

Pengaruh Revolusi Industri 4.0 Terhadap Penerapan Teknologi Informasi



Dr. Darmawan Napitupulu, ST, M.Kom

PROFILE



Nama : Darmawan Baginda Napitupulu

Affiliation : 1. Researcher di Lembaga Ilmu Pengetahuan Indonesia (LIPI)

2. Lecture M.Kom Universitas Budi Luhur

3. Ketua IDRI Provinsi DKI Jakarta

4. Vice President Ko2pi (Komunitas Kolaborasi Publ

Indonesia)

Last Education: Doktor (S3) Ilmu Komputer - Universitas Indonesia

Contact : 081314060258

Sinta Profile

7. Kategori Lembaga/Pelaku Non Perguruan Tinggi Untuk Lembaga/Pelaku Non Perguruan Tinggi dengan nilai Sinta Score 2016-2018 tertinggi

 Lembaga Ilmu Pengetahuan Indonesia Sinta Score 2016-2018: 729 Sinta Score Keseluruhan: 2477	1
 Badan Tenaga Nukir Nasional Sinta Score 2016-2018: 160 Sinta Score Keseluruhan: 1985	2
 Badan Pengkajian dan Penerapan Teknologi Sinta Score 2016-2018: 66 Sinta Score Keseluruhan: 1710	3
 Lembaga Penerbangan dan Antariksa Nasional Sinta Score 2016-2018: 32 Sinta Score Keseluruhan: 310	4
 Badan Penelitian dan Pengembangan Kementerian Kesehatan Sinta Score 2016-2018: 2 Sinta Score Keseluruhan: 75	5

**Peringkat Pertama Sinta Awards 2018 :
Produktivitas Publikasi Tertinggi Institusi Lembaga Penelitian Non Perguruan Tinggi**



Top Authors Lembaga Ilmu Pengetahuan Indonesia :

No	Nama Penulis	Jumlah Publikasi	Scopus	Scimago
1	YOHANIS GUSTIANTO	46,07	30,38	
2	WIDODO HERMANTO	32,82	21,27	
3	WIDODO HERMANTO	32,82	21,27	
4	YOHANIS GUSTIANTO	46,07	30,38	
5	YOHANIS GUSTIANTO	46,07	30,38	
6	YOHANIS GUSTIANTO	46,07	30,38	
7	YOHANIS GUSTIANTO	46,07	30,38	
8	YOHANIS GUSTIANTO	46,07	30,38	
9	YOHANIS GUSTIANTO	46,07	30,38	
10	YOHANIS GUSTIANTO	46,07	30,38	

Reviewer, Editor & Mentor

- **International Journal on Advanced Science, Engineering and Information Technology (IJASEIT) 2017- Now (Scopus)**
- **International Journal of Artificial Intelligence Research (IJAIR) 2017- Now (DOAJ)**
- **Nommensen International Conference on Technology and Engineering (NICTE) 2018 (Scopus)**
- **International Conference on Life, Innovation, Change and Knowledge (I-CLICK) 2018 (Scopus & Thomson)**
- **International Conference on Advance & Scientific Innovation (ICASI) 2018 (Scopus)**
- **International Conference on Computing, Engineering & Design (ICCED) 2017 (IEEE Xplore)**
- **Workshop on Multidisciplinary and Its Applications (WMA) Scopus 2018 (Scopus)**

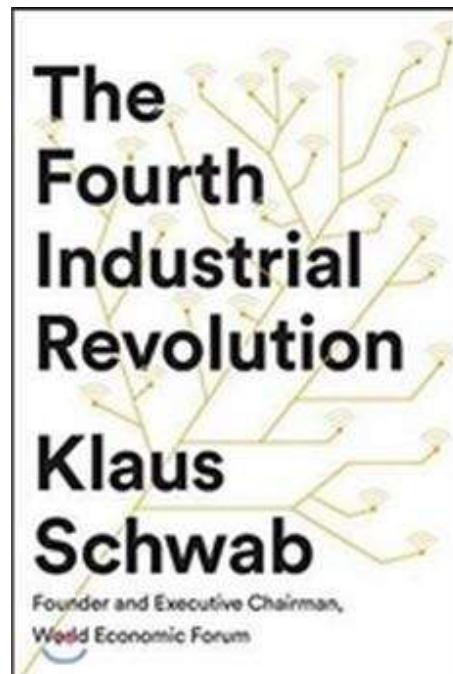
INDUSTRY 4.0

Konsep revolusi industri 4.0 pertama kali diperkenalkan oleh Profesor Klaus Schwab.

Ekonom terkenal asal Jerman itu menulis dalam bukunya, *The Fourth Industrial Revolution* bahwa konsep itu telah mengubah hidup dan kerja manusia.

Professor Klaus Schwab : Founder and Executive Chairman of the World Economic Forum

'What is the Fourth Industrial Revolution?', 'What will change what?', 'How will it affect us,' and 'How can we use it for public interest?'. The idea and strategy of those who have clearly recognized the era of the Fourth Industrial Revolution, such as intellectuals and businessmen who are in the forefront of each field and area, and who have started to worry and prepare for it



Book Review

Overall, *The Fourth Industrial Revolution* consists of three main parts: the history of the industrial revolution; what the revolution's drivers are; and its impacts towards society's lives. In the first part, Schwab explained the many phases of the industrial revolution up to the current one, which is the fourth industrial revolution. We started from the steam engine to what we have now. Basically, the third revolution is the phase at which computers were created. Previously, computers need a large room for storage, but it has now become smaller and could fit on our table and our lap. So, what is the fourth industrial revolution? That is when technology blurs the borders between our physical, biological, and digital lives.

In the second part, Schwab explains what caused the emergence of the fourth industrial revolution. He divided the reasons into three clusters: physical, biological, and digital. His arguments are based on the research of the World Economic Forum and other organizations. In the physical cluster, he mentioned four manifestations of the fourth industrial revolution: driverless vehicles, 3D printing, robotics, and new materials. In the biological cluster, technology has allowed us to create unprecedented innovations from genes editing to bioprinting—that we previously can only see in the movies. Lastly, in the digital cluster, the creation of the Internet of Things (IoT) technologies has assisted the emergence of this revolution. By using our smartphones and the Internet, all devices become connected and creates a new relationship called hyperconnectivity.

We cannot deny indeed that the presence and advancements of technology brings a new stage of our lives. But does it make our daily activities easier? Absolutely. However, these manifestations do bring another kind of impact into our lives. The author describes the impact of the fourth industrial revolution in detail in the third chapter of his book. The discussion starts with the economic sector, and move on to the business, government, social, and the specific impacts on individuals. It is not a new issue that robotics brings vulnerability to the workforce. However, robots will not replace humans. Schwab mentions that the fourth industrial revolution will provide an opportunity for human labor to improve cognition and affection so that humans and robots can work together. Furthermore, it is essential for us to create labor empowerment amid the existing disruption.

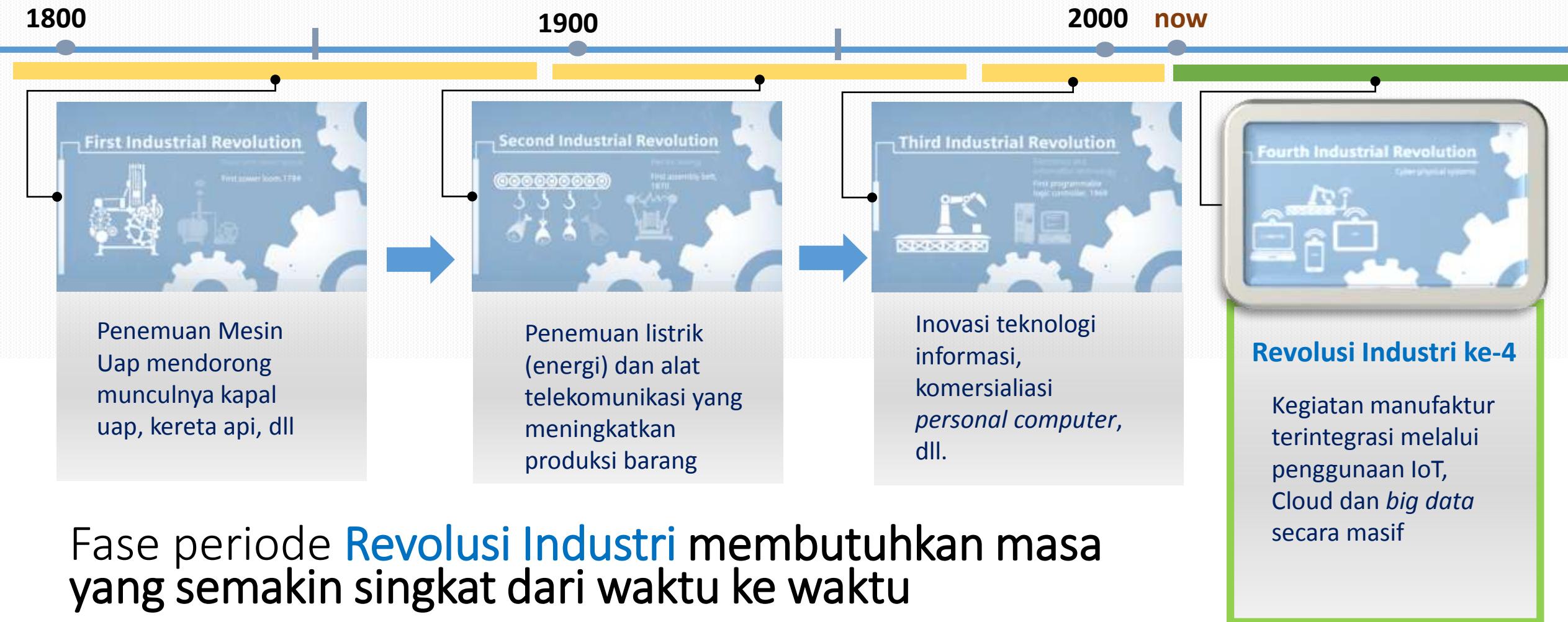
DEFINITION INDUSTRY 4.0

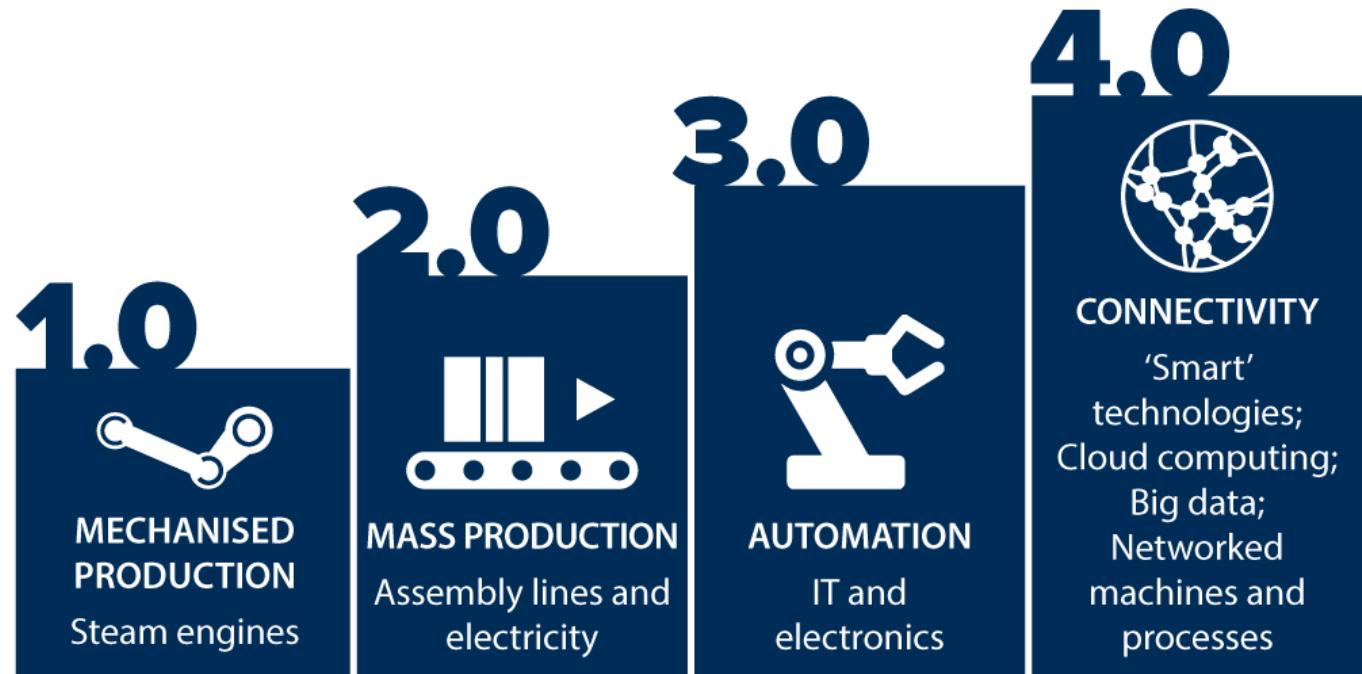
An approach to control production process by providing real time synchronization of flows and by enabling unitary & customize production (Kohler & Weiz, 2016)

A general concept enabling manufacturing with elements of tactical intelligence using advanced IOT, cloud & big data technology (Trappey et al., 2016)

Internet & supporting technologies serve as backbone to integrate physical objects, human actors, intelligent machines, product lines and processes to form a new kind of intelligent, networked and agile value chain (Schumacher, Erol & Sihn, 2016)

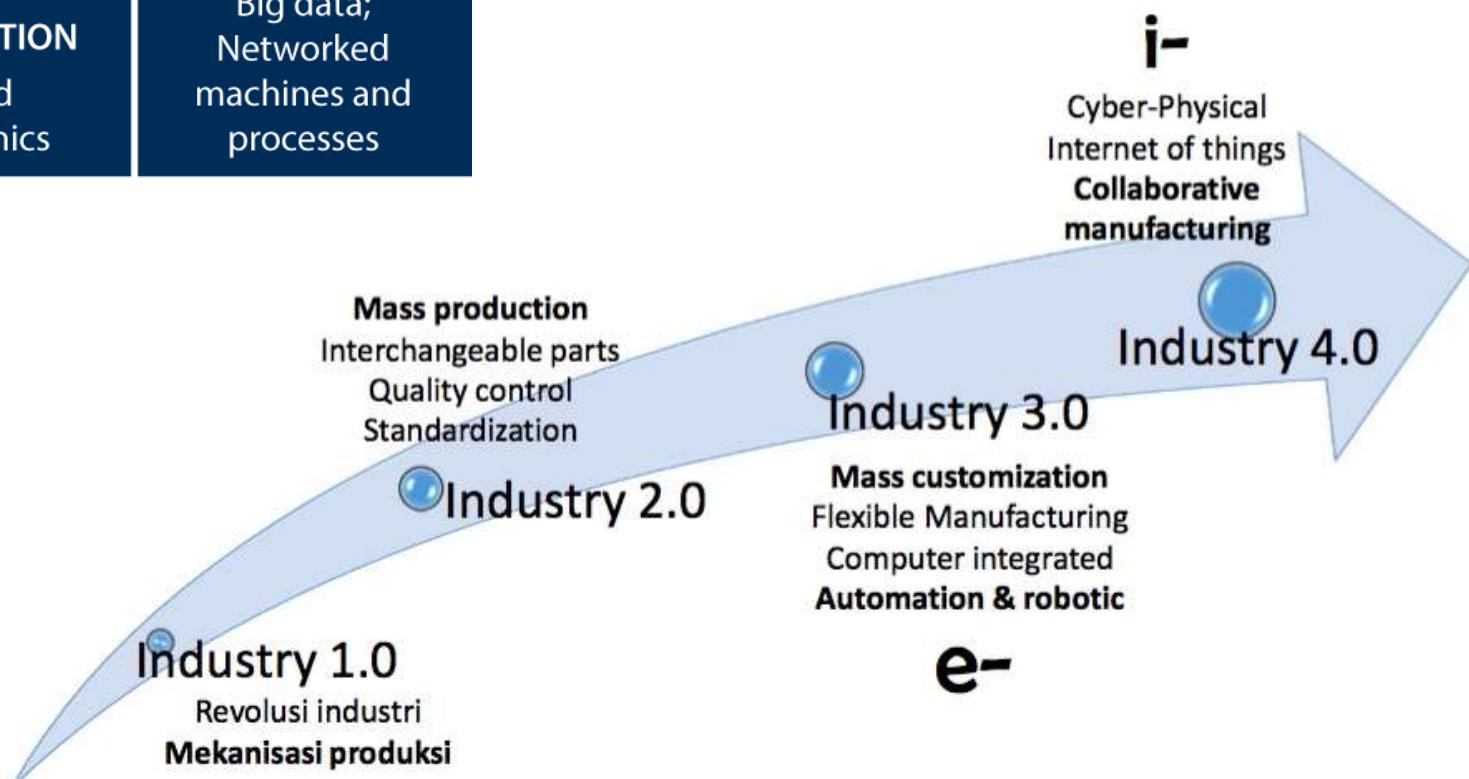
Tahap-Tahap Revolusi Industri





The stages of industrial development

Source: Oxford Analytica



What ever the revolution is:

- The main objectives of an industry:

Shorten time
to market



Increase
flexibility



Boost
efficiency

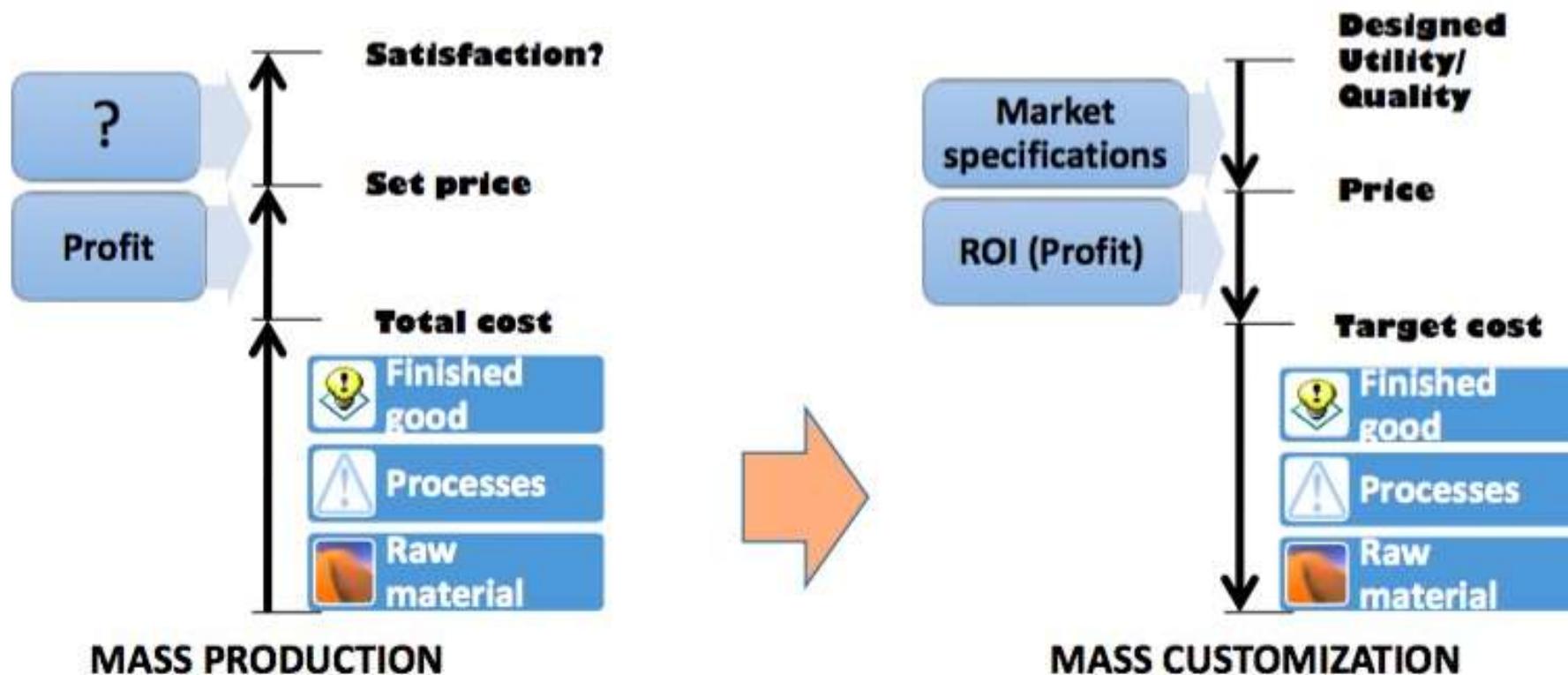


- Shorter innovation cycles
- More complex products
- Greater data volumes

- Individualized mass production
- Volatile markets
- High productivity

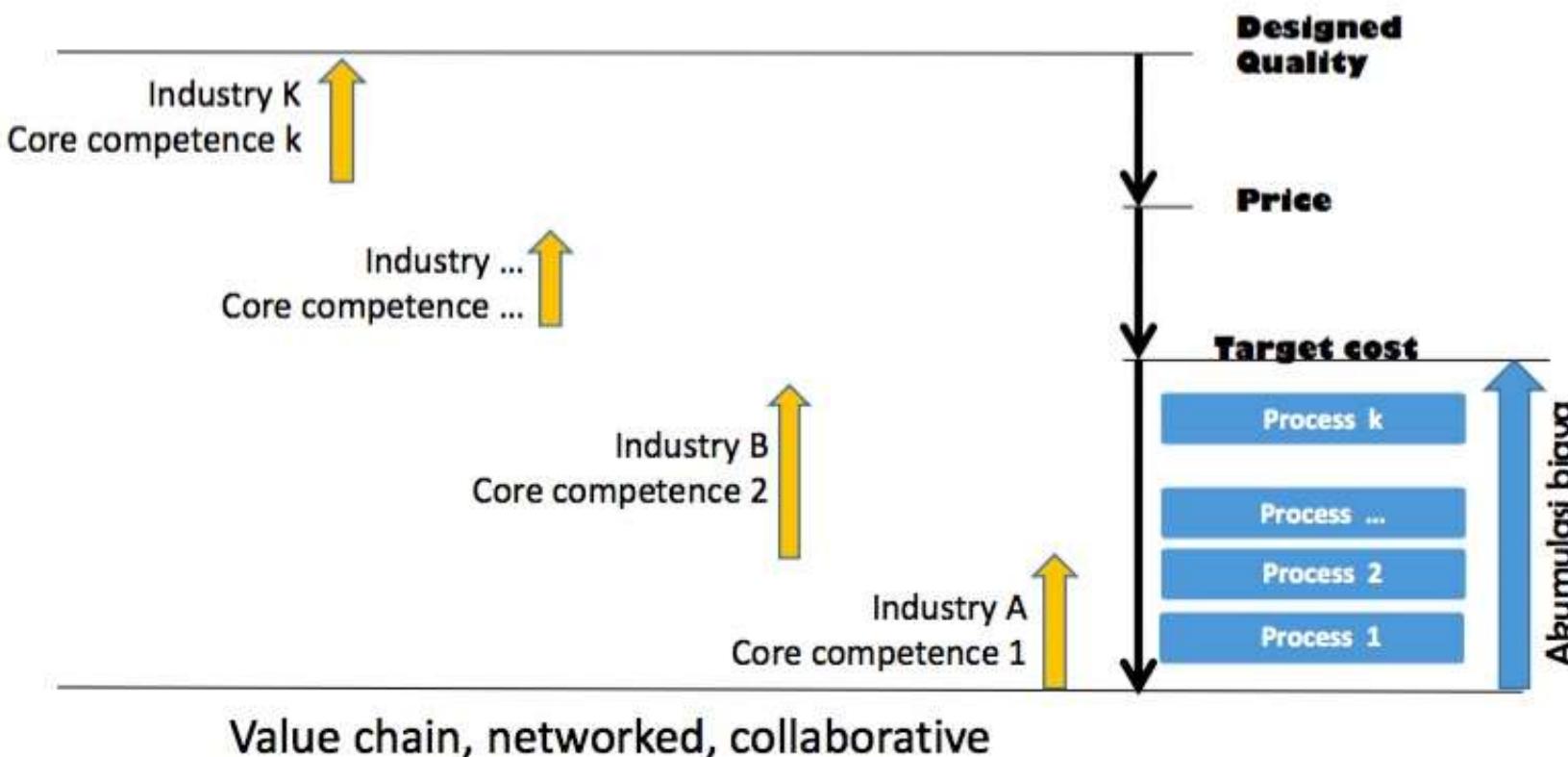
- Energy efficiency and resource efficiency are critical competition factors

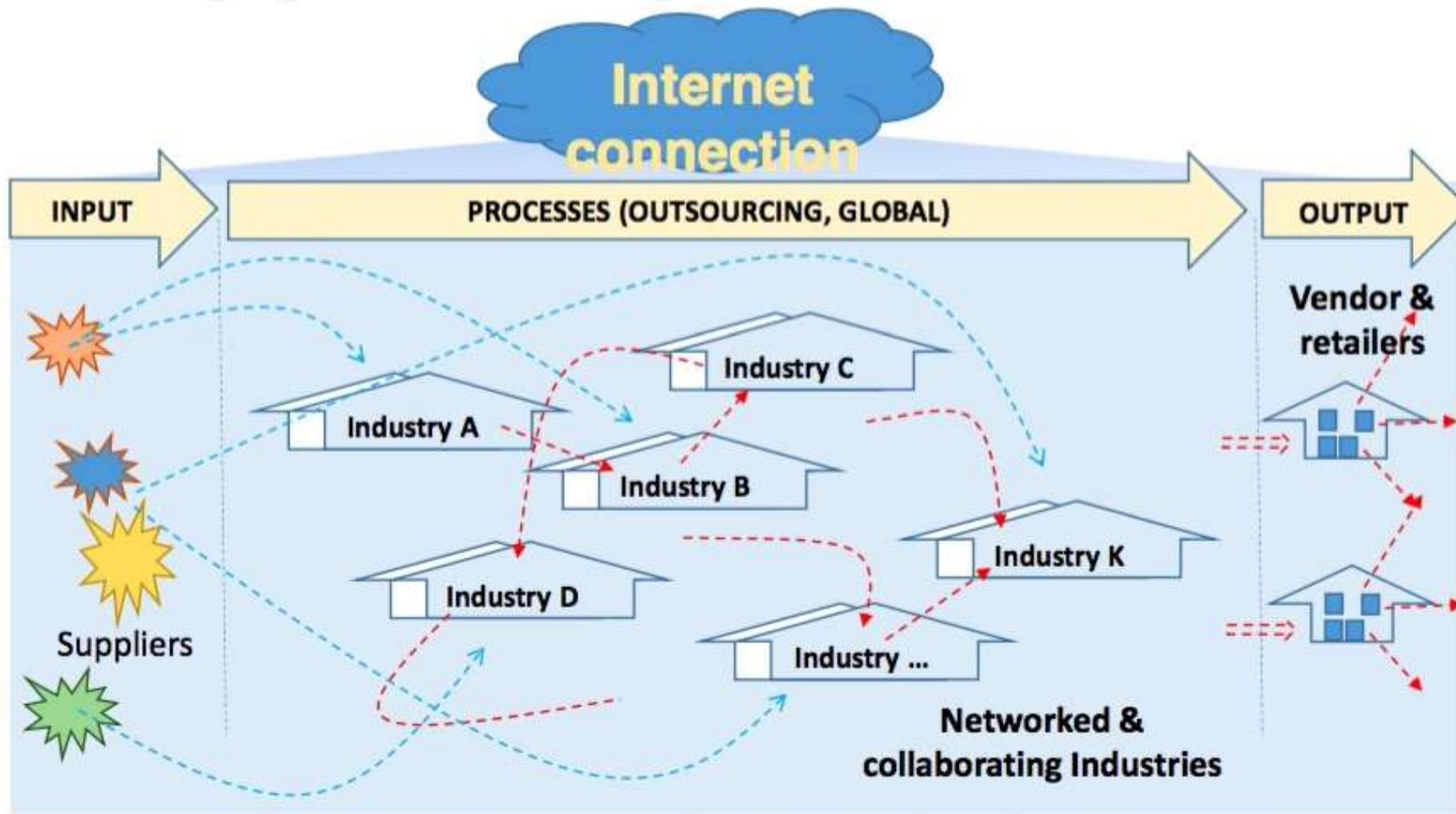
INDUSTRY 2.0 → INDUSTRY 3.0



INDUSTRY 3.0 → INDUSTRY 4.0

More on value creation & cost reduction...
Core competence on process & worker





Production processes and products are being digitized (cyber physical);
manufacturers, suppliers and customers are establishing closer networks, and innovation
cycles are being reduced.

COLLABORATIVE MANUFACTURING





Outsourcing
Outsourcing +
Outsourcing ...



Wajah Kegiatan Ekonomi Dunia saat Ini



Saat ini berbagai macam kebutuhan manusia telah banyak menerapkan dukungan **internet** dan **dunia digital** sebagai wahana interaksi dan transaksi

Sharing economy



e-Education



e-Government



Cloud Collaborative



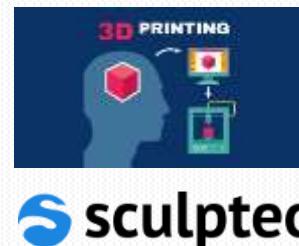
Marketplace



Online Health Services



Smart Manufacturing



Smart City



Smart Appliances



Era Baru Industrilisasi Digital

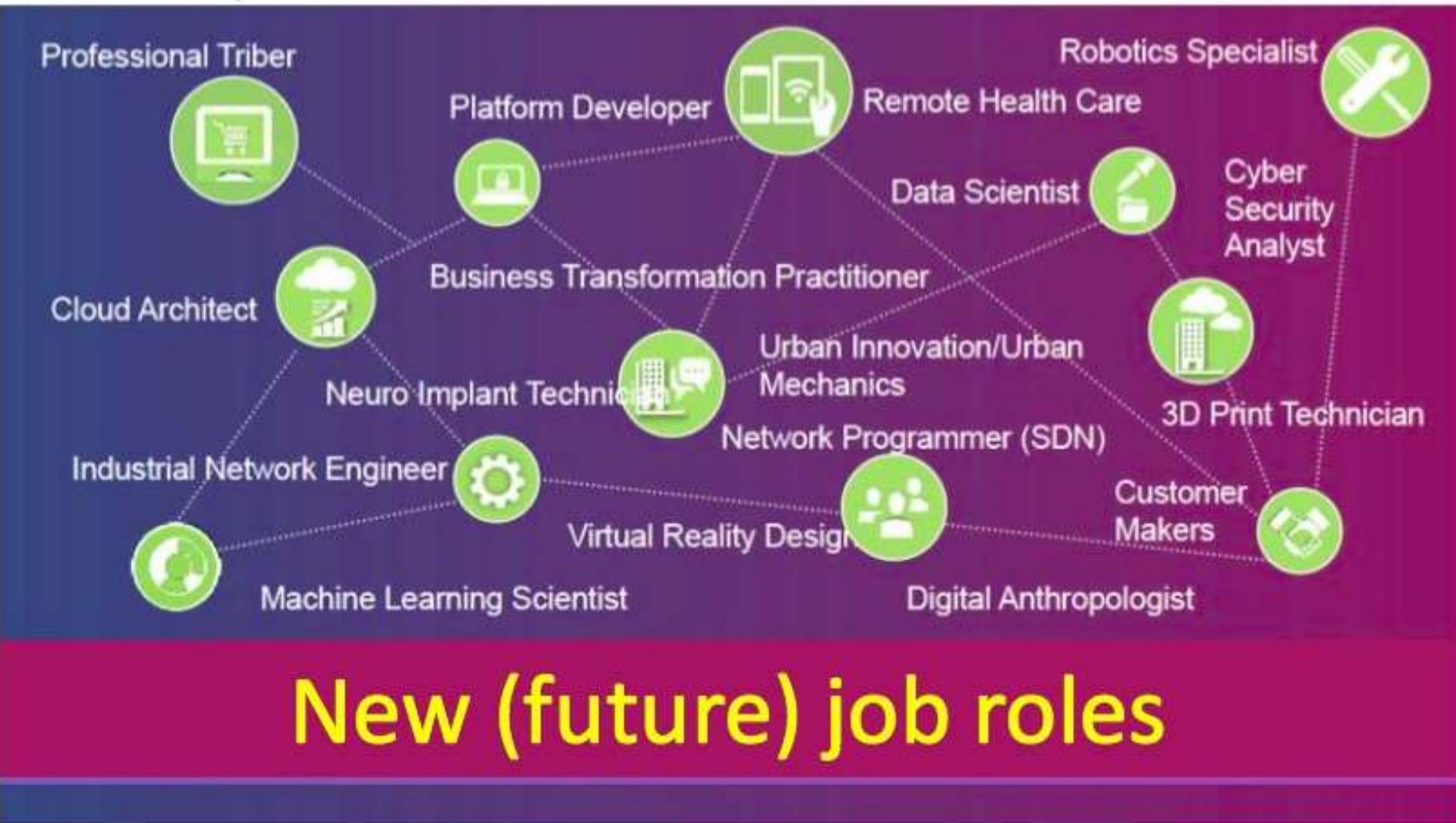


Ancaman:

- Secara global era digitalisasi akan menghilangkan sekitar 1 – 1,5 miliar pekerjaan sepanjang tahun 2015-2025 karena digantikannya posisi manusia dengan mesin otomatis (Gerd Leonhard, *Futurist*);
- Diestimasi bahwa di masa yang akan datang, 65% murid sekolah dasar di dunia akan bekerja pada pekerjaan yang belum pernah ada di hari ini (*U.S. Department of Labor report*).

Peluang:

- Era digitalisasi berpotensi memberikan peningkatan *net* tenaga kerja hingga 2,1 juta pekerjaan baru pada tahun 2025
- Terdapat potensi pengurangan emisi karbon kira-kira 26 miliar metrik ton dari tiga industri: elektronik (15,8 miliar), logistik (9,9 miliar) dan otomotif (540 miliar) dari tahun 2015-2025 (World Economic Forum).

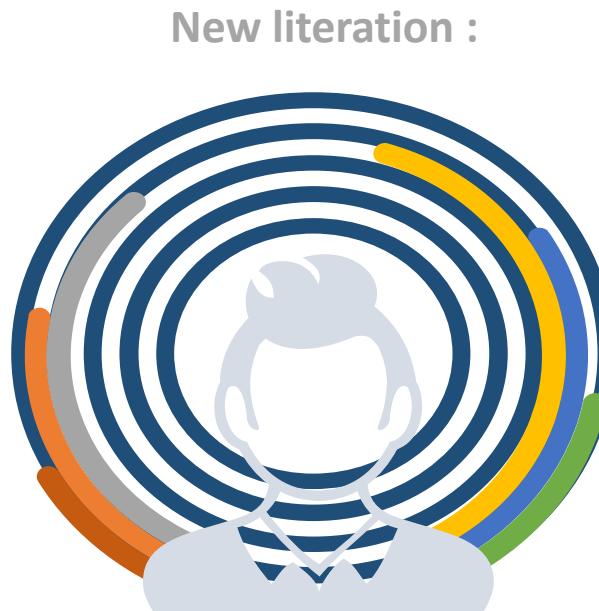


The needs **New literation**

In facing the 4th Industrial Revolution

In order to produce qualified graduates,
curriculum needs a new orientation, due to the
4th Industrial Revolution.

”

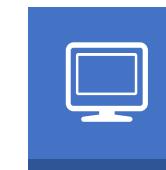


STEM



Data Literation

The ability to read, to analyze, to use information (**Big Data**) in the digital world.



Technology Literation

The ability to understand mechanical (system) work, to use the application of technology like (**Coding, Artificial Intelligence, & Engineering Principles**).

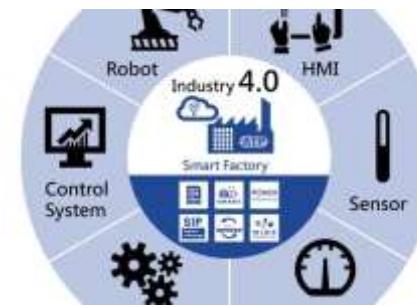
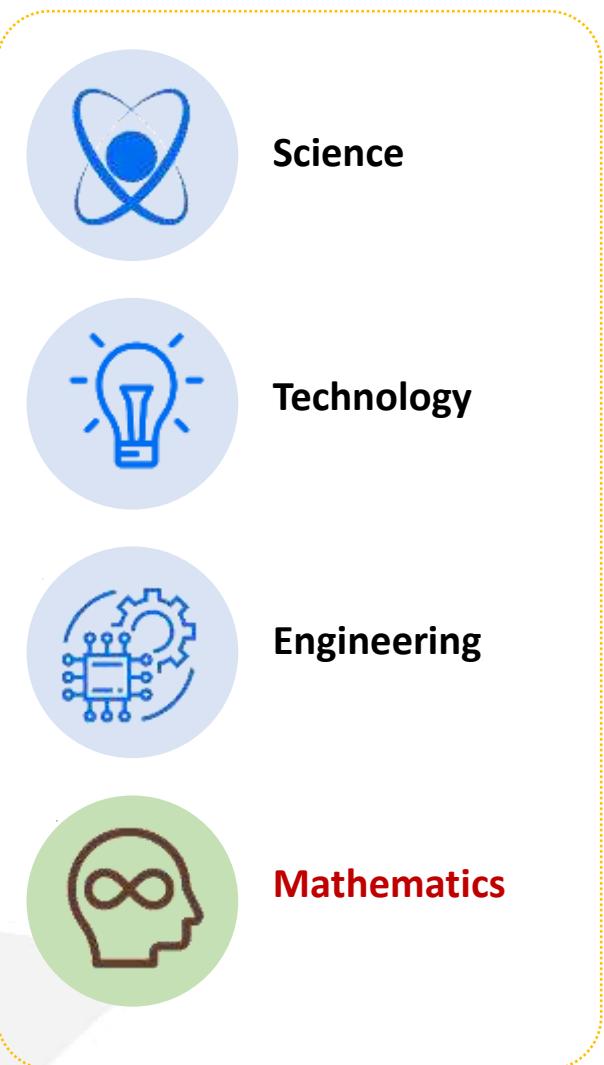


Human Literation

Humanities, Communication and Design



Human Resources



**ENHANCING COMPETITIVENESS
AND WEALTH OF NATION**



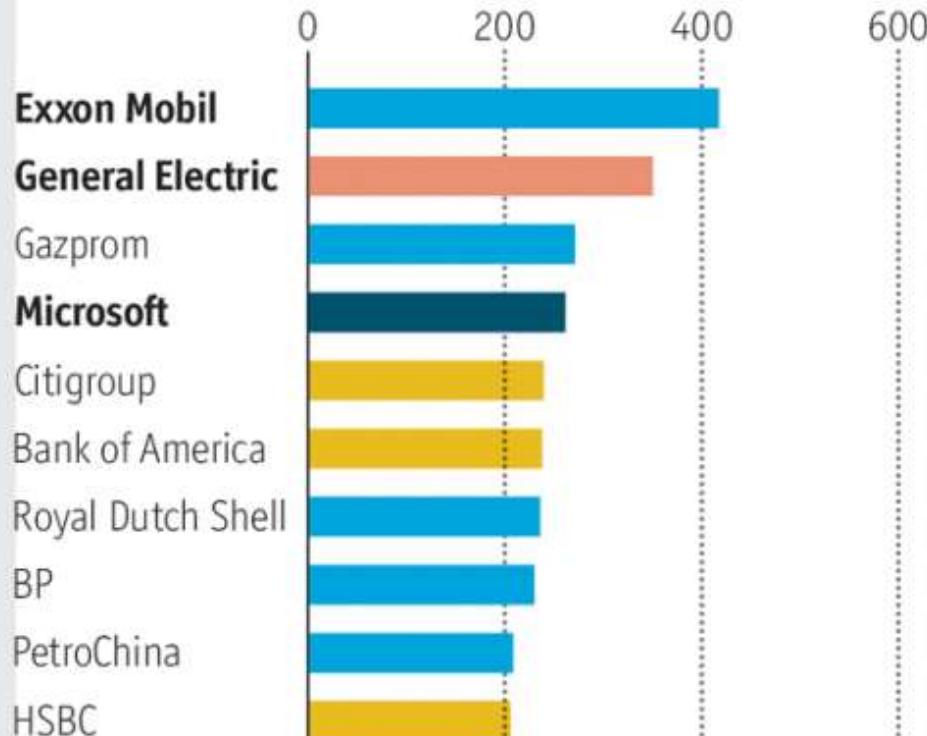
The Rise of The Superstars

A virtually new world

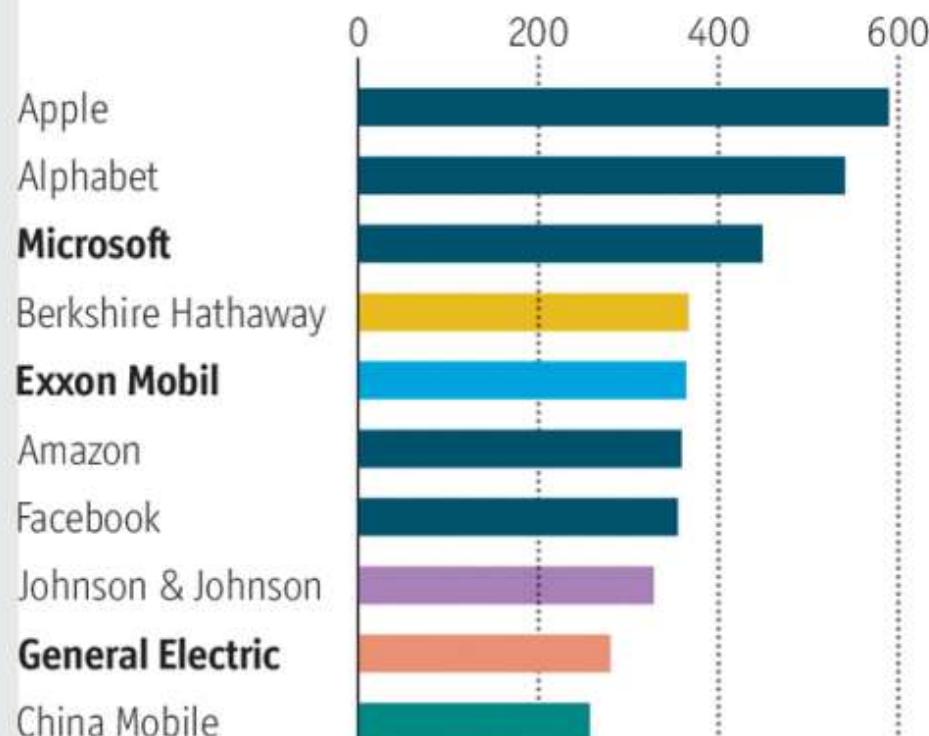
World, largest listed companies by market capitalisation, \$bn

Sector: Energy Financials Health care Industrials IT Telecoms

End 2006



2016*

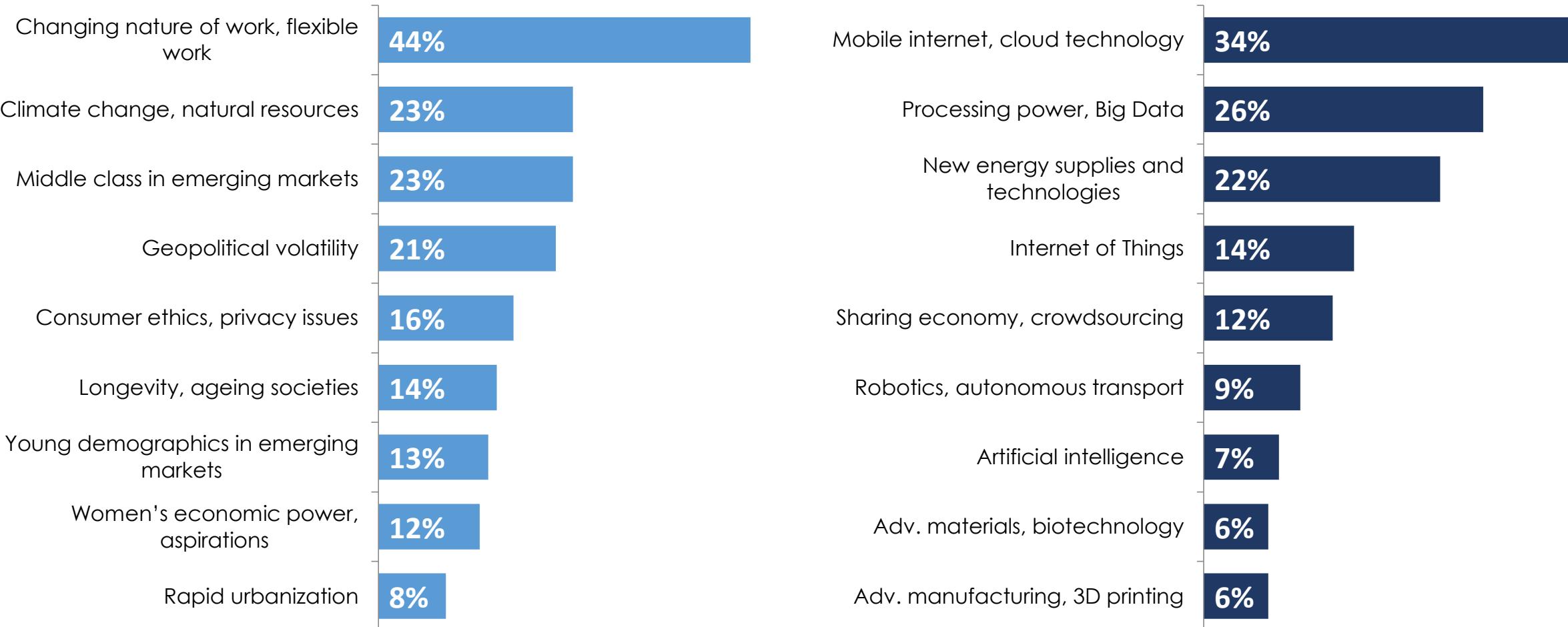


Source: Bloomberg

*At August 24th 2016

Drivers of change, industries overall

Share of respondents rating driver as top trend, %



Gejala-Gejala Transformasi di Indonesia

Saat ini beberapa jenis model bisnis dan pekerjaan di Indonesia sudah terkena dampak dari arus era digitalisasi

- Toko konvensional yang ada sudah mulai tergantikan dengan model bisnis *marketplace*.
- Taksi atau Ojek Tradisional posisinya sudah mulai tergeserkan dengan moda-moda berbasis online



Skills di Industri Masa Depan

Skills

Cognitive Abilities

Systems Skills

Complex Problem Solving

Content Skills

Process Skills

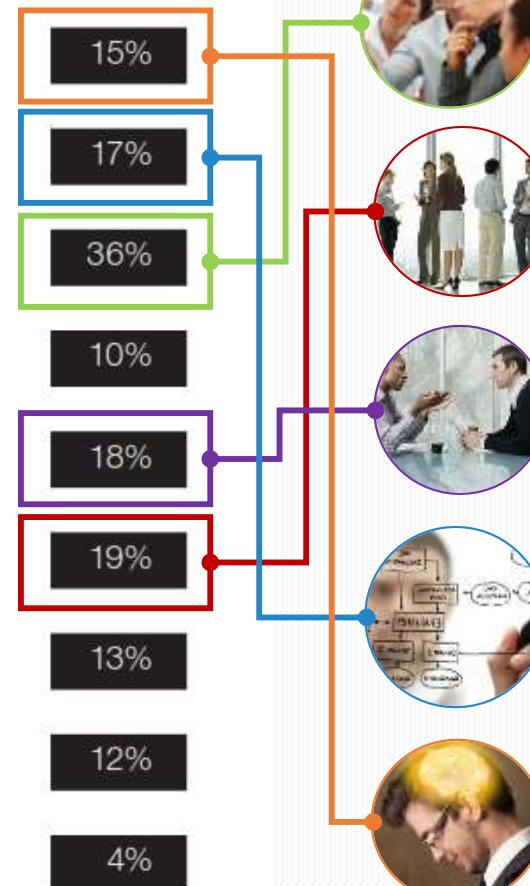
Social Skills

Resource Management Skills

Technical Skills

Physical Abilities

Scale of Skill Demand in 2020



Complex Problem Solving

Kemampuan untuk memecahkan masalah yang asing dan belum diketahui solusinya di dalam dunia nyata.

Social Skill

Kemampuan untuk melakukan koordinasi, negosiasi, persuasi, *mentoring*, kepekaan dalam memberikan bantuan hingga *emotional intelligence*

Process Skill

Kemampuan terdiri dari: *active listening*, *logical thinking*, dan *monitoring self and the others*

System Skill

Kemampuan untuk dapat melakukan *judgement* dan keputusan dengan pertimbangan *cost-benefit* serta kemampuan untuk mengetahui bagaimana sebuah sistem dibuat dan dijalankan

Cognitive Abilities

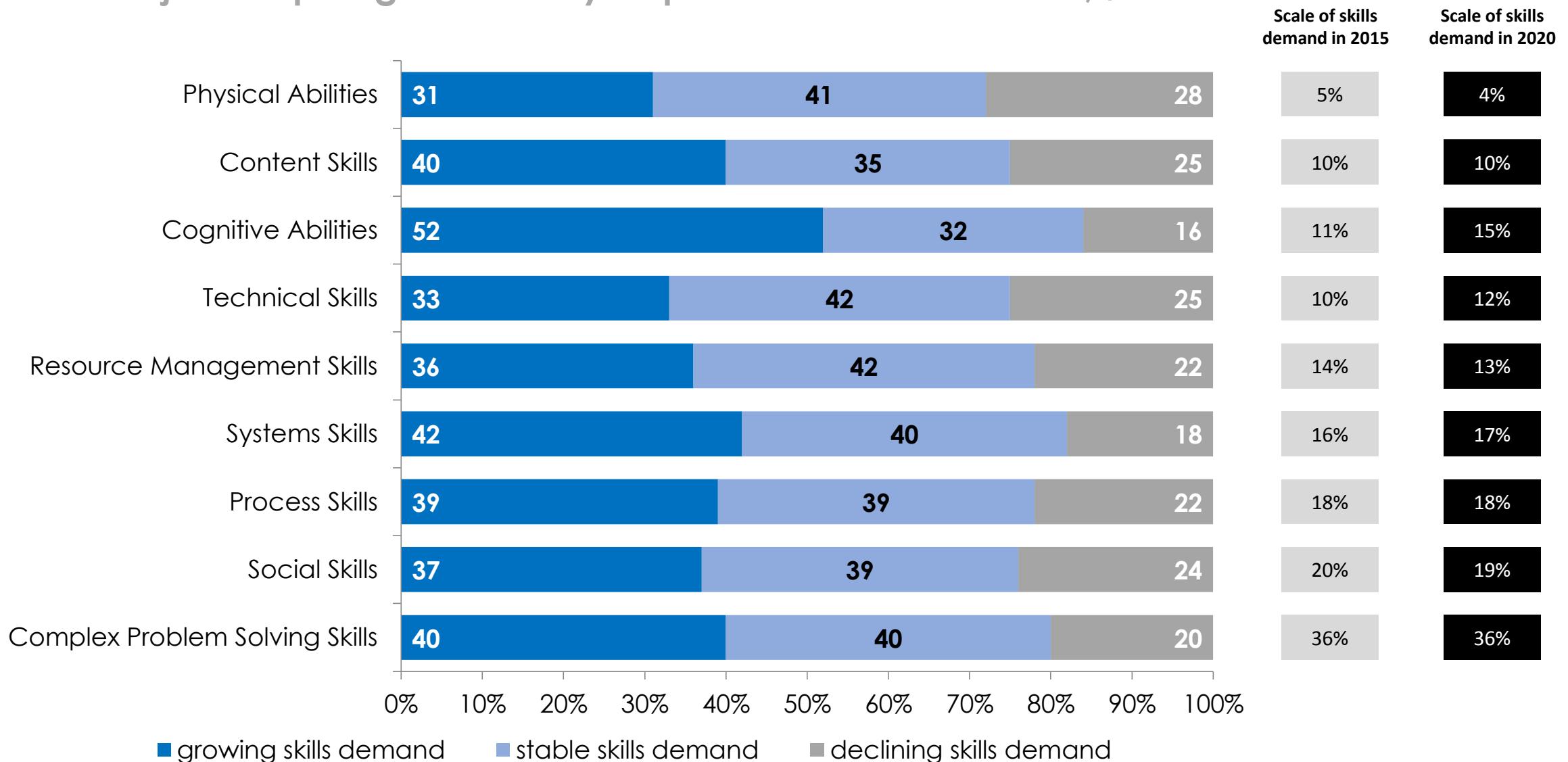
Skill yang terdiri dari antara lain: *Cognitive Flexibility*, *Creativity*, *Logical Reasoning*, *Problem Sensitivity*, *Mathematical Reasoning*, dan *Visualization*.

(Share of jobs requiring skills family as part of their core skill set, %)

Sumber: The Future of Jobs Report, World Economic Forum, definisi skill berdasarkan O*NET Content Model, US Department of Labor & Bureau of Labor Statistics

Change in demand for core work-related skills, 2015-2020, all industries

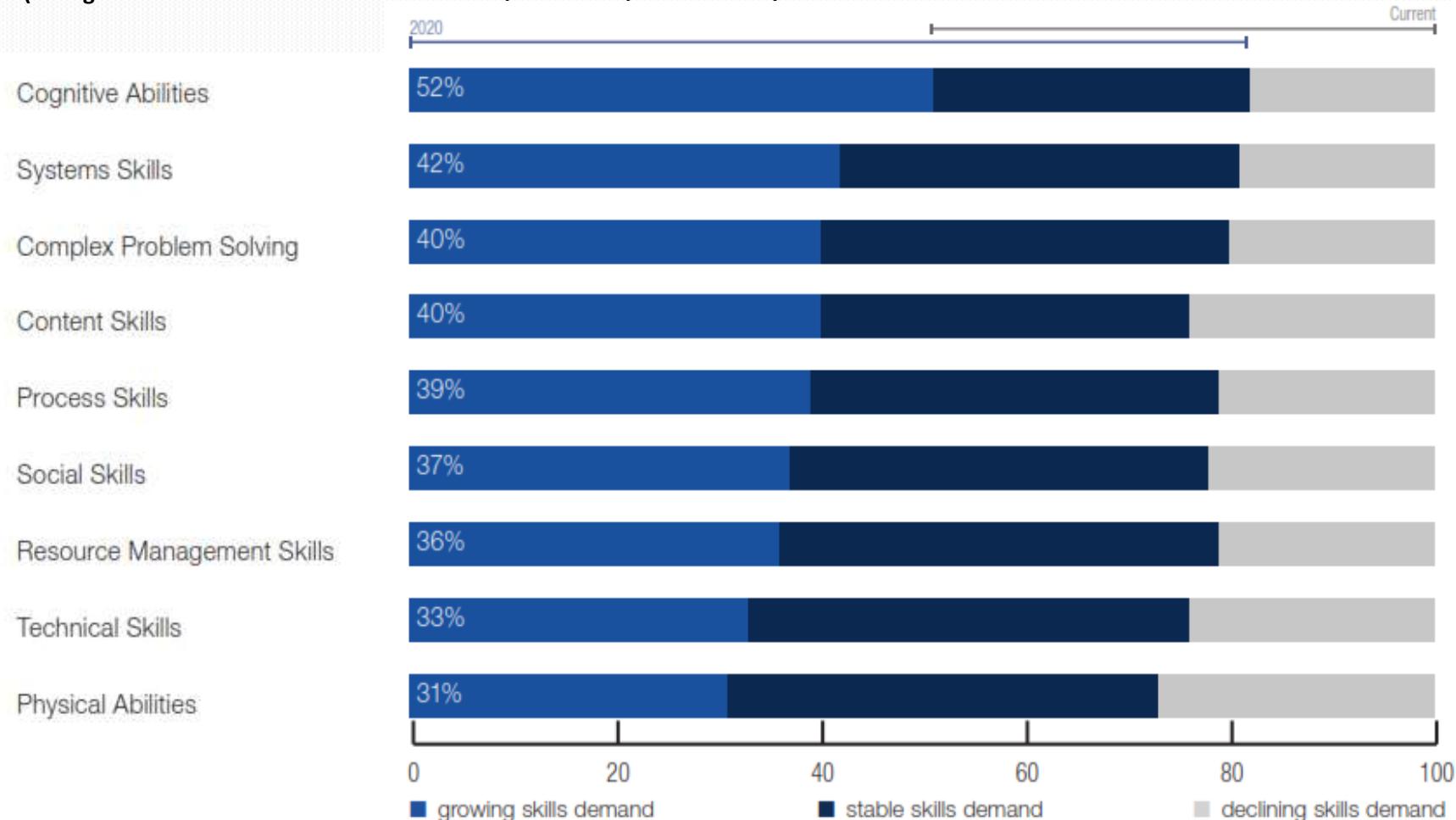
Share of jobs requiring skills family as part of their core skill set, %



Tantangan-Tantangan

Skills di Industri Masa Depan

(Change in demand for core work-related skills, 2015-2020, all industries)



- 1) Cognitive Abilities
- 2) System Skills
- 3) Complex Problem Solving
- 4) Content Skills
- 5) Process Skills

Merupakan 5 *skills* yang pertumbuhan permintaannya akan paling tinggi berdasarkan beberapa sektor industri, di mana sebelumnya sektor tersebut tidak banyak membutuhkannya

Sumber: idem

Manusia Memproduksi Data

Manusia memproduksi beragam data yang jumlah dan ukurannya sangat besar

- Astronomi
- Bisnis
- Kedokteran
- Ekonomi
- Olahraga
- Cuaca
- Financial
- ...



Pertumbuhan Data

Astronomi

- **Sloan Digital Sky Survey**
 - New Mexico, 2000
 - 140TB over 10 years
- **Large Synoptic Survey Telescope**
 - Chile, 2016
 - Will acquire 140TB every five days

kilobyte (kB)	10^3
megabyte (MB)	10^6
gigabyte (GB)	10^9
terabyte (TB)	10^{12}
petabyte (PB)	10^{15}
exabyte (EB)	10^{18}
zettabyte (ZB)	10^{21}
yottabyte (YB)	10^{24}

Biologi dan Kedokteran

- European Bioinformatics Institute (**EBI**)
 - 20PB of data (genomic data doubles in size each year)
 - A single sequenced human genome can be around 140GB in size

Perubahan Kultur dan Perilaku

A word cloud centered around the words "social media" in large red and blue letters. The cloud includes words like sharing, information, networking, industrial, internet, and many others related to digital communication and technology.



Datangnya Tsunami Data

- Mobile Electronics market
 - 4.43B mobile phone users in 2015
 - 7B mobile phone subscriptions in 2015
- Web and Social Networks generates amount of data
 - Google processes 100 PB per day, 3 million servers
 - Facebook has 300 PB of user data per day
 - Youtube has 1000PB video storage
 - 235 TBs data collected by the US Library of Congress
 - 15 out of 17 sectors in the US have more data stored per company than the US Library of Congress

kilobyte (kB)	10^3
megabyte (MB)	10^6
gigabyte (GB)	10^9
terabyte (TB)	10^{12}
petabyte (PB)	10^{15}
exabyte (EB)	10^{18}
zettabyte (ZB)	10^{21}
yottabyte (YB)	10^{24}



Kebanjiran Data tapi Miskin Pengetahuan

We are **drowning in data**, but
starving for knowledge!

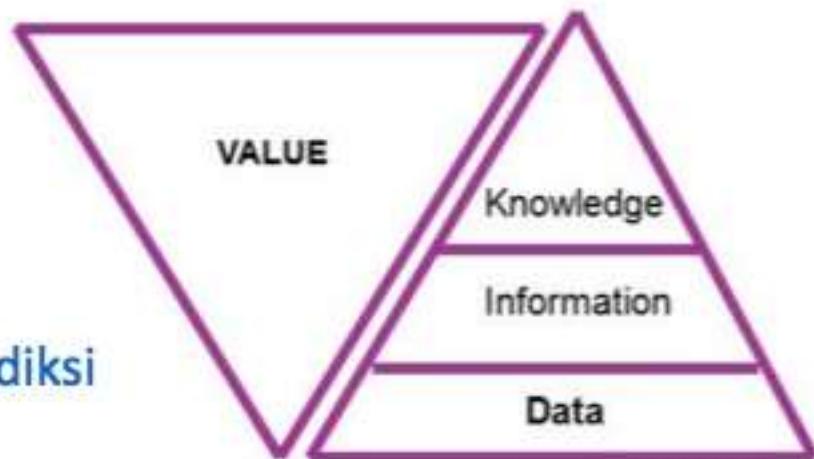
(John Naisbett, Megatrends, 1988)



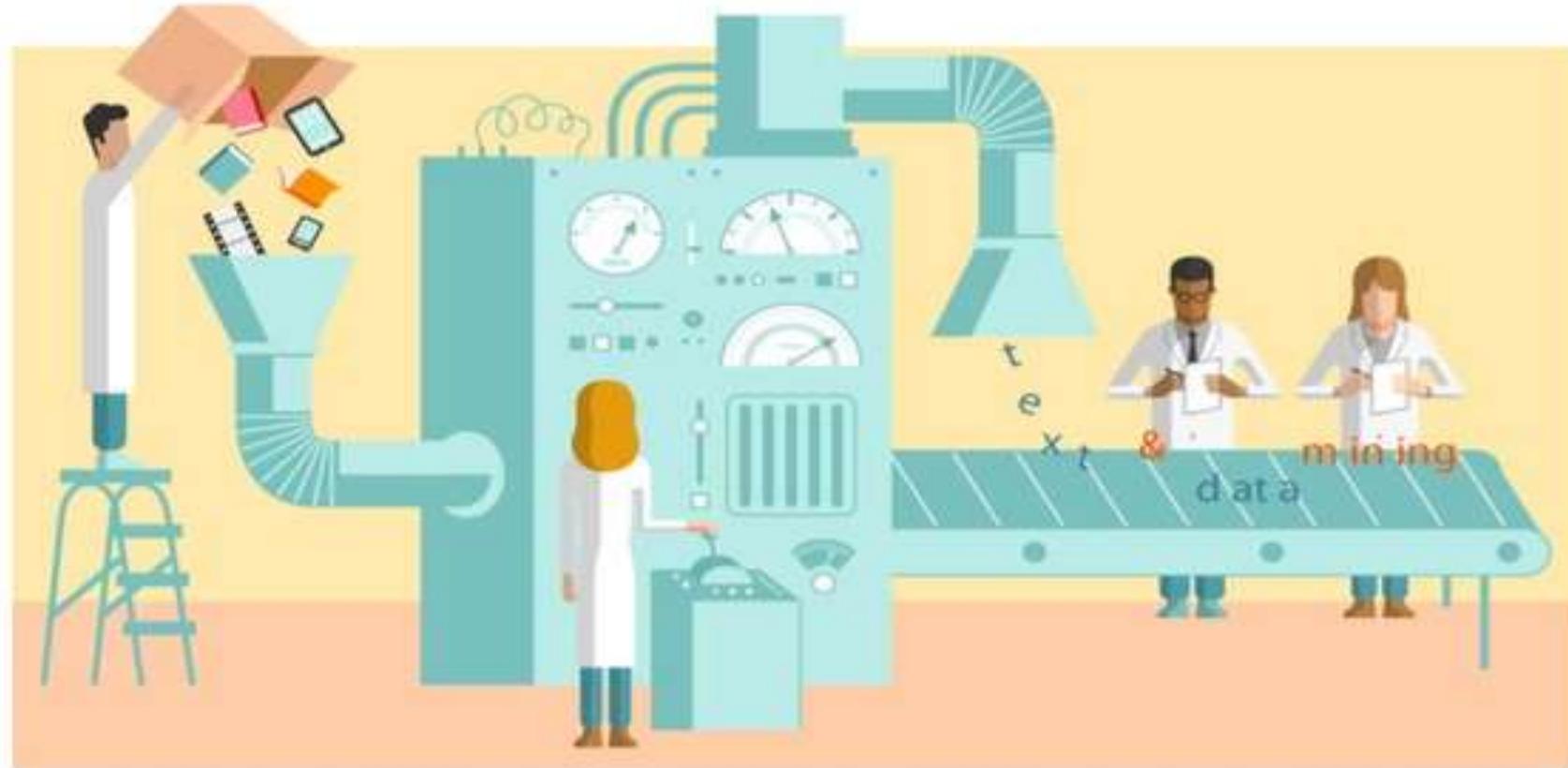
Mengubah Data Menjadi Pengetahuan

- Data harus kita olah menjadi **pengetahuan** supaya bisa **bermanfaat** bagi manusia

- Dengan **pengetahuan** tersebut, manusia dapat:
 - Melakukan **estimasi** dan **prediksi** apa yang terjadi di depan
 - Melakukan analisis tentang **asosiasi**, **korelasi** dan **pengelompokan** antar data dan atribut
 - Membantu **pengambilan keputusan** dan **pembuatan kebijakan**

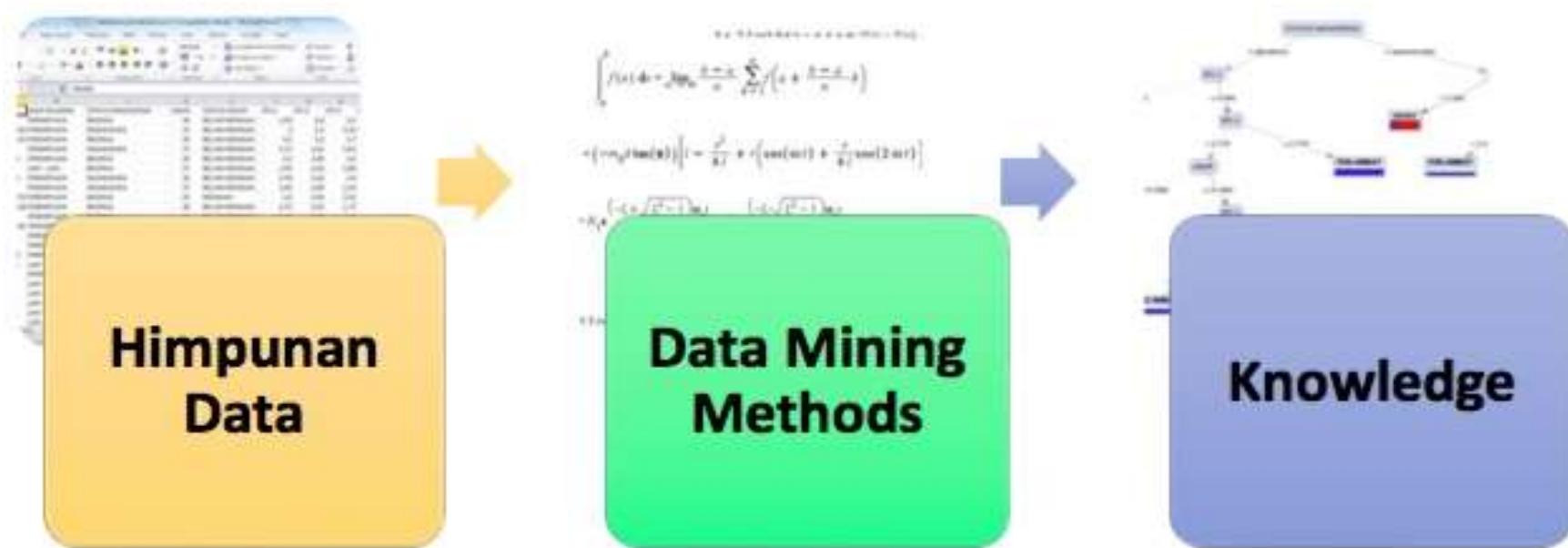


III Memining Data Menjadi Pengetahuan

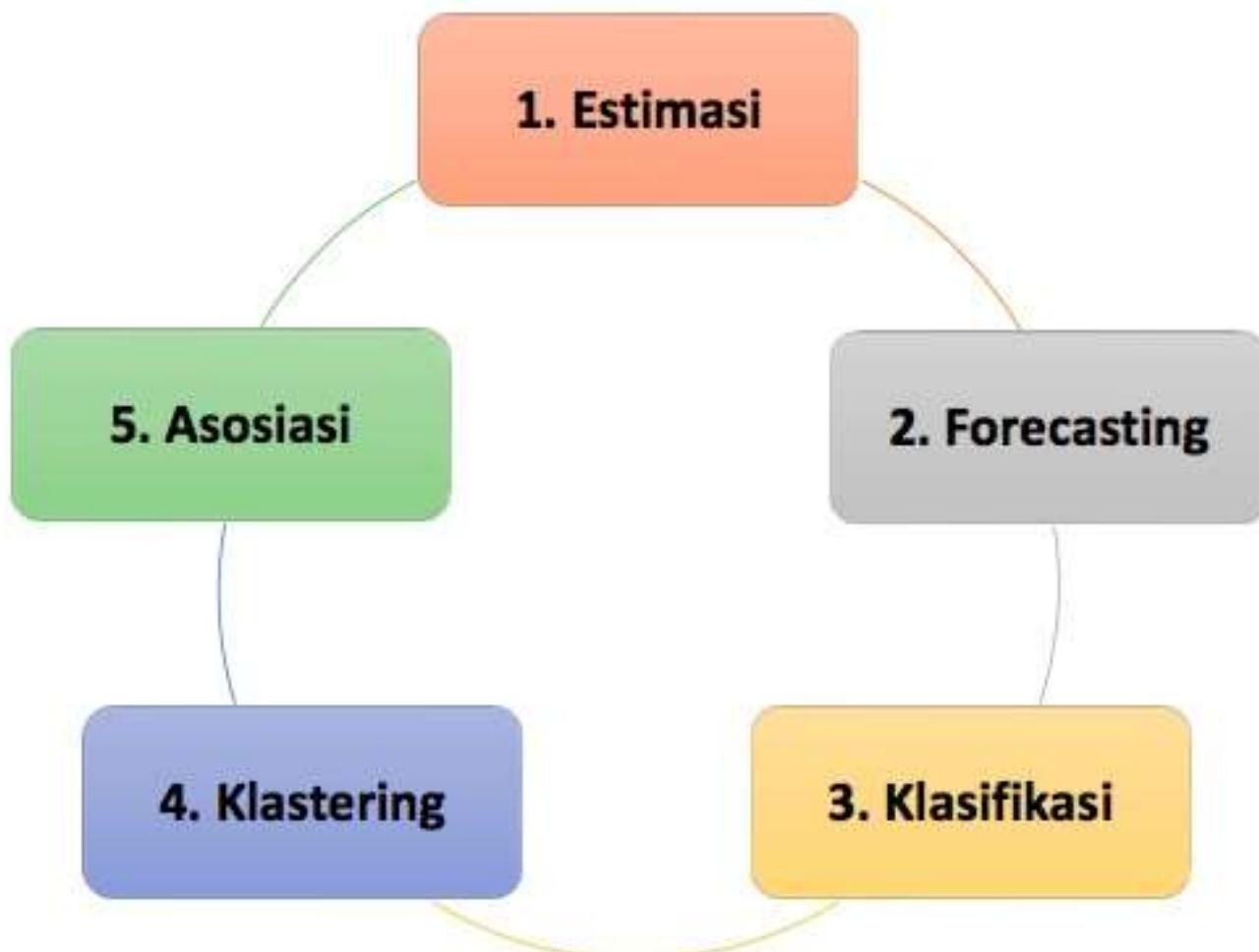


Data Mining: Disiplin ilmu yang mempelajari **metode untuk mengekstrak pengetahuan** atau menemukan pola dari suatu data yang besar

III Memining Data Menjadi Pengetahuan



Data Mining



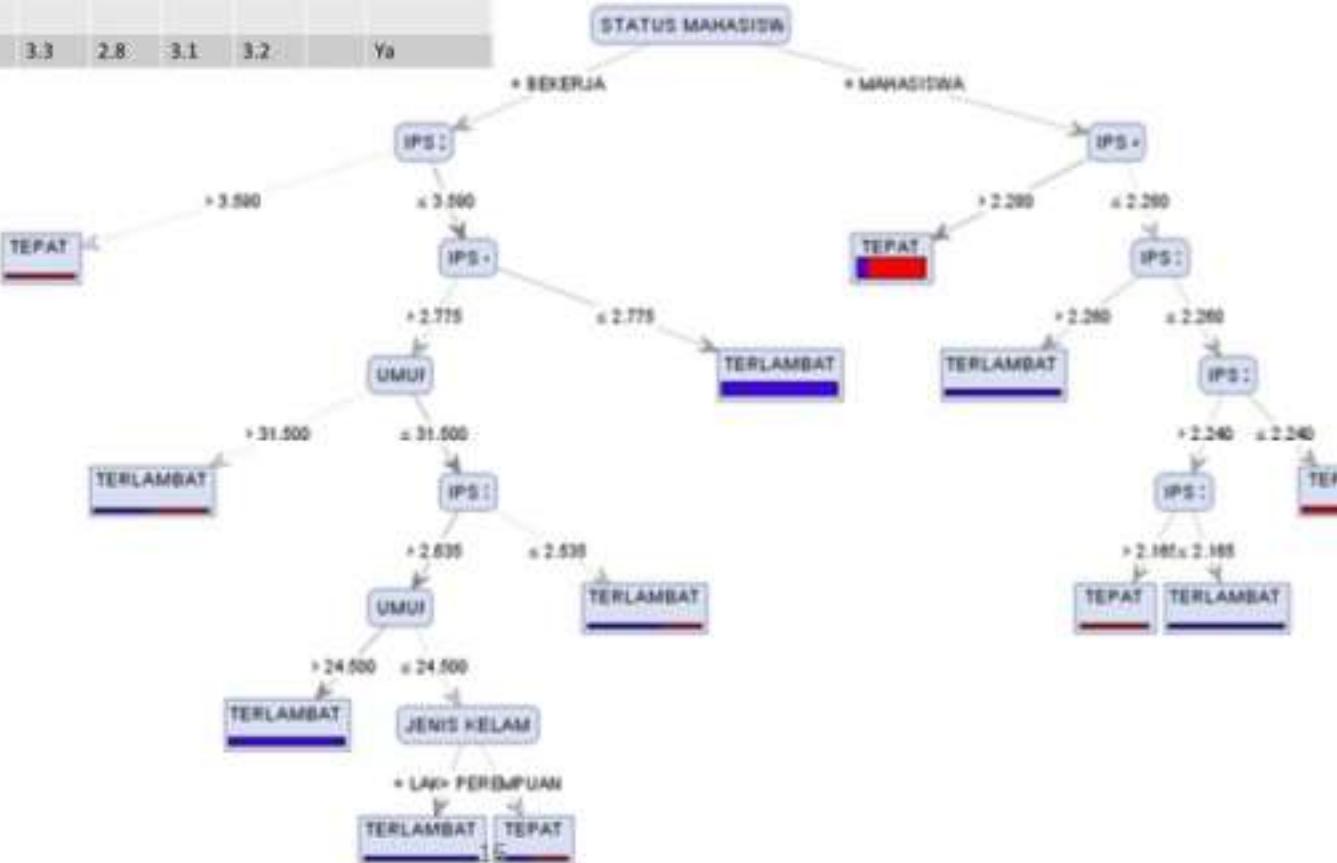
Contoh Data di Kampus

- Puluhan ribu data mahasiswa di kampus yang diambil dari sistem informasi akademik
- Apakah pernah kita ubah menjadi pengetahuan yang lebih bermanfaat? TIDAK!
- Seperti apa pengetahuan itu? Rumus, Pola, Aturan

NIM	Gender	Nilai UN	Asal Sekolah	IPS1	IPS2	IPS3	IPS 4	...	Lulus Tepat Waktu
10001	L	28	SMAN 2	3.3	3.6	2.89	2.9		Ya
10002	P	27	SMA DK	4.0	3.2	3.8	3.7		Tidak
10003	P	24	SMAN 1	2.7	3.4	4.0	3.5		Tidak
10004	L	26.4	SMAN 3	3.2	2.7	3.6	3.4		Ya
...									
...									
11000	L	23.4	SMAN 5	3.3	2.8	3.1	3.2		Ya

Prediksi Kelulusan Mahasiswa

NIM	Gender	Nilai UN	Asal Sekolah	IPS1	IPS2	IPS3	IPS 4	...	Lulus Tepat Waktu
10001	L	28	SMAN 2	3.3	3.6	2.89	2.9		Ya
10002	P	27	SMA DK	4.0	3.2	3.8	3.7		Tidak
10003	P	24	SMAN 1	2.7	3.4	4.0	3.5		Tidak
10004	L	26.4	SMAN 3	3.2	2.7	3.6	3.4		Ya
...									
...									
11000	L	23.4	SMAN 5	3.3	2.8	3.1	3.2		Ya



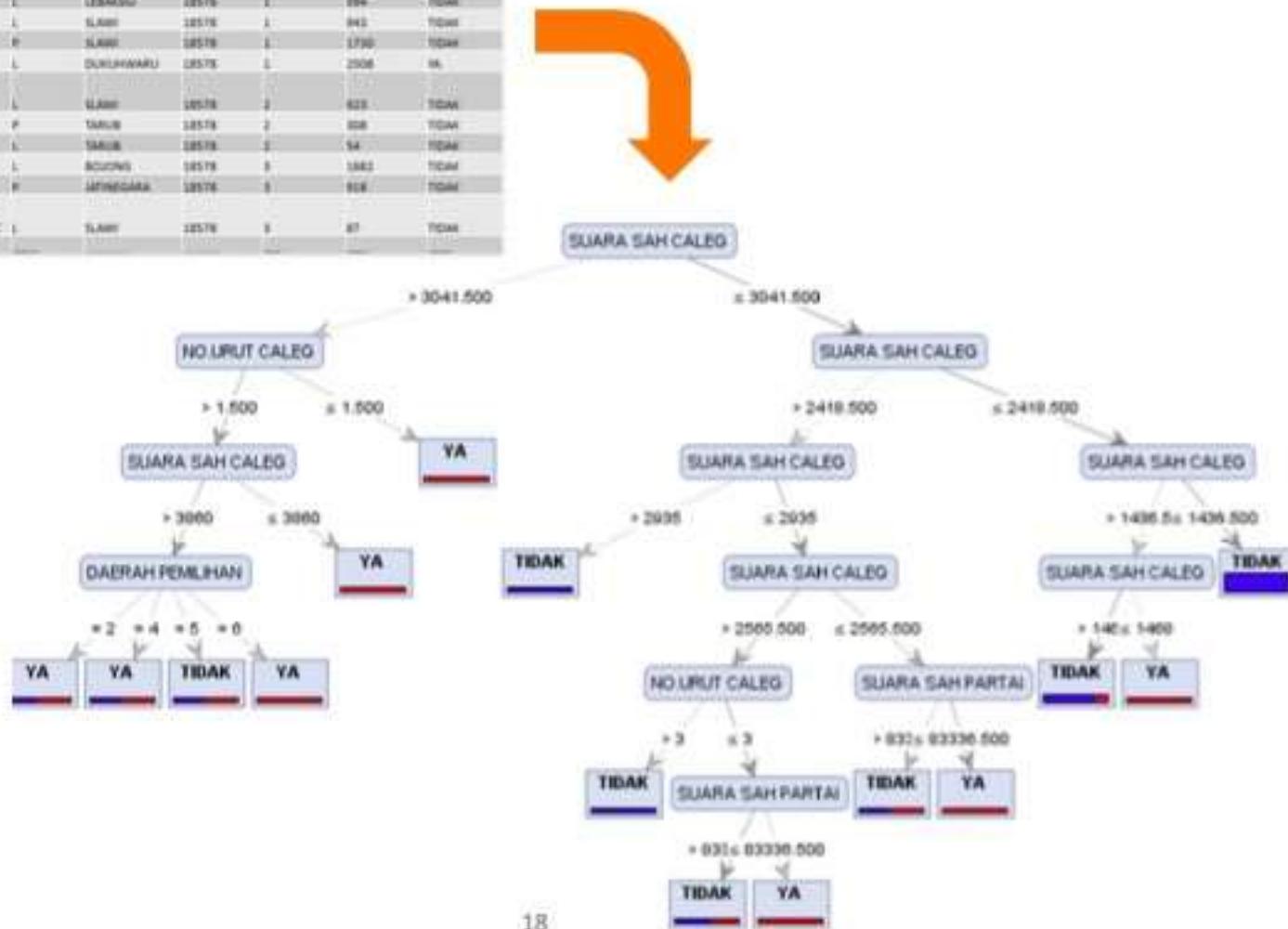
Contoh Data di Komisi Pemilihan Umum

- Puluhan ribu data calon anggota legislatif di KPU
- Apakah pernah kita ubah menjadi pengetahuan yang lebih bermanfaat? TIDAK!

NAMA PARTAI POLITIK	NAMA CALON LEGESLATIF	JENIS KELAMIN	KECAMATAN	SUARA SAH PARTAI	DAERAH PEMILIHAN	SUARA SAH CALEG	TERPILIH ATAU TIDAK
HANURA	TOTO SUKISNO,BSc	L	LEBAKSIU	18578	1	594	TIDAK
HANURA	EDI PURYANTO,SH	L	SLAWI	18578	1	943	TIDAK
PKB	ELI RETNOWATI,SH	P	SLAWI	18578	1	1730	TIDAK
PKB	SAHYUDIN	L	DUKUHWARU	18578	1	2508	YA
GOLKAR	H.FAJAR SIGIT KUSUMAJAYA,SH	L	SLAWI	18578	2	923	TIDAK
GOLKAR	SUMIRAH	P	TARUB	18578	2	308	TIDAK
GOLKAR	DARYOTO	L	TARUB	18578	2	54	TIDAK
PKS	KHAPIP APRONI,S.Pdi	L	BOJONG	18578	3	1682	TIDAK
PKS	ENDANG SUCI RAHAYU	P	JATINEGARA	18578	3	918	TIDAK
PDI-P	KH.CHAFIDZ ISA MUFTI ,LC	L	SLAWI	18578	3	87	TIDAK

Prediksi Calon Legislatif DKI Jakarta

NAMA PARTAI POLITIK	NAMA CALON LEGISLATIF	JENIS KELAMIN	NEKAMANAH	SUARA SAH PASTAU	SUARA PEMILIHAN	SUARA SAM KALES	TEPATW AKALI TIDAK
HANURA	TOTO SAWANGAN	L	LEBAKBU	18578	1	394	TIDAK
HANURA	EDI PURWANTO SH	L	SLAMI	18578	1	942	TIDAK
PKB	ELI RETNOWATI SH	P	SLAMI	18578	1	1790	TIDAK
PKB	SAYLUHUN	L	DUKUNWARU	18578	1	2008	YA
	HABIB SIDT						
MOJOKAR	KUSUMAWANITA SH	L	SLAMI	18578	2	621	TIDAK
MOJOKAR	SUMARAH	P	TARIK	18578	2	328	TIDAK
MOJOKAR	SARINDRA	L	TARIK	18578	2	54	TIDAK
PDI-P	GHAFIP APRONIWSA	L	SLAMINA	18578	3	1882	TIDAK
PDI-P	ENDANG SUKI RAMBUTU	P	LAHMEDARA	18578	3	818	TIDAK
PDI-P	ENI CHAFIZIA MULYAHUTU	L	SLAMI	18578	3	87	TIDAK



From Stupid Apps to Smart Apps

Stupid Applications

- Sistem Informasi Akademik
- Sistem Pencatatan Pemilu
- Sistem Laporan Kekayaan Pejabat
- Sistem Pencatatan Kredit



Smart Applications

- Sistem Prediksi Kelulusan Mahasiswa
- Sistem Prediksi Hasil Pemilu
- Sistem Prediksi Koruptor
- Sistem Penentu Kelayakan Kredit

Evolution of Sciences

- Sebelum 1600: **Empirical science**
 - Disebut sains kalau bentuknya **kasat mata**
- 1600-1950: **Theoretical science**
 - Disebut sains kalau bisa **dibuktikan secara matematis** atau eksperimen
- 1950s-1990: **Computational science**
 - Seluruh disiplin ilmu bergerak ke **komputasi**
 - Lahirnya banyak **model komputasi**
- 1990-sekarang: **Data science**
 - Kultur manusia **menghasilkan data besar**
 - Kemampuan komputer untuk mengolah data besar
 - Datangnya data mining sebagai arus utama sains

*Jim Gray and Alex Szalay, The World Wide Telescope:
An Archetype for Online Science, Comm. ACM, 45(11): 50-54, Nov. 2002*



XL Go Membuka Kebebasan GRATIS MiFi hanya dengan mengaktifkan paket XL Go

JAN 20, 2016 @ 02:39 PM 15,446 VIEWS

The Little Black Book

Report: Why "Data Scientist" Is The Best Job To Pursue In 2016



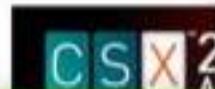
Gregory Ferenstein, CONTRIBUTOR

FULL BIO ▾

Opinions expressed

(Ferenstein Wire) jobs in America, a company review's voluntary reviews company's massive composite score openings, and car

According to the report, Data Scientist is an imp



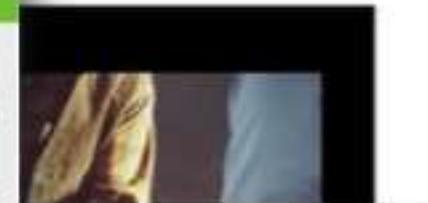
Update: Sunday, 24 Oct 2016 13:40 AM ET
By Samiha S. Bhagat

CNBC

JOBS

ECONOMY | WORLD ECONOMY | US ECONOMY | THE FED | CENTRAL BANKS | JOBS

Data science jobs top Glassdoor survey for best work-life balance



25 Best Jobs in America

Employee Choice Awards

Other Lists

Other Interview Questions

Best Jobs

Best Cities for Jobs

Trends

Additional Resources

Press FAQ

Trends FAQ

Free Employee Account

Press Center

25 Best Jobs in America

Want a new job? Glassdoor is here to help, identifying the 25 Best Jobs in America for 2016. The jobs that made this list have the highest overall Glassdoor Job Score, determined by combining three key factors – number of job openings, salary and career opportunities rating. These jobs stand out across all three categories.

United States 2016

Rank	Job Title	Job Openings	Median Base Salary	Career Opportunity	Job Score
1	Data Scientist	4,734	\$116,880	4.1	4.7
2	Tax Manager	1,374	\$115,200	3.9	4.7

III Perusahaan Pengolah Pengetahuan

- **Uber** - the world's largest taxi company, **owns no vehicles**
- **Google** - world's largest media/advertising company, **creates no content**
- **Alibaba** - the most valuable retailer, **has no inventory**
- **Airbnb** - the world's largest accommodation provider, **owns no real estate**
- **Gojek** - perusahaan angkutan umum, **tanpa memiliki kendaraan**
- **Groceria** – perusahaan penjual sayur dan daging di pasar, **tanpa punya toko dan barang dagangan**



Bagaimana Merespon *Masa Depan*



1. Komitmen **peningkatan** investasi di pengembangan *digital skills*
2. Selalu mencoba dan menerapkan *prototype* teknologi terbaru, *Learn by doing!*
3. Menggali bentuk **kolaborasi baru** bagi model sertifikasi atau pendidikan dalam ranah peningkatan *digital skill*
4. Dilakukannya **kolaborasi** antara dunia industri, akademisi, dan masyarakat untuk mengidentifikasi permintaan dan ketersediaan skill bagi era digital di masa depan
5. Menyusun kurikulum pendidikan yang telah memasukan **materi** terkait *human-digital skills*

Referensi

- https://www.kopertis7.go.id/uploadmateri_pedoman/Ainun_Naim.ptx
- <http://romisatriawahono.net/publications/2018/romi-bigdata-mar2018.pdf>
- <http://k8bksti.ub.ac.id/wp-content/uploads/2017/10/Keynote-Speaker-Dradjad-Irianto.pdf>
- Tjandrawinata, R., 2016. Industri 4.0: revolusi industri abad ini dan pengaruhnya bidang kesehatan dan bioteknologi. Working Paper Dexa Medica Group

TERIMA KASIH