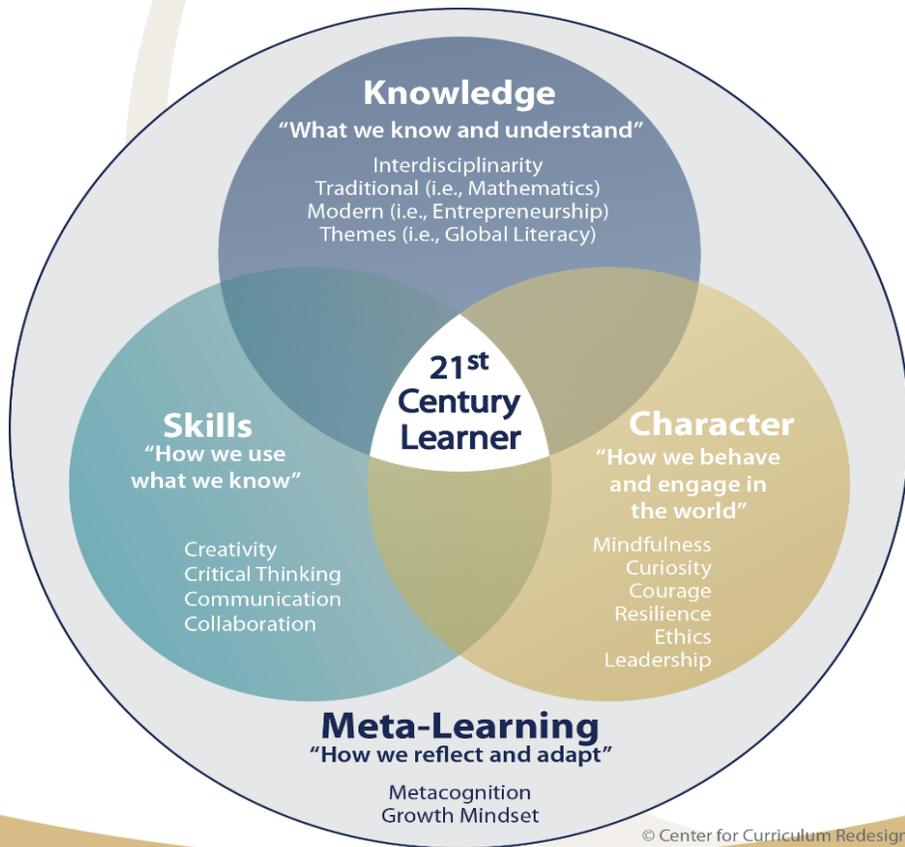
- They need to open not only as an institution to the outside, but also inside (**flipping the curriculum**).
- As the world of the 21st century bears little resemblance to that of the 19th century, education curricula need to be deeply redesigned for the four dimensions of **Knowledge, Skills, Character** and **Meta-Learning**. Adapting to 21st century needs means revisiting each dimension and the interplay between them.
  - **Math** cannot be taught as an isolated subject;
  - **Physics** cannot be restricted to a school lab;
  - **ICT** cannot be confined inside to a tech lab;
  - **History** and **Geography** cannot keep on depending only on a “chalkboard”; and
  - even **new subjects** need to be added to the curriculum.

The 4IR is ushered in by advancements in robotics, virtual reality, cloud technology, big data, artificial intelligence, the internet of things and other technologies; it is characterised by the fusion of technologies and the blurring of the lines between the physical, digital and biological aspects of life.

- Students need to understand how they can **correlate** and **use** and **apply** different knowledge in diversified contexts , what they really mean and how they can create synergies among different subjects to develop/create “*something*” that connects to the real world.
- Students need to work in a **framework of projects** and from there they need to collaborate with their colleagues, with their teachers and with the outside world.
- They need to **develop new ways of communicating**, they need to be put in front of complex situations to develop critical thinking and complex problem solving and to learn how to be imaginative, creative, adaptable, flexible and to develop brain plasticity.

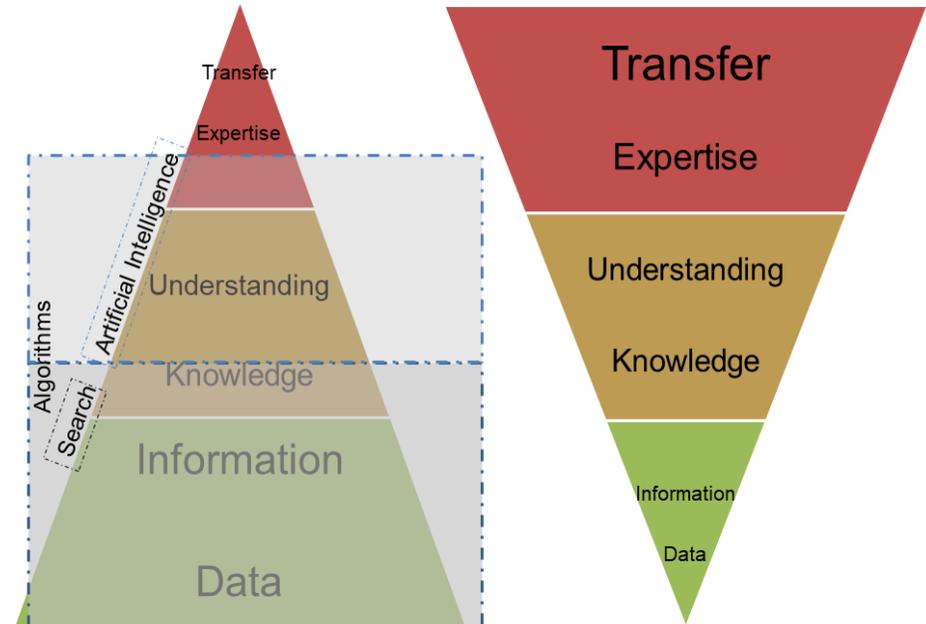
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- Within a framework based on the development of “multi cross-subjects” projects, **STEM** can play a very important role by acting as an anchor to the development of projects that can embrace all types of subjects.



### Flipping the Curriculum

© Center for Curriculum Redesign



# A Challenge for Teachers

- Teachers are having to **rethink their teaching methods**.
  - With new technologies deployed in classrooms – tools which students are familiar with outside the classroom (e.g. flipped classroom)
- Taking advantage of students' expertise in **online communication**.
  - to create new ways of channeling their knowledge or train their peers or teachers in **collaborative working**
  - giving them greater **scope for creativity**, promoting more exchange between students and changing the role of the teacher to that of a learning catalyst for students, (i.e. integrating digital technology successfully in the classroom).\

- The need to focus on **ICT** and **future technologies**, **teacher education** and lifelong learning for an **adaptable** and **flexible education system**.
- Such a system should be **outcomes-based** and ensure continuous improvement in the teaching and learning environment and in teaching and learning practices.
- Future education systems should strongly focus on **outcomes-based curricula and programmes** and facilitate flexible awarding of educational qualifications based on outcomes-based units.
- Making **IR more human through personal history** gives ideas on how to get beyond images of vast machines and disease-ridden slums and back to the individual human beings children can relate to.

# Preparing your students for the 4IR

- Follow a “learning-by-making” approach to STEM education – **constructionism**
- Successful teachers today have set aside any uncertainty about working with technology and have transformed their classrooms into **experiential, hands-on learning environments**.
- A hands-on learning approach helps students **build the skills they need to be career-ready**, developing abilities such as **problem-solving, teamwork, creativity** and **critical-thinking**.
  - **Example:** A student who is building a robot or constructing a music synthesizer or any compelling project. Through the hands-on development process of that robot or synthesizer the **student is learning wider science skills** that can be applied to the real world.
- Teachers embracing **learning-by-making** is vital to future success in the global economy.

# How about Parents?

- Most parents aren't as well-versed in ICT as their offspring, but by **familiarising themselves with the online tools and content** provided by the school, parents can discover a whole new way of communicating with their children.
- Parents will be more regularly informed on **what's going on at school**: not only the activities and events, but what homework their kids have, and what their grades are.
- Instead of the traditional report card, parents will have the opportunity to **play a more active role** in their children's education.

# Challenges

**... Not all organizations & industry sectors are at the same stage of understanding as what this means to their business**

**... Level of disruptions, the risk & opportunities differs for each business & sectors**

**... Affecting services, products or business model**

# AI & SDGs



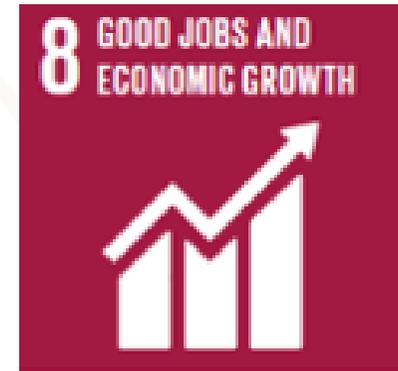
**Tracking poverty  
(SDG1)**



**Diagnosis  
(SDG3)**



**Causal influences  
development programs  
education (SDG4)**



**Micro-finance  
(SDG8)**



**Greenhouse emissions  
and smart cities (SDG11&13)**



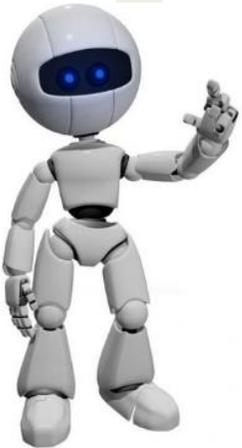
**Global partnerships (SDG17)**

# Food for Thought

Is AI creating a digital quake where > 80 percent of companies and jobs will need to change or fail?

What are the implications to society, economic development, and path to prosperity?

AI technical standards achieve SDGs?



# Top 10 Skills to be relevant in IR4

## in 2020

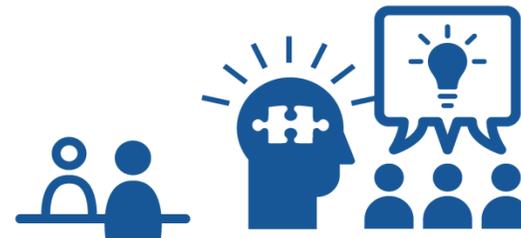
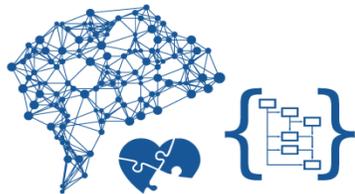
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1. Complex Problem Solving
2. Critical Thinking
3. Creativity
4. People Management
5. Coordinating with Others
6. Emotional Intelligence
7. Judgment and Decision Making
8. Service Orientation
9. Negotiation
10. Cognitive Flexibility

## in 2015

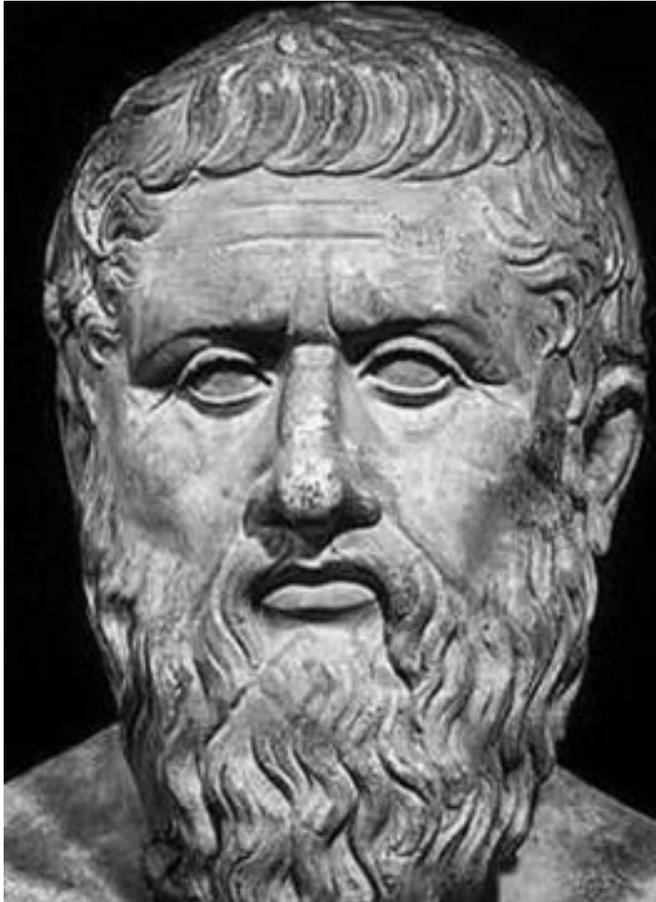
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1. Complex Problem Solving
2. Coordinating with Others
3. People Management
4. Critical Thinking
5. Negotiation
6. Quality Control
7. Service Orientation
8. Judgment and Decision Making
9. Active Listening
10. Creativity



Source: Future of Jobs Report, World Economic Forum

# Quote



Knowledge which is acquired under  
compulsion obtains no hold on the  
mind.

— *Plato* —

**Darwikianism**

**Thank you**

Define tomorrow.

UNISA

