Are you seeking a textbook on data centers and how to learn about them?

BICSI Japan
Rui Takei, RCDD, DCDC, B.Ed.

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Rui Takei, RCDD, DCDC, B.Ed.

After earning an Associate's Degree in Electrical Engineering from Kisarazu National College of Technology in 1997, Rui Takei joined Tokyo Telecommunication Network Co (now KDDI) as a Telecommunications Engineer. Over the next 24 years, he specialized in providing cabling connectivity services for data centers and telecommunication carriers.

Presently, he holds the position of Chief Telecommunications Engineer within the company, and since 2021, he has also spearheaded the training and education program for junior employees.

Amidst the challenges posed by the COVID-19 pandemic, he pursued a correspondence bachelor's course at Soka University in Tokyo, successfully graduating in 2023 with a degree in education .

Additionally, as a dedicated BICSI volunteer, he has served as a board member for the Japan Affiliate for a decade, earning accolades such as the inaugural BICSI Outstanding Global Member of the Year Award in 2014, the BICSI Outstanding Member of the Year Award in 2018, and the Larry G. Romig Committee Member of the Year Award in 2023.

Furthermore, he actively contributes as a member of the Registrations & Credentials Supervision Committee (RCSC) and serves as the vice chair of the Datacenter Operation Standards Working Group.

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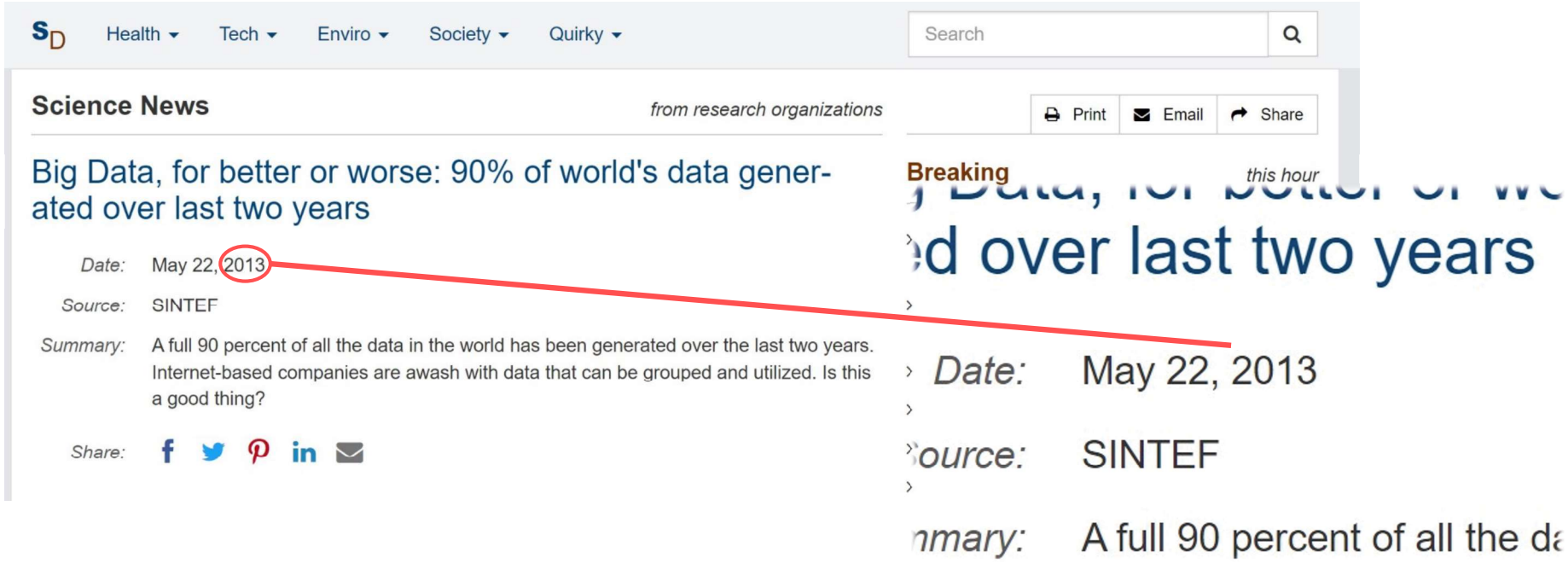
Annual amount of data generated on the internet

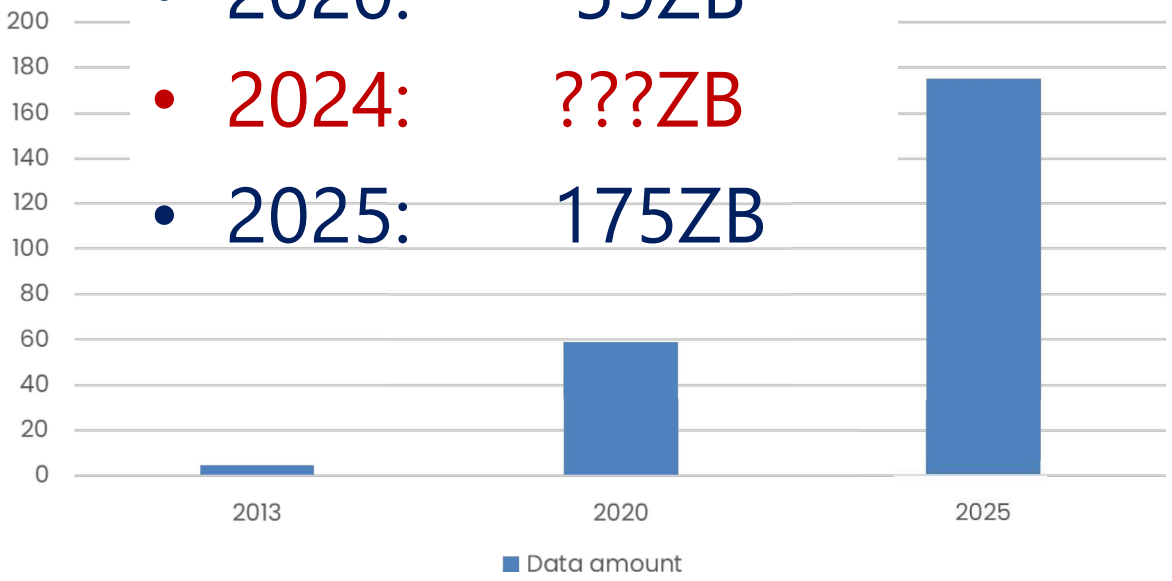


- 90% of world's data generated over last two years

https://www.sciencedaily.com/releases/2013/05/130522085217.htm

Annual amount of data generated on the internet

- 2013: 4.4ZB
- 2020: 59ZB
- 2024: ???ZB
- 2025: 175ZB



http://www.iotjournaal.nl/wp-content/uploads/2017/01/idc-digital-universe-2014.pdf
https://www.businesswire.com/news/home/20200508005025/en/IDCs-Global-DataSphere-Forecast-Shows-Continued-Steady-Growth-in-the-Creation-and-Consumption-of-Data
https://explodingtopics.com/blog/data-generated-per-day

Annual amount of data generated on the internet

- 147ZB of data to be generated in 2024 (forecast)

147 zetta bytes(147x10^21)

=147,000,000,000,000,000,000,000bytes

zetta	exa	peta	tera	giga	mega	kilo
10^21	10^18	10^15	10^12	10^9	10^6	10^3

https://explodingtopics.com/blog/data-generated-per-day

Annual amount of data generated on the internet

- 147 Zettabytes(147x10^21)=147,000,000,000,000,000,000,000bytes

- SSD capacity for PCs, 512 GB is normal these days.
- 147ZB/512GB=287billion
- 147ZB=287billion of 512GB SSD.
- World internet users = 5.3billion
- 54 PCs with 512GB SSD per person

https://datareportal.com/reports/digital-2023-october-global-statshot
https://creativecommons.org/licenses/by-sa/3.0/
https://firefly.adobe.com/generate/images

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Annual amount of data generated on the internet

- 147 Zettabytes(147x10^21)=147,000,000,000,000,000,000,000bytes
- 512GB・SSD＝L:　80mm x 287 billion ＝2,296,000km
- 2,296,000ｋｍ/circumference of the earth;40,000km
  ＝57times around the earth

Amount of original data is 1/9 – 1/10 of the total.
In other words, 50 times around the earth SSDs' data is deprecated, copied or quoted. (Untrustworthy)

https://www.businesswire.com/news/home/20200508005025/en/IDCs-Global-DataSphere-Forecast-Shows-Continued-Steady-Growth-in-the-Creation-and-Consumption-of-Data
https://www.jaxa.jp/countdown/f13/special/moon_j.html#:~:text=%E5%9C%B0%E7%90%83%E3%81%8B%E3%82%89%E6%9C%88%E3%81%BE%E3%81%A7%E3%81%AE,%E8%BB%8C%E9%81%93%E3%81%AB%E6%8A%95%E5%85%A5%E3%81%95%E3%82%8C%E3%81%BE%E3%81%99%E3%80%82

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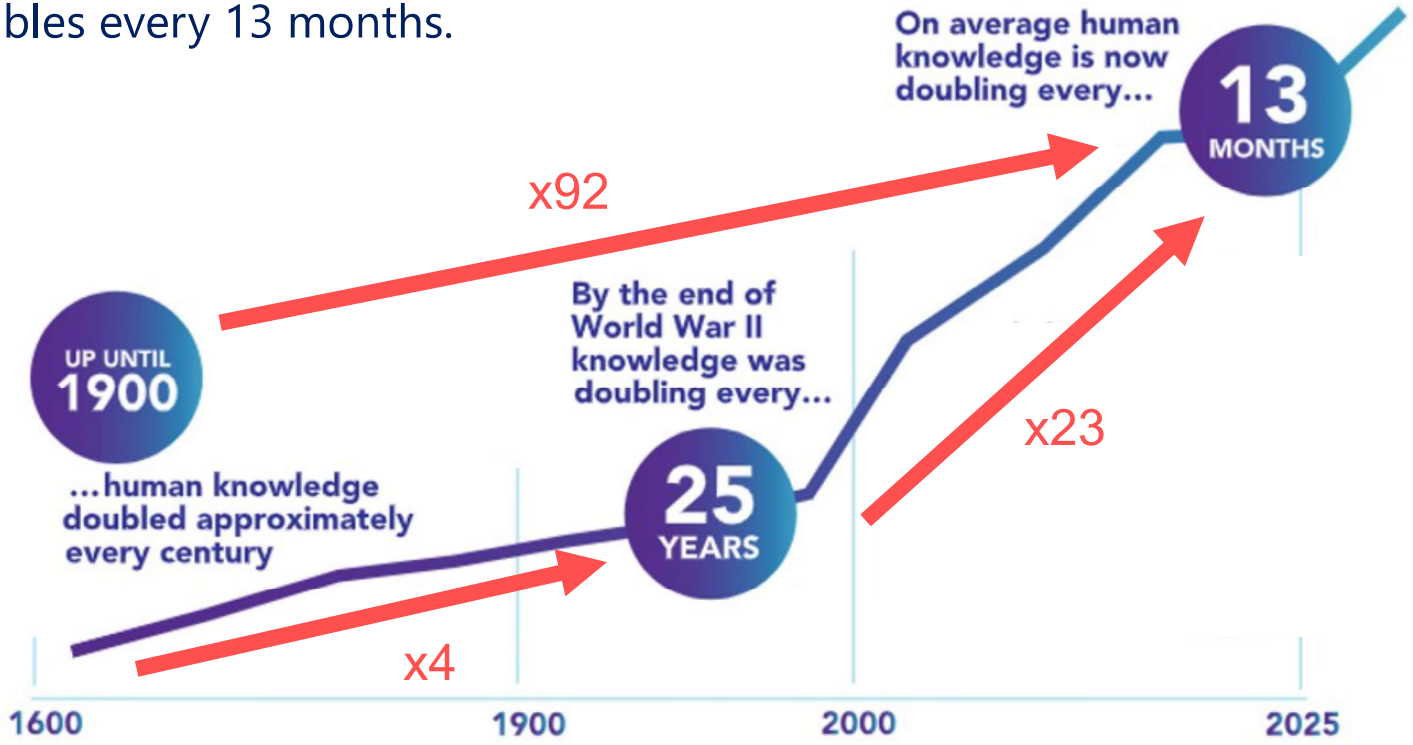
Growth rate of human knowledge

- Until about 1900, it doubled every 100 years.
- By 1945, it doubled every 25 years.
- Now it doubles every 13 months.



The Knowledge Doubling Curve FIRE YOUR HIRING HABITS BY JOHN W. MITCHELL

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Skill Domains of Data Center Professionals

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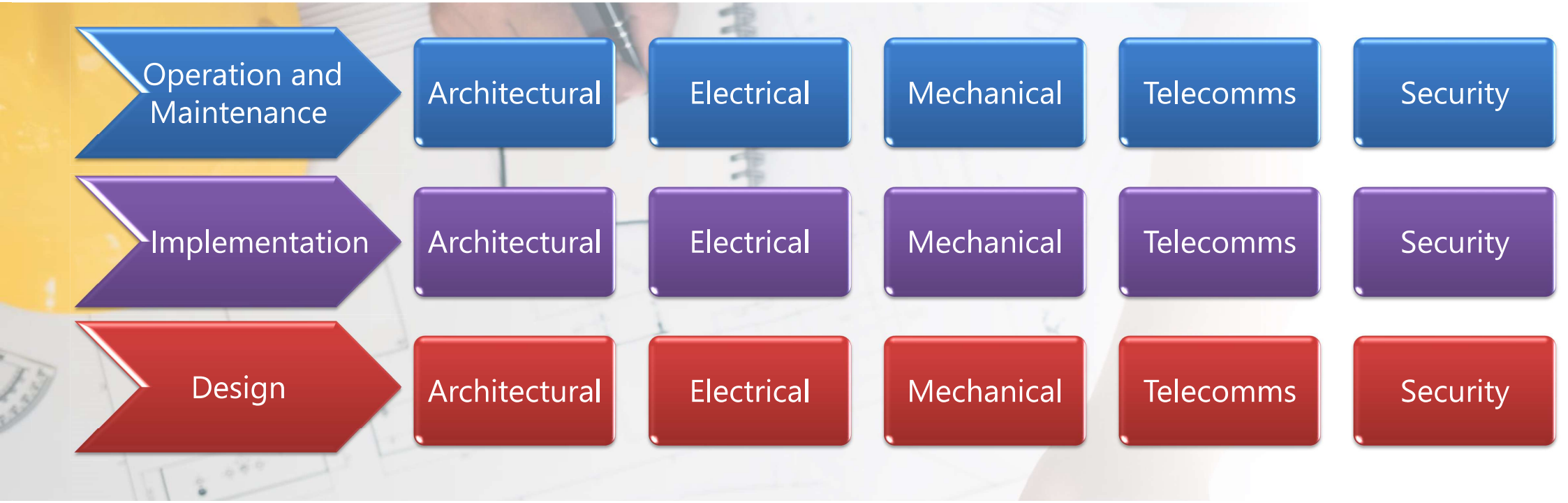
Skill domains in the field of data center facilities



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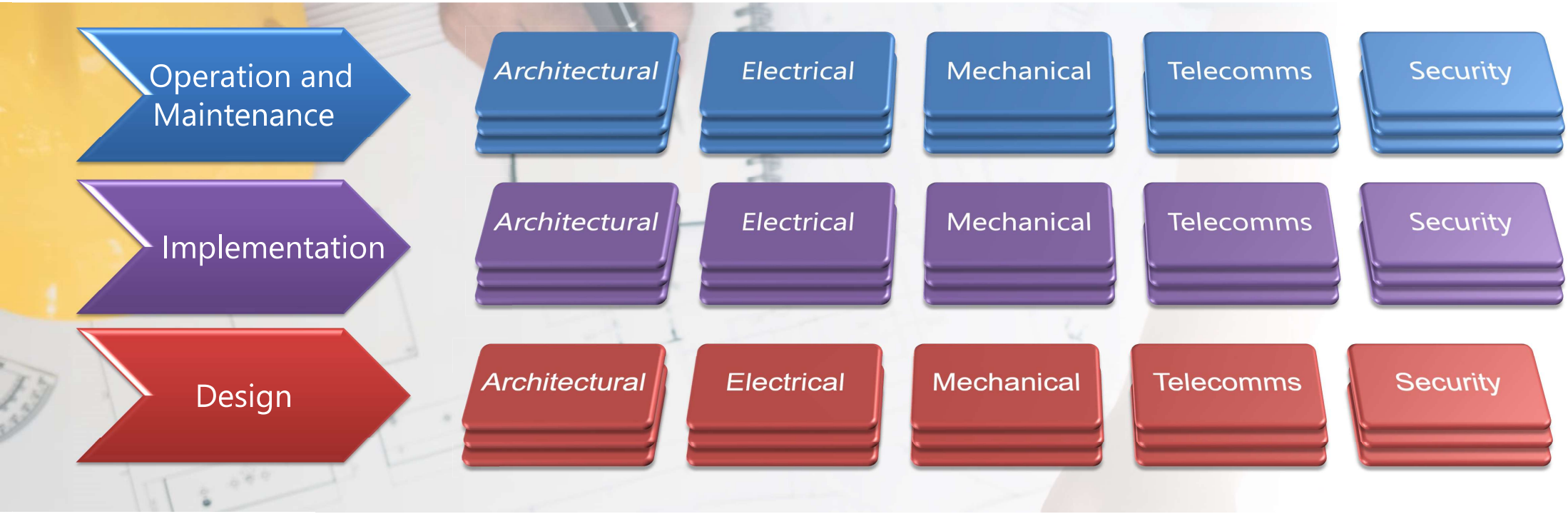
Skill domains in the field of data center facilities



Each domain is split into levels of experience from beginner to expert and it takes 3-5 years or sometimes 7+ years to progress.

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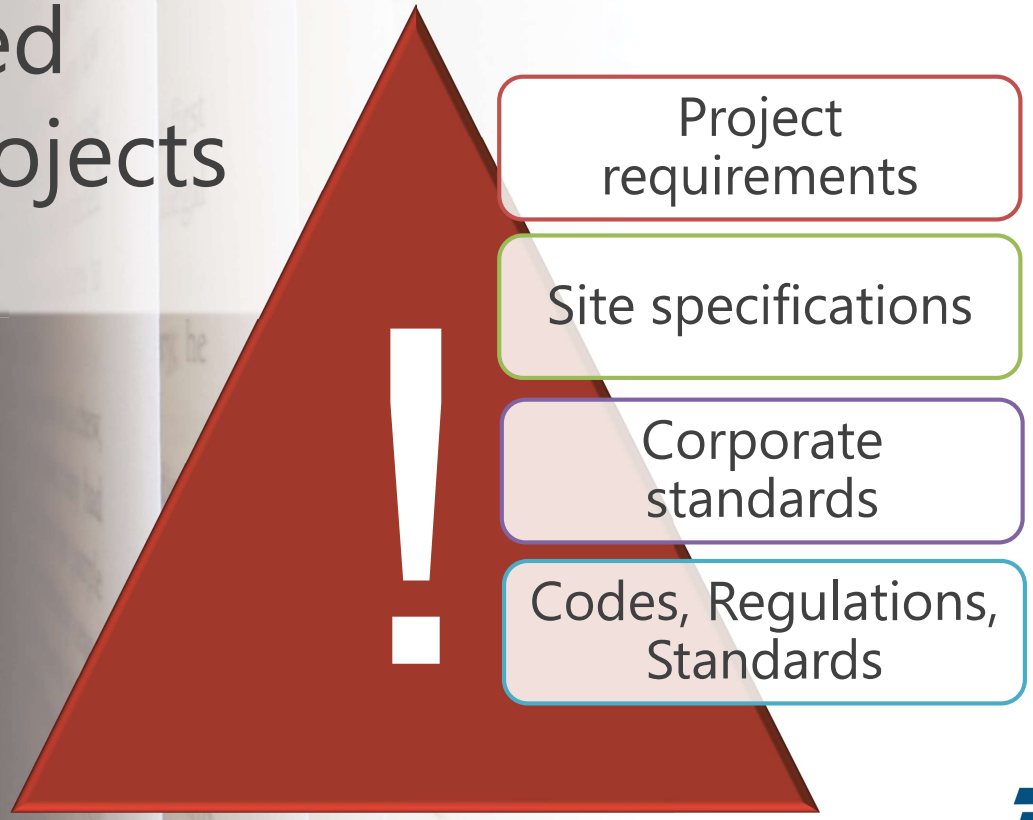
Rules and requirements to be followed in data center projects



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Improving data center reliability

Greater Redundancy

- More and more diverse facilities
- More complex topologies

Reduce human errors

- More procedures and checks
- More personnel and roles

Prevent facility failures

- More metrics and monitored items
- More frequent inspections and items

Improve trouble response

- More preventive measures
- More documentation

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Energy and environmental measures in a data center

- Renewable energy
- Carbon footprint
- Energy efficiency
- Environmental measures
- Green building

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Working environment of a data center personnel

- Working in a closed space
- Working with confidential info
- Working constantly under pressure
- Repetitive work
- Punctual work
- Emergency response

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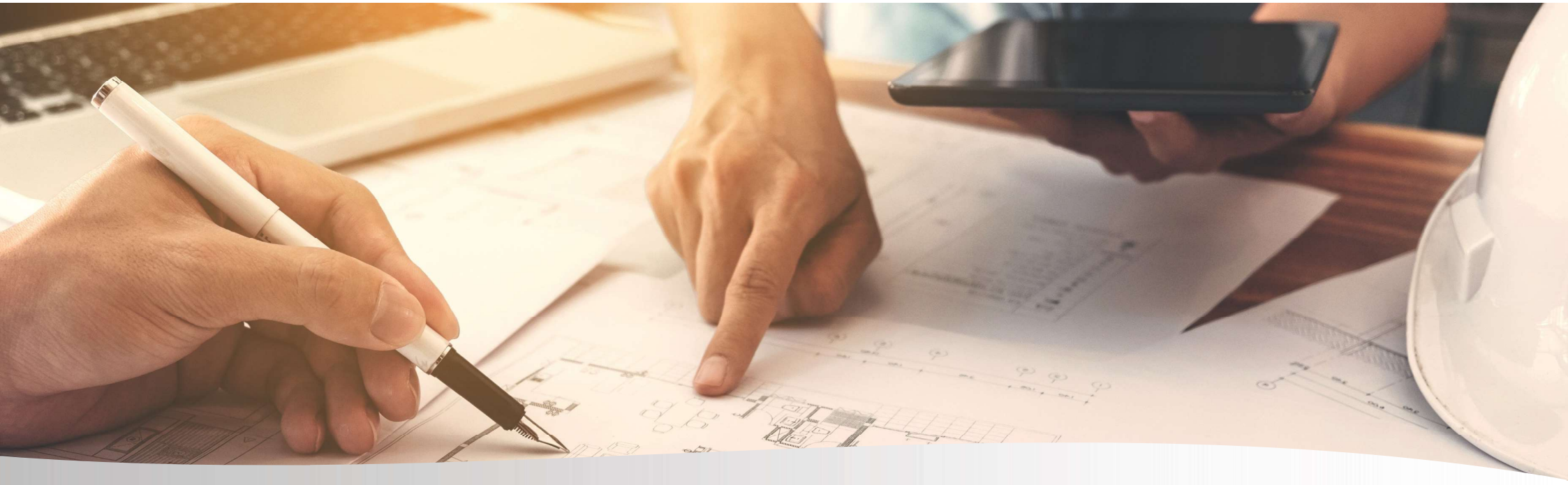

Making up for retiring workforce

- *"23% of (worldwide) data center professionals expect to be retired by 2025"*
- - Retirement of experienced engineers generally lead to loss of important knowledge and experience to the whole industry.
- On the other hand, nurturing their replacement takes both time and effort.

https://www.missioncriticalmagazine.com/ext/resources/whitepapers/Data-Center-2025-Report.pdf

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Where are the data center textbooks?

- What is a standard data center?
- What's right and wrong for a data center?
- Where are the examples?
- How can I learn about other domains of expertise?
- Where can I find a structured reference source?

Data center standards can be a solution

For example, data center standards published by BICSI provides best practices, with requirements and recommendations.

This standard also complements TIA, CENELEC, ISO/IEC and other published data center standards and documents.

The standard includes other guidelines for data centers where appropriate.

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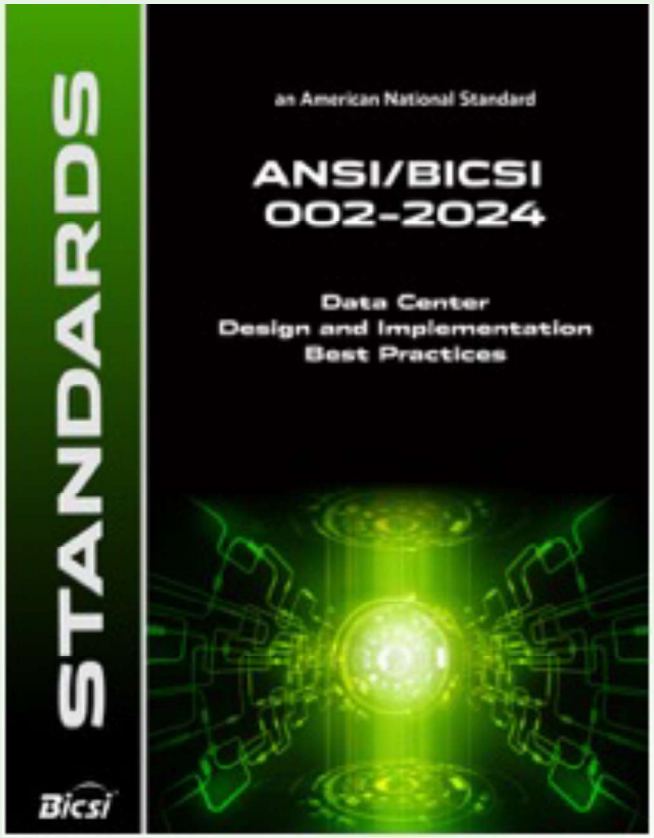
ANSI/BICSI 002-2024

Data Center Design and Implementation Best Practices

- **Design methodology**
  - Facilities, cabling, network, services and applications
  - Data center service outsourcing
  - Colocation planning
- **Site selection and space planning**
  - Edge, modular and "container" data centers
  - Site services and hazards
  - Traditional and open concepts
- **Building structural and architectural requirements**
- **Electrical systems**
  - Utility to ITE power systems
  - Standby and backup power systems
  - DC power
- **Mechanical systems**
  - Heat rejection and cooling systems
  - Ventilation and air flow management
  - Immersion (liquid cooling)
- **Security and fire**
  - Architectural, electronic and operational security
  - Fire safety for chimneys and aisle enclosures
- **Facility and building systems**
  - DCIM
  - IP-enabled and intelligent systems
- **Telecommunications infrastructure**
  - Cabling media and connectivity
  - Hot and cold aisles
  - Cabinet airflow and cabling capacity
- **Network infrastructure**
- **Data center commissioning & maintenance**
- **Energy efficiency**
- **Multi-site data center architecture**
- **Colocation Planning**



17 Chapters
12 Appendices
Total 575 pages

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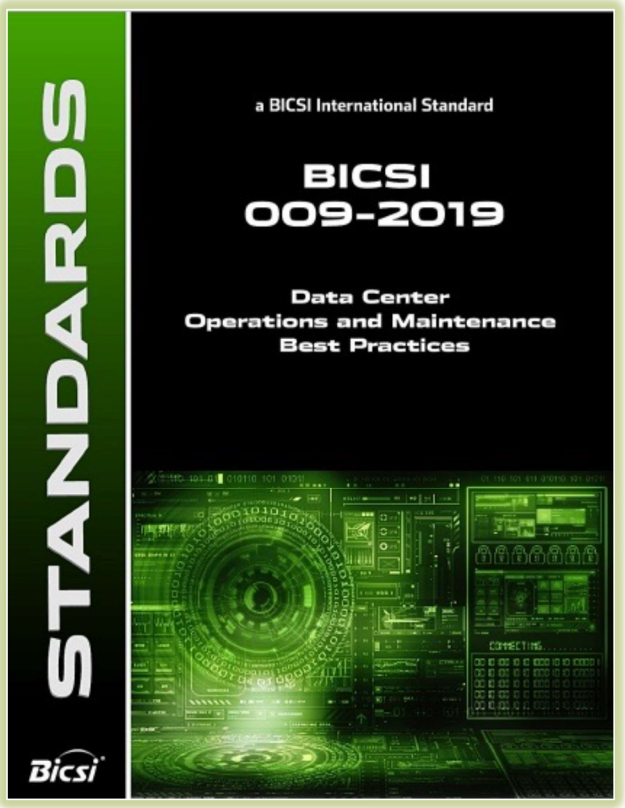
BICSI 009
Data Center Operations and Maintenance Best Practices

- Governance
- Standard operating procedures
  - ICT cut-overs, technology refresh and migration
  - Work orders
  - Work safety
  - Storage, staging, and related tasks
  - Equipment delivery and shipments
- Security
  - Security plan
  - Physical, cyber & IT security
  - Material control and loss prevention
  - Computer room and critical facility areas special considerations
  - Event response
- Maintenance
  - Management
  - Maintenance plans and contracts
  - Patrols and inspections
  - ITE moves, adds and changes
  - Power, cooling, and cabling systems
  - Building area and physical space maintenance
- Emergency operating procedures
  - On-site and offsite events
  - Emergency response
  - Disaster recovery
- Management
  - Operations management
  - Management tools (e.g., DCIM, BMS, AIM)
  - Service provider management
  - Change control and documentation



10 Chapters
1 Appendix
Total 140pages

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Services for data center industry provided by BICSI

Standards and publications

- ANSI/BICSI 002Data Center Design and Implementation Best Practices
- BICSI 009Data Center Operations and Maintenance Best Practices
- Essentials of Data Center Projects

Training program

- DC101: Introduction to Data Center Design
- DC102: Applied Data Center Design and Best Practices
- DCDC Test Preparation Course

Credential program

- Data Center Design Consultant™ (DCDC®)

Networking and conferences

- Seminars, Conferences and Exhibitions
- Professional committees
- Technical volunteering

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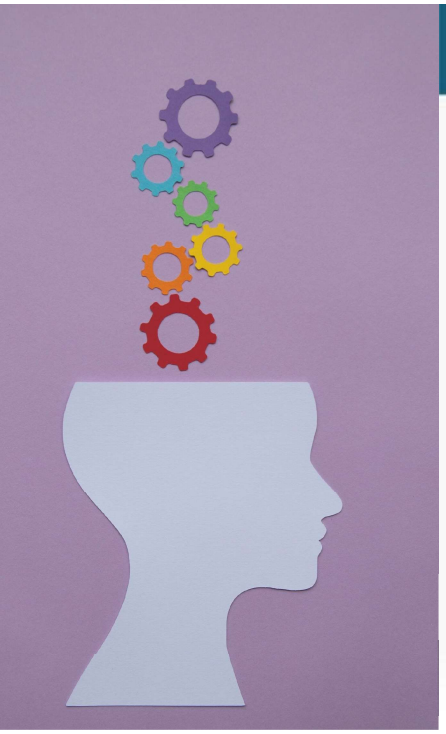
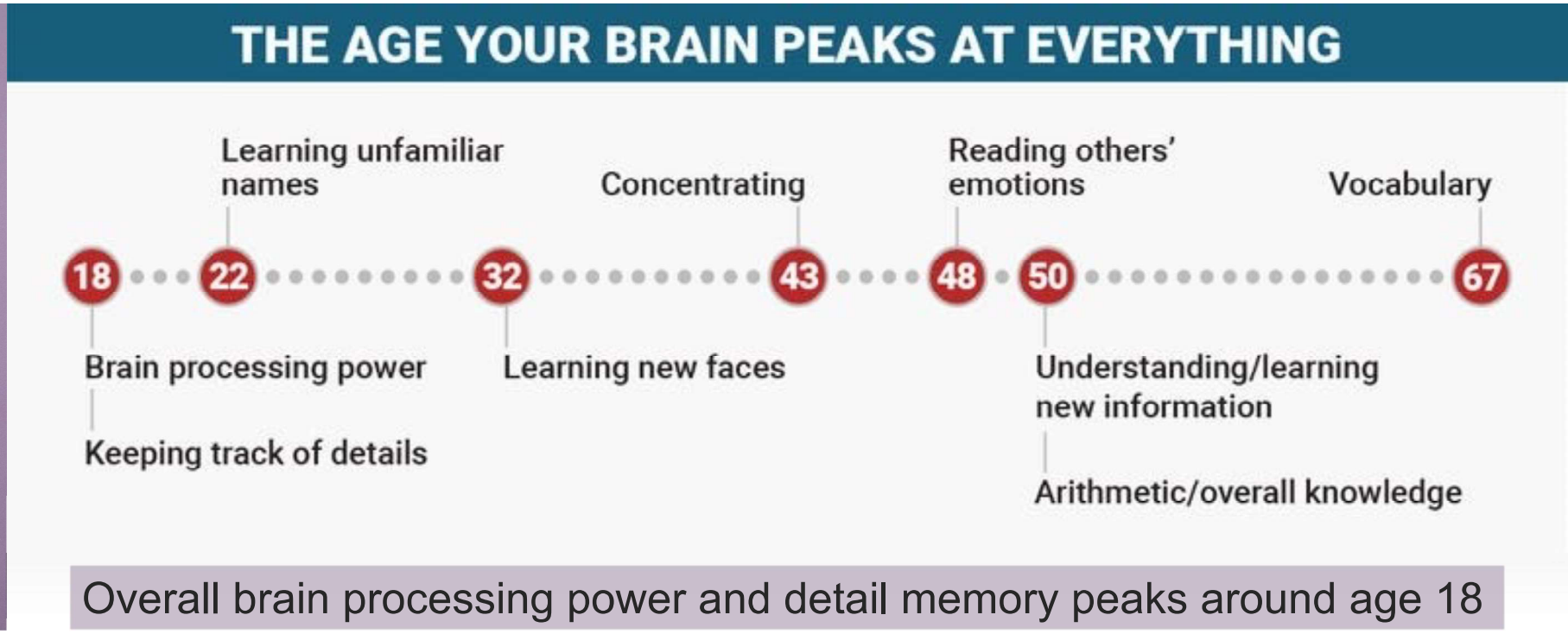
Peak of brain power through human age





Overall brain processing power and detail memory peaks around age 18

https://xtech.nikkei.com/atcl/learning/column/19/00023/00001/?P=3
https://www.businessinsider.com/smartest-age-for-everything-math-vocabulary-memory-2017-7#overall-brain-processing-power-and-detail-memory-peaks-around-age-18-1

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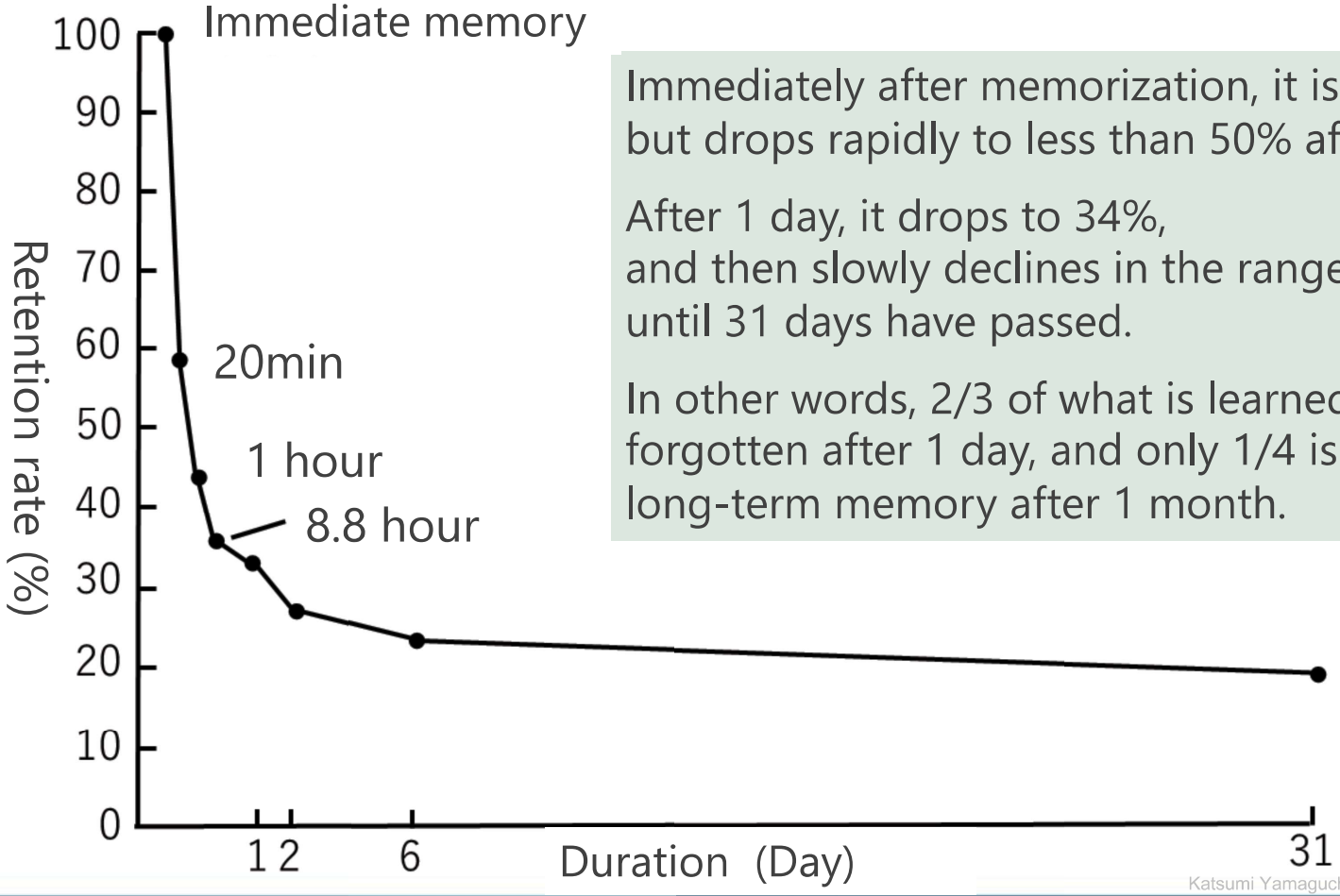
Ebbinghaus' forgetting curve



Immediately after memorization, it is 100%, but drops rapidly to less than 50% after 1 hour.

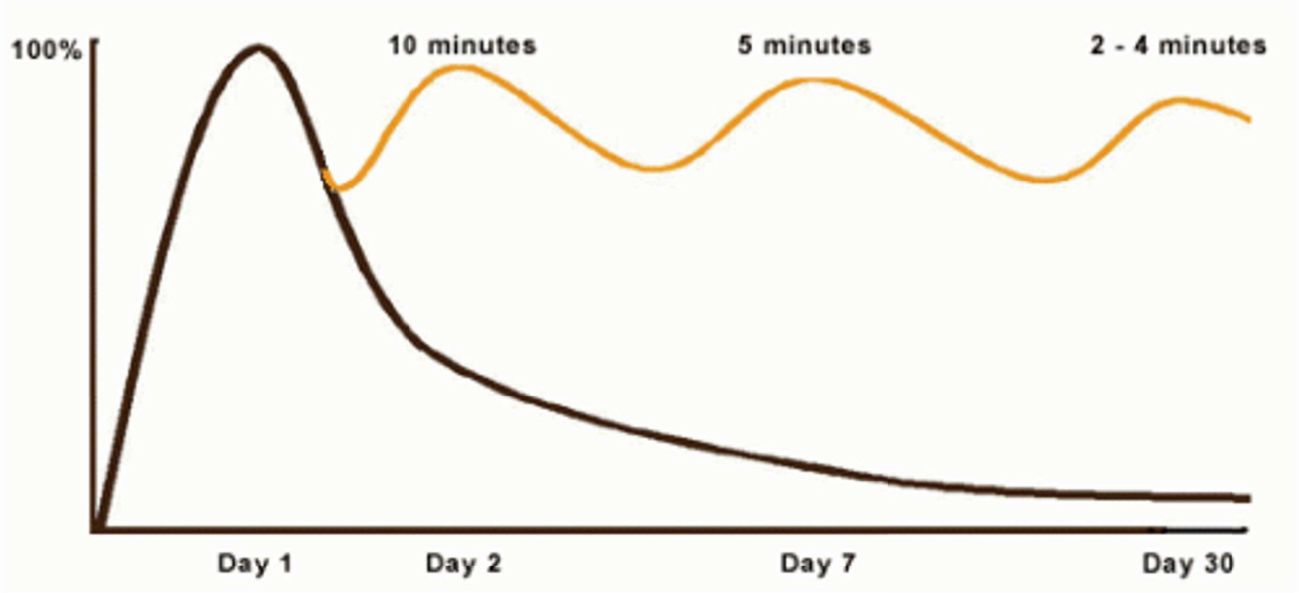
After 1 day, it drops to 34%, and then slowly declines in the range of 20-30% until 31 days have passed.

In other words, 2/3 of what is learned is forgotten after 1 day, and only 1/4 is retained as long-term memory after 1 month.

Katsumi Yamaguchi, 2014: Introduction to Psychology, p.44

University of Waterloo's Forgetting Curve

If they do not review, they would need to re-study for 40-50 minutes before the knowledge is tested.



Reviewing within one day is very important and missing that opportunity will require a significant level of effort to relearn afterwards.

https://uwaterloo.ca/campus-wellness/curve-forgetting

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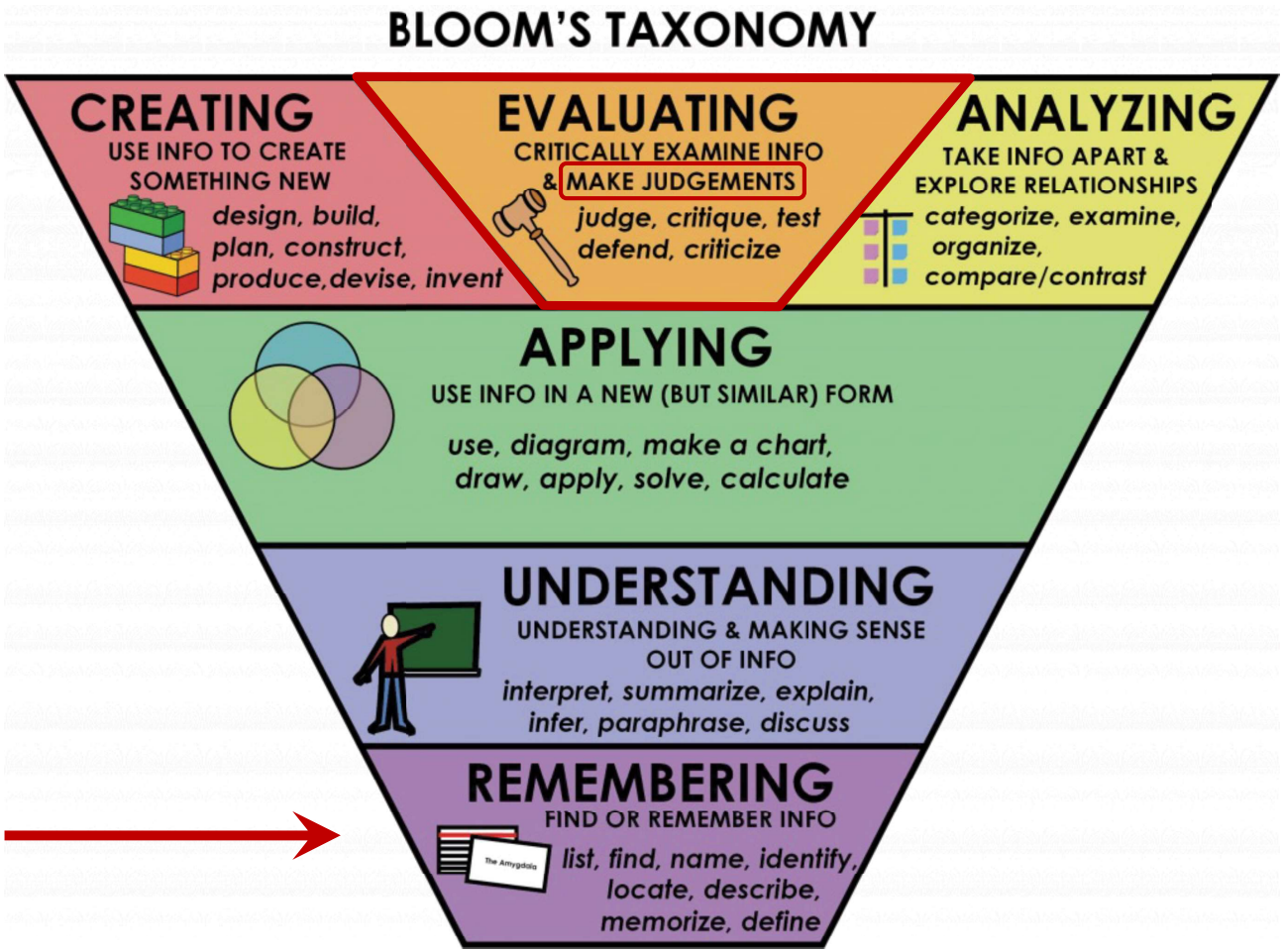
Reviewing is VERY important

Reviewing has equal value to opening a new page and tackling a new topic.
Memorizing is not a goal of learning.
Memorizing the results of learning is important.
Review allows knowledge to be stored for the long term.
Review is essential to learning.

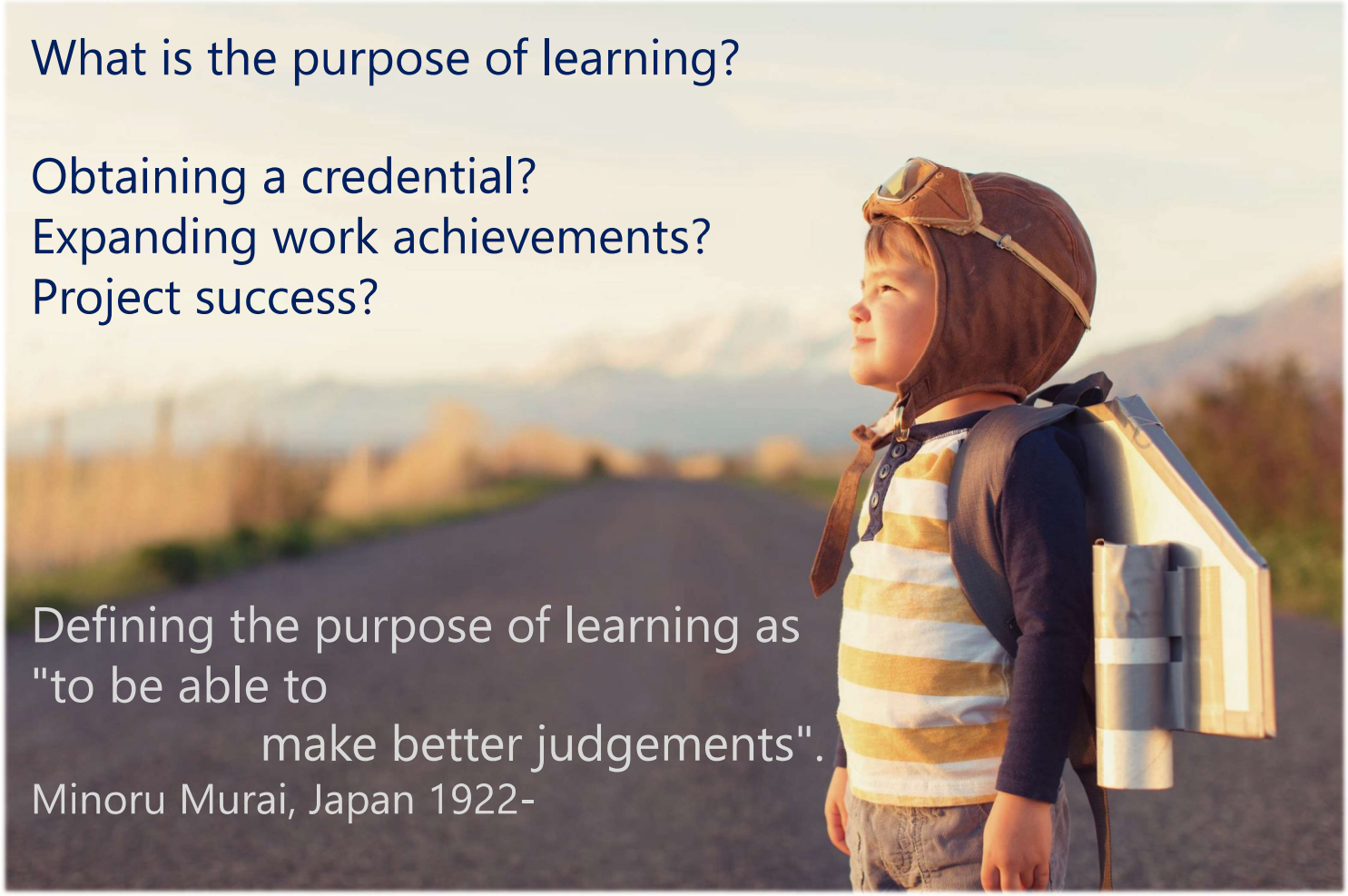
Now, everyone, "Do you UNDERSTAND?"

Revised Bloom's Taxonomy



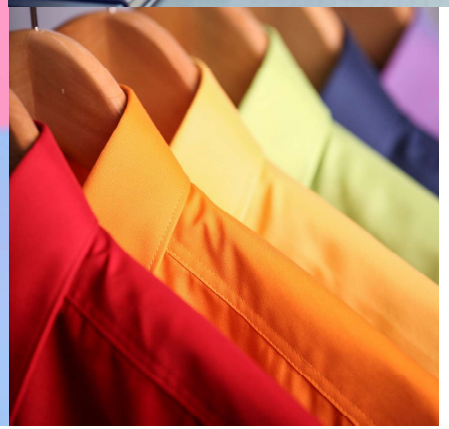
https://kpu.pressbooks.pub/learningtolearnonline/chapter/use-critical-questioning-and-reflection-to-support-your-learning/

What is the purpose of learning?



What is making judgement for the better?

People live their lives from the time they wake up in the morning to the time they go to bed, making many thousands of "judgments" like,
"Is this the right thing to do?"



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What is making judgement for the better?

When you decide that this is "good", you are probably selecting a state or condition that is "just right" for you.



And you may decide that “this is just right” for this occasion.

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What is making judgement for the better?

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What is making judgement for the better?

- If we want to do a better job, do a better project, or educate staff better, we need to learn to expand our own “goodness” so that we can make better judgements.

The purpose of our learning as
“to be able to make better judgements”

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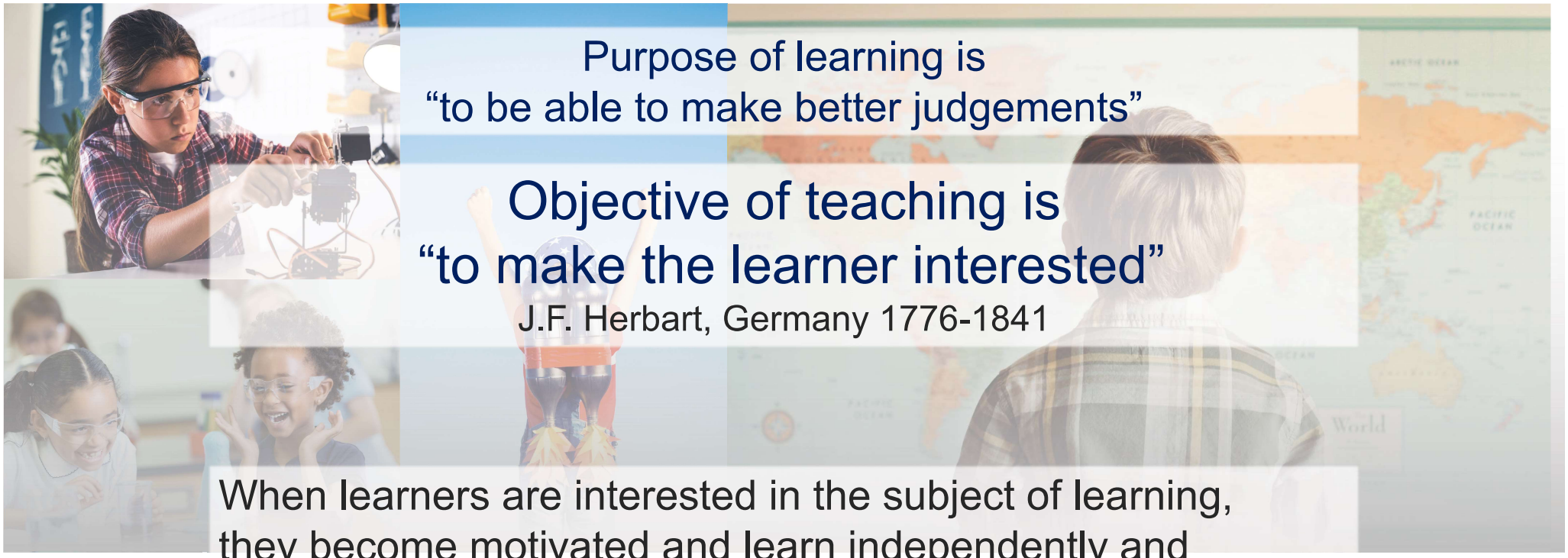
What is making judgement for the better?

No one knows
when to make the judgment.

Objective of teaching



Purpose of learning is
“to be able to make better judgements”

Objective of teaching is
“to make the learner interested”

J.F. Herbart, Germany 1776-1841

When learners are interested in the subject of learning, they become motivated and learn independently and autonomously, leading to a better daily life and work.

Shinichi Ushida, 2017: Die Stelle des Begriffs „Interesse“ in Bildungslehre von Eggersdorfer, F. X.
https://www.soka.ac.jp/files/ja/20170516_235932.pdf

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Summary

- Learn until you understand to make better judgements, not until you memorize.
- Reviewing past pages is equal to opening a new page.
- Try to broaden and deepen the scope of your learning. Shallow, quick approaches are not effective.
- Let's define the purpose of learning as to make better judgements.
- To do this, let's make the learning itself better.
- It is important to be interested in the subject of learning.
- If you are interested, you will be motivated.
- Being taught by someone else is an opportunity to become interested.

Move on to evaluate the impact of this presentation!!


DID YOU
KNOW
?
2023
Porto
Business
School
José Esteves

Now you know...

- Knowing leads to learning, through questioning, and generating interest.
- Questioning leads to better judgements.
- To keep questioning is to keep learning, and questions are not asked by someone else, but come from within ourselves.
- The questions that come out from within you are unique to you.
- A question becomes a cause, an answer becomes a result, and a result also leads to new questions.

To make better judgements, it is important to keep learning.

Thank You!

Rui Takei , RCDD, DCDC, B.Ed.

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Sources

Annual amount of data generated on the internet

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https://creativecommons.org/licenses/by-sa/3.0/

Growth rate of human knowledge

The Knowledge Doubling Curve FIRE YOUR HIRING HABITS BY JOHN W. MITCHELL

Making up for retiring workforce

https://www.missioncriticalmagazine.com/ext/resources/whitepapers/Data-Center-2025-Report.pdf

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https://www.soka.ac.jp/files/ja/20170516_235932.pdf

DID YOU KNOW 2023

https://www.youtube.com/watch?v=u_7G8Xy61zs

(As of 2024. March 22)

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