NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

Technology Innovation - Construction
技术创新 - 建筑科技

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97905202

Agenda

- 技术创新 - Technology Innovation -Construction
-人工智能和机器学习 - AI and machine learning
- 科学研究论文Scientific Research Paper – IMRAD
- 增强现实,虚拟现实, 元宇宙 – AR VR and Metaverse

Discussion questions

1. How is technology innovation shaping the future of work, and what might be some potential consequences for the global workforce?
2. In what ways can technology innovation exacerbate social inequalities, and how can societies work to ensure benefits are more evenly distributed?
3. What ethical considerations should be taken into account when developing new technologies, especially those that could have significant impacts on privacy and personal freedoms?
4. How do emerging technologies, like artificial intelligence and machine learning, challenge existing regulatory frameworks, and what changes might be necessary to keep up?
5. What role should governments play in fostering technology innovation, and should there be limits to state involvement?
6. Can technology innovation be environmentally sustainable, and what are some examples of technologies that balance progress with ecological responsibility?
7. How is technology innovation influencing education and learning, and what might be the long-term impacts on human cognitive abilities?
8. What are the implications of technology innovation for healthcare, and how can it improve or complicate patient care?
9. How does the rapid pace of technology innovation impact cultural and societal norms, and are there ways to mitigate potential cultural disruptions?
10. What measures can be implemented to protect consumers from the potential risks associated with new technologies, such as data breaches or the loss of jobs to automation?

1. 技术创新如何塑造工作的未来，对全球劳动力市场可能产生哪些后果？
2. 技术创新在哪些方面可能加剧社会不平等，社会应如何努力确保利益更公平分配？
3. 在开发可能对隐私和个人自由产生重大影响的新技术时，应考虑哪些伦理问题？
4. 新兴技术，如人工智能和机器学习，如何挑战现有的监管框架，需要进行哪些变革？
5. 政府在促进技术创新方面应该扮演什么角色，国家介入的界限应该是什么？
6. 技术创新能否环境可持续，有哪些技术实现了进步与生态责任的平衡？
7. 技术创新如何影响教育和学习，长期来看可能对人类认知能力有什么影响？
8. 技术创新对医疗保健有哪些影响，它是如何改善或复杂化病人护理的？
9. 技术创新的快速发展如何影响文化和社会规范，有哪些方式可以缓解可能的文化冲突？
10. 可以实施哪些措施来保护消费者免受新技术潜在风险的侵害，如数据泄露或失业到自动化？

Video

- 【【发明家】4种新发明的现代建筑技术，施工更加高效省力】https://www.bilibili.com/video/BV18r4y1L76p/?share_source=copy_web
- 【中国基建，到底有多强？】https://www.bilibili.com/video/BV1Z34y1j7mm/?share_source=copy_web
- 【中国的20个最令人称奇的建筑 20 Most Amazing Architecture in China 中文字幕】https://www.bilibili.com/video/BV1Ex411Q7g1/?share_source=copy_web
- 【观天下：建筑行业的未来，全自动化建造技术】https://www.bilibili.com/video/BV1kz4y1R71a/?share_source=copy_web
- 【央视报道远大《零碳之路》体验堪称世界上最极端的节能建筑——活楼的建筑技术】https://www.bilibili.com/video/BV1cj411h79K/?share_source=copy_web
- 【技术创新-什么是技术创新？】https://www.bilibili.com/video/BV1RK4y1j7LR/?share_source=copy_web
- 【为啥我们要大力发展技术创新？】https://www.bilibili.com/video/BV1Lc411D7DV/?share_source=copy_web
- 【华为：以技术创新为基础的全球化崛起之路】https://www.bilibili.com/video/BV1aA411z7oC/?share_source=copy_web

Dr TT

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PhD in Computer Engineering at Nanyang Technological University
Doctor of Business Administration, MBA (University of Newcastle)
LLM (NUS), LLB and LLM (University of London)
CFA, ACCA, CIMA
Chartered Accountant Singapore, Malaysia and Australia
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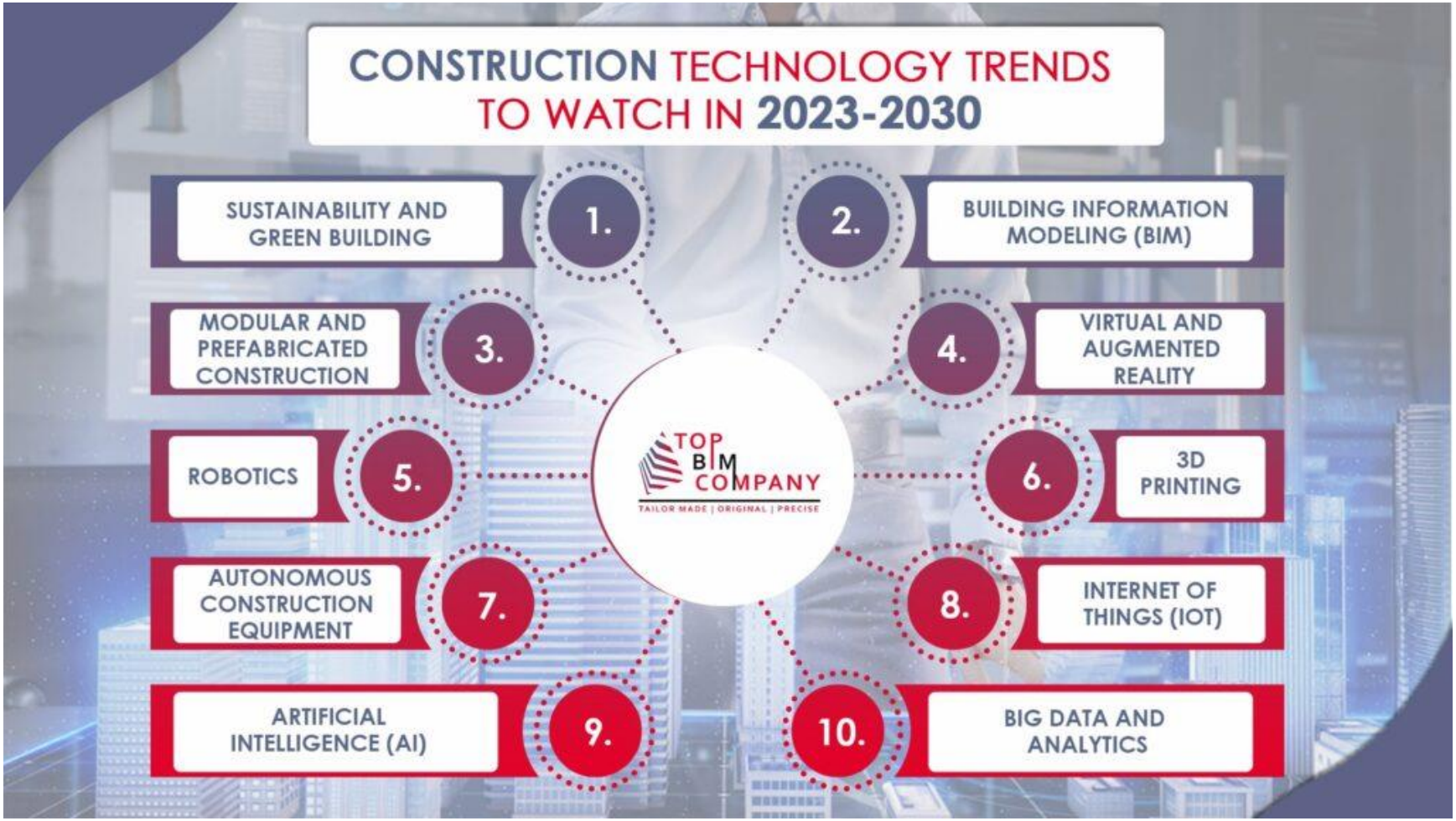
南洋商学院数据分析与人工智能高级讲师
南加州大学电气工程学士学位和计算机工程硕士学位
南洋理工大学计算机工程博士学位
工商管理学博士，工商管理硕士（纽卡斯尔大学）
法学硕士（NUS），法学学士和法学硕士（伦敦大学)
CFA, ACCA and CIMA
特许会计师新加坡、马来西亚和澳大利亚
15 years of teaching
25 years of research
45 Publications
15年的教学
25年的研究
45种出版物

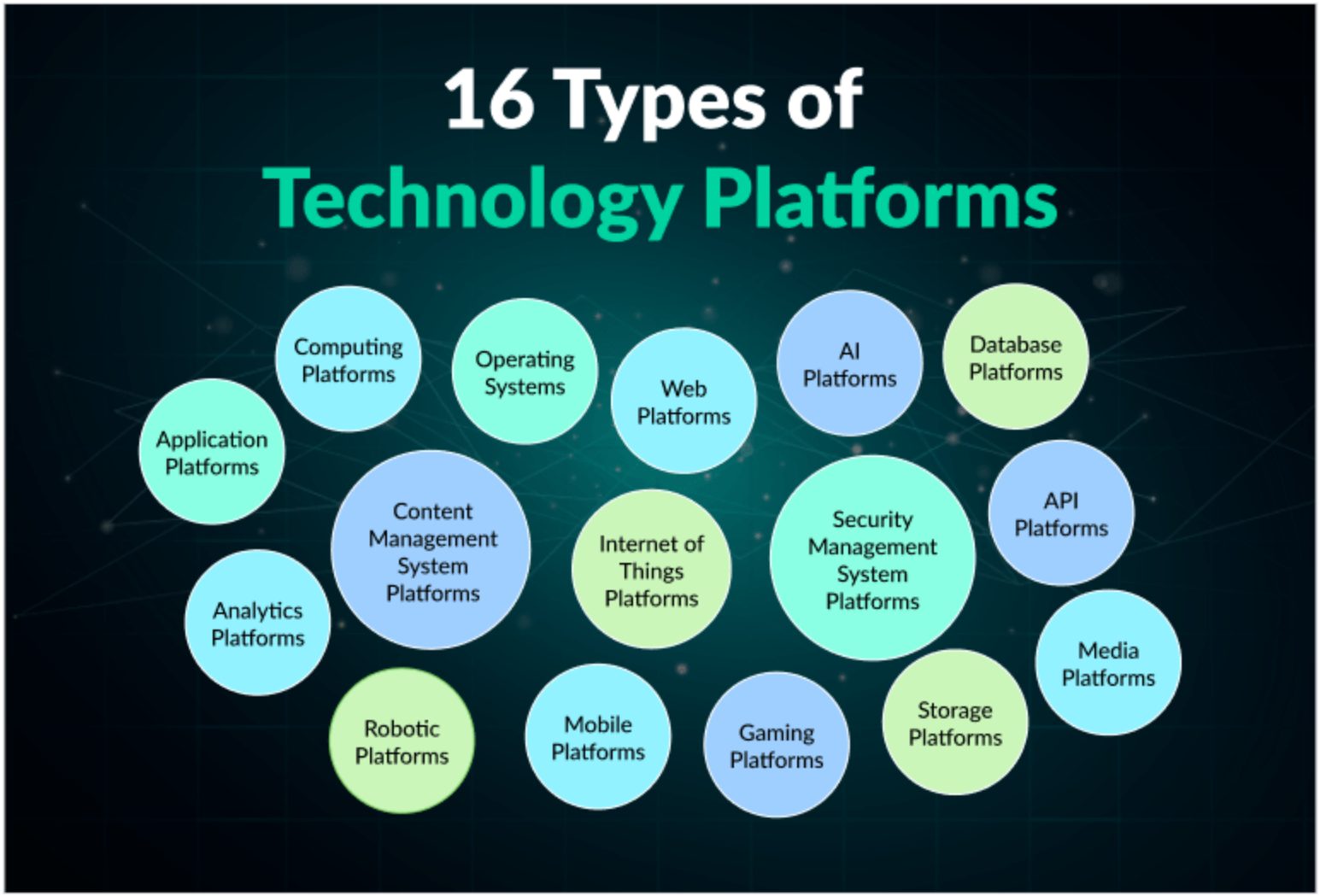
Teaching in NTU

- Bachelor : AI in Accounting and Finance
  本科学士：会计和金融方面的人工智
- Master : AI and Big Data in Business
  硕士：商业大数据
- Master : AI with Advanced Predictive Techniques in Finance
  硕士：金融高级预测技术的人工智能
- Master of Science in Business Analytics (July 2020)
  商业分析硕士(2020年7月)

Singapore

TODAY
2030


CONSTRUCTION TECHNOLOGY TRENDS TO WATCH IN 2023-2030
1. SUSTAINABILITY AND GREEN BUILDING
2. BUILDING INFORMATION MODELING (BIM)
3. MODULAR AND PREFABRICATED CONSTRUCTION
4. VIRTUAL AND AUGMENTED REALITY
5. ROBOTICS
6. 3D PRINTING
7. AUTONOMOUS CONSTRUCTION EQUIPMENT
8. INTERNET OF THINGS (IOT)
9. ARTIFICIAL INTELLIGENCE (AI)
10. BIG DATA AND ANALYTICS
TOP BIM COMPANY
TAILOR MADE | ORIGINAL | PRECISE


16 Types of
Technology Platforms
Computing Platforms
Operating Systems
Web Platforms
AI Platforms
Database Platforms
Application Platforms
Content Management System Platforms
Internet of Things Platforms
Security Management System Platforms
API Platforms
Analytics Platforms
Media Platforms
Robotic Platforms
Mobile Platforms
Gaming Platforms
Storage Platforms

Types of Innovation

Radical innovation

It **changes the circumstances of a brand**, whether in terms of market or of business dynamics.

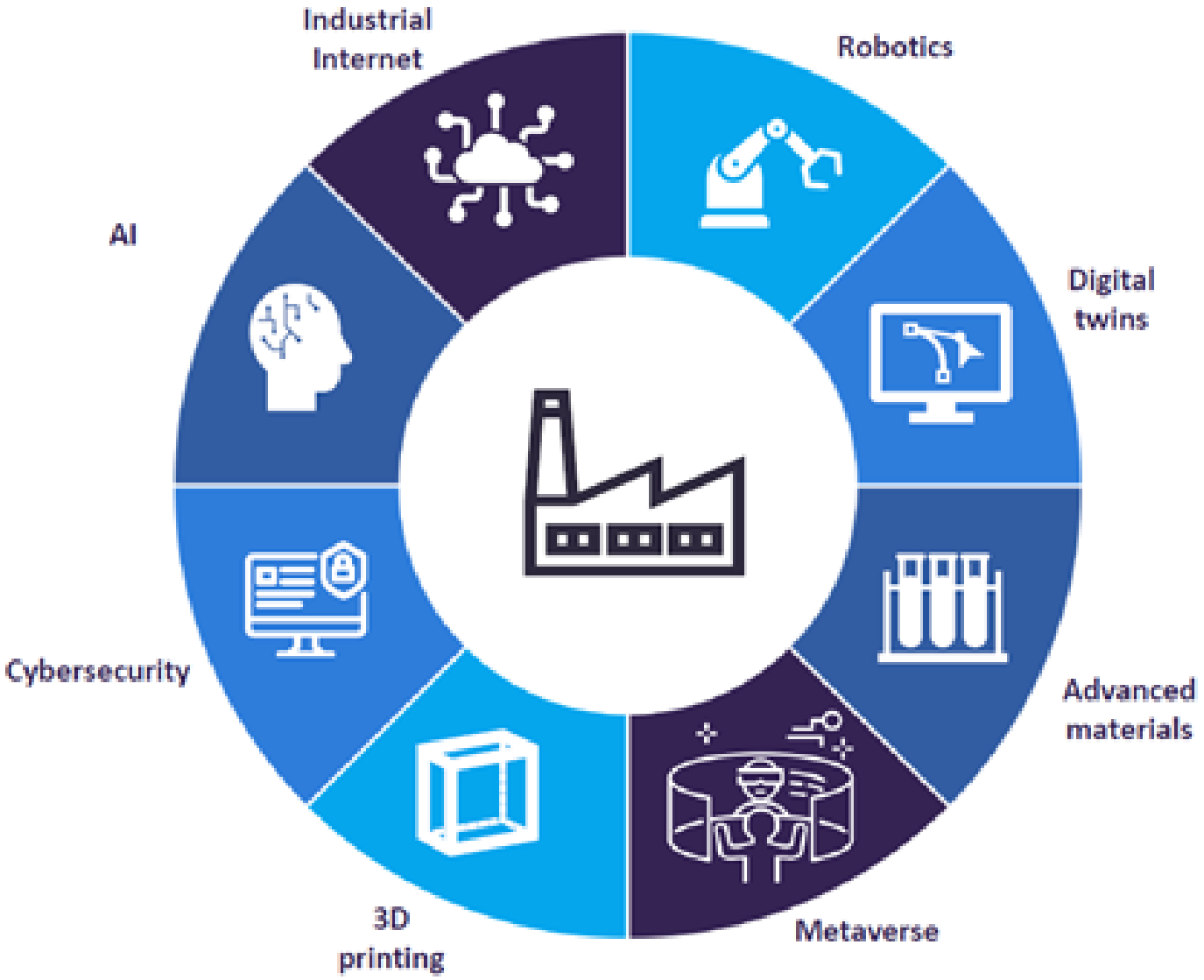
Incremental innovation

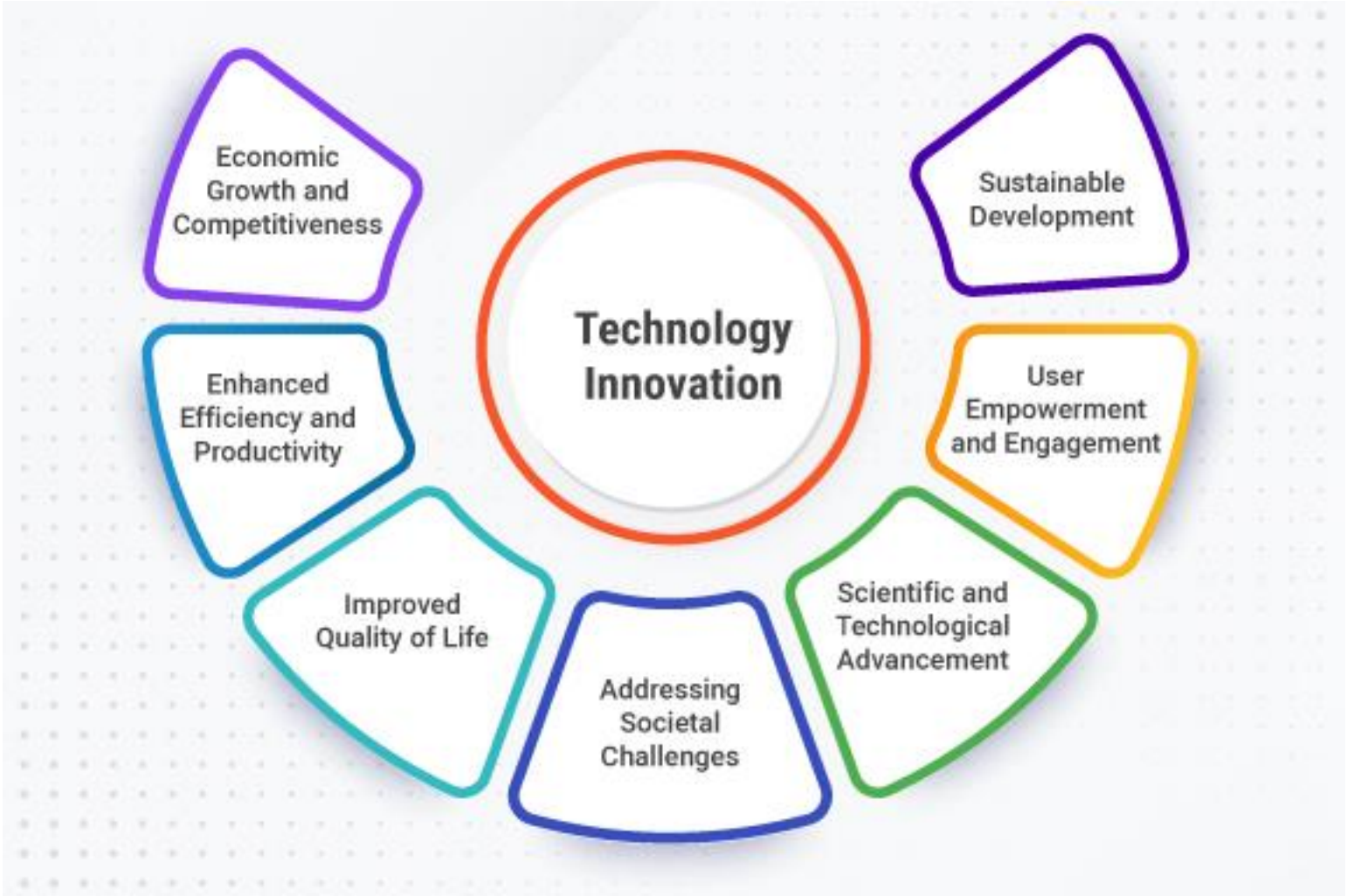
It **adds new features** to a product, brand, or production methods without promoting a very drastic change.

Disruptive innovation

It follows the market more than a specific brand. It's a **scalable change** that reachs many people at the same time.

SYDLE

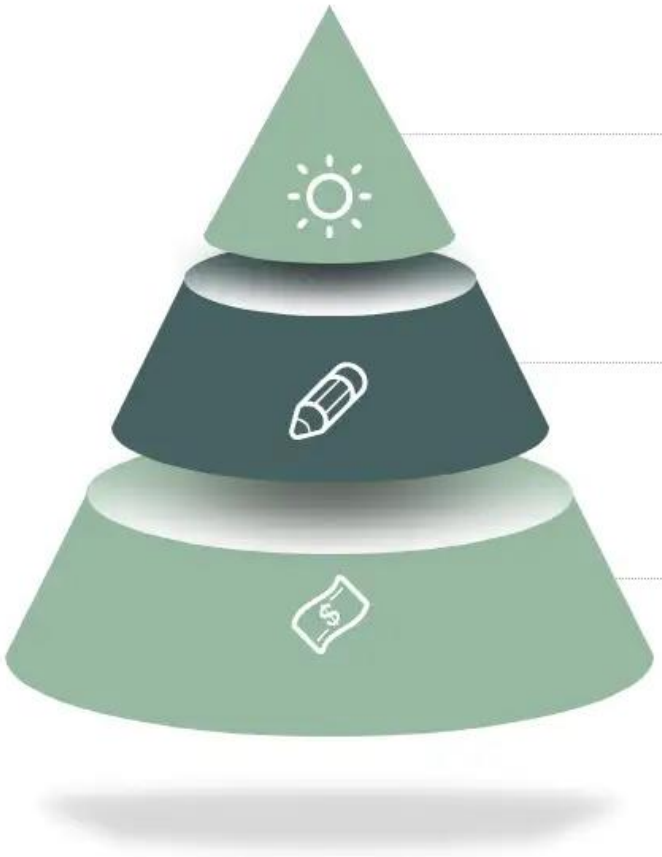

Industrial Internet
Robotics
AI
Digital twins
Cybersecurity
Advanced materials
3D printing
Metaverse


Technology Innovation
Economic Growth and Competitiveness
Sustainable Development
Enhanced Efficiency and Productivity
User Empowerment and Engagement
Improved Quality of Life
Scientific and Technological Advancement
Addressing Societal Challenges

8 Best Examples of Technology Innovation
World-Wide Web
Mobile Technology and Smartphones
Cloud Computing
Artificial Intelligence (AI)
3D Printing
Renewable Energy Technologies
Biotechnology and Genetic Engineering
WaInternet of Things (IoT)Imart

基础
研发
生产
研发
应用
研发
现场生
产技术
品质
管理
产品
管理
技术
服务
技术体系
TECHNOLOGY SYSTEM

芯片
龙芯、飞腾、兆芯.
主板
昆仑卫士
整机
曙光、浪潮、联想
服务器
曙光、浪潮、联想
操作系统
中标麒麟、银河麒麟、中科方德、深之度、普华
应用系统
应用迁移
版式软件
数科、书生、福昕
流式软件
永中、金山
中间件
金蝶、中创、东方通
数据库
人大金仓、达梦、南大通用、神通



1. 具有创新性和先进性
2. 技术创新可持续性
3. 具有高风险性

15所
核心高校
20所
中心
高校
30所
重点高校
浙江大学
山东大学
四川大学
天津大学
清华大学
北京化工大学
华东理工大学
大连理工大学
青岛科技大学
西安交通大学
南京大业大学
中国石油大学（华东）
香港中文大学（深圳）

工程设计与创新
Engineering design and innovation

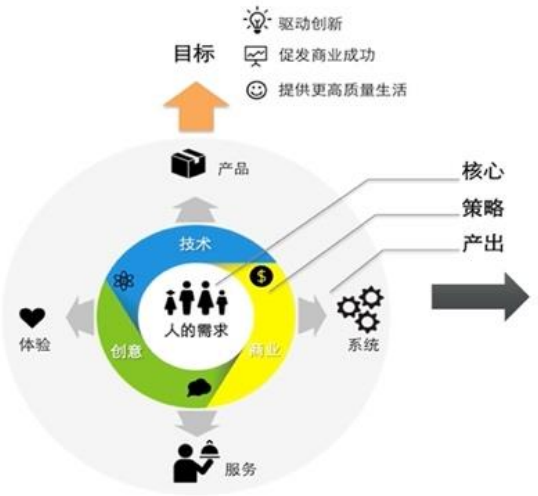
中心与区域发展

Industrial Design Center of Shanghai University of Engineering Science and Shanghai development

上海工程技术大学工业设计中心

上海需求

- 制造业的转型升级
- 创新创业打开局面
- 科创中心文化品牌



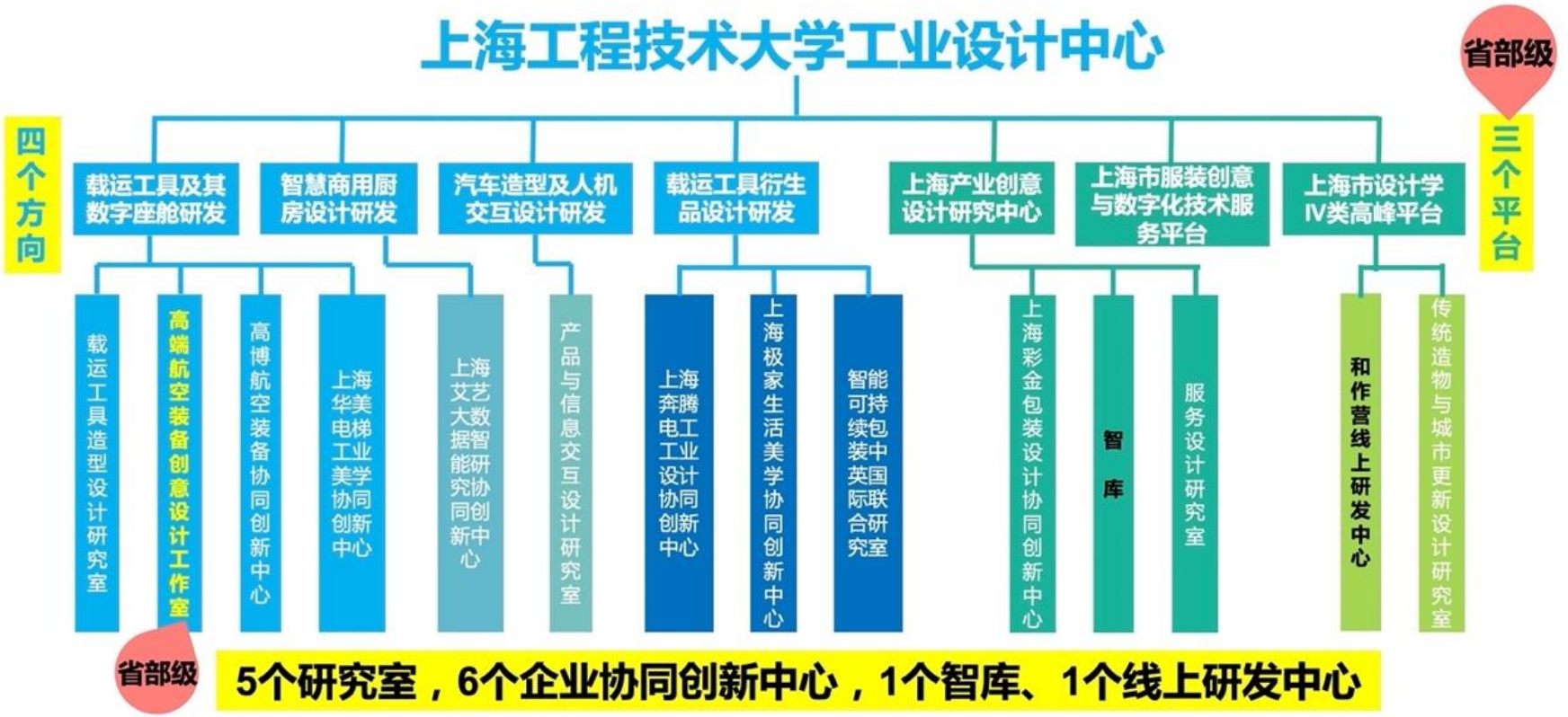
关键问题

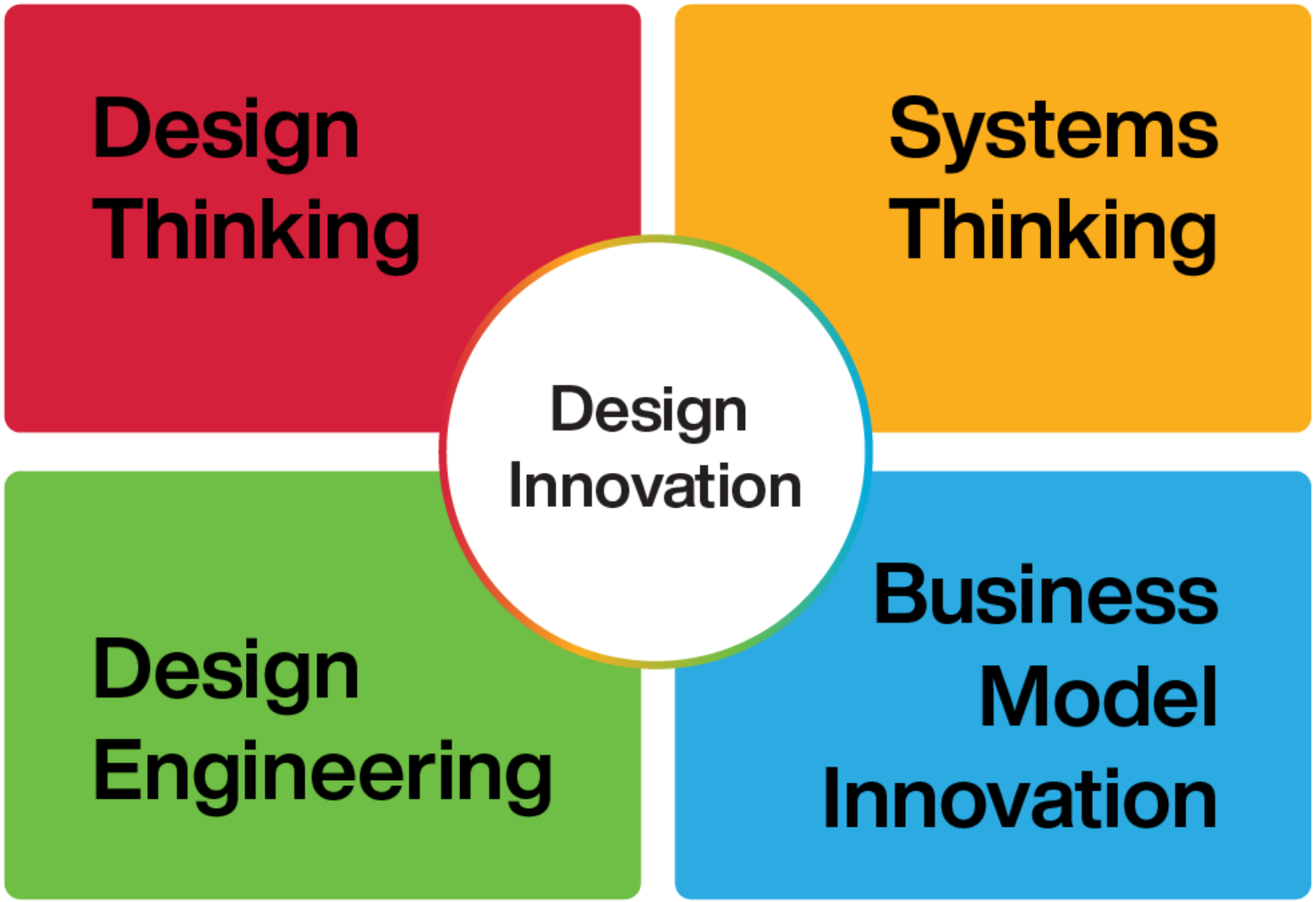
- 设计与先进制造业的相互作用机制
- 设计与现代服务业的相互作用机制
- 设计与创新文化与品牌相互作用机制

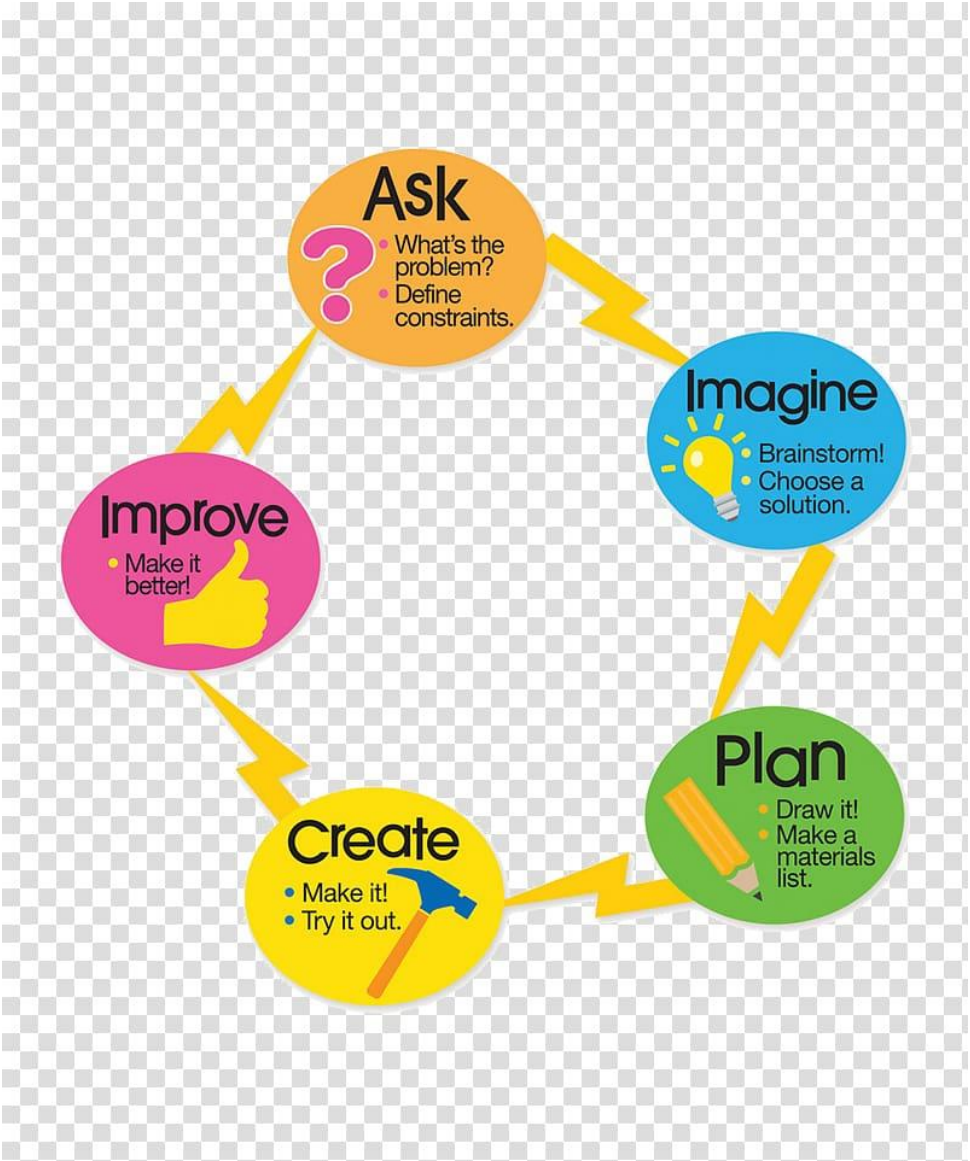
设计驱动创新
design-driven innovation

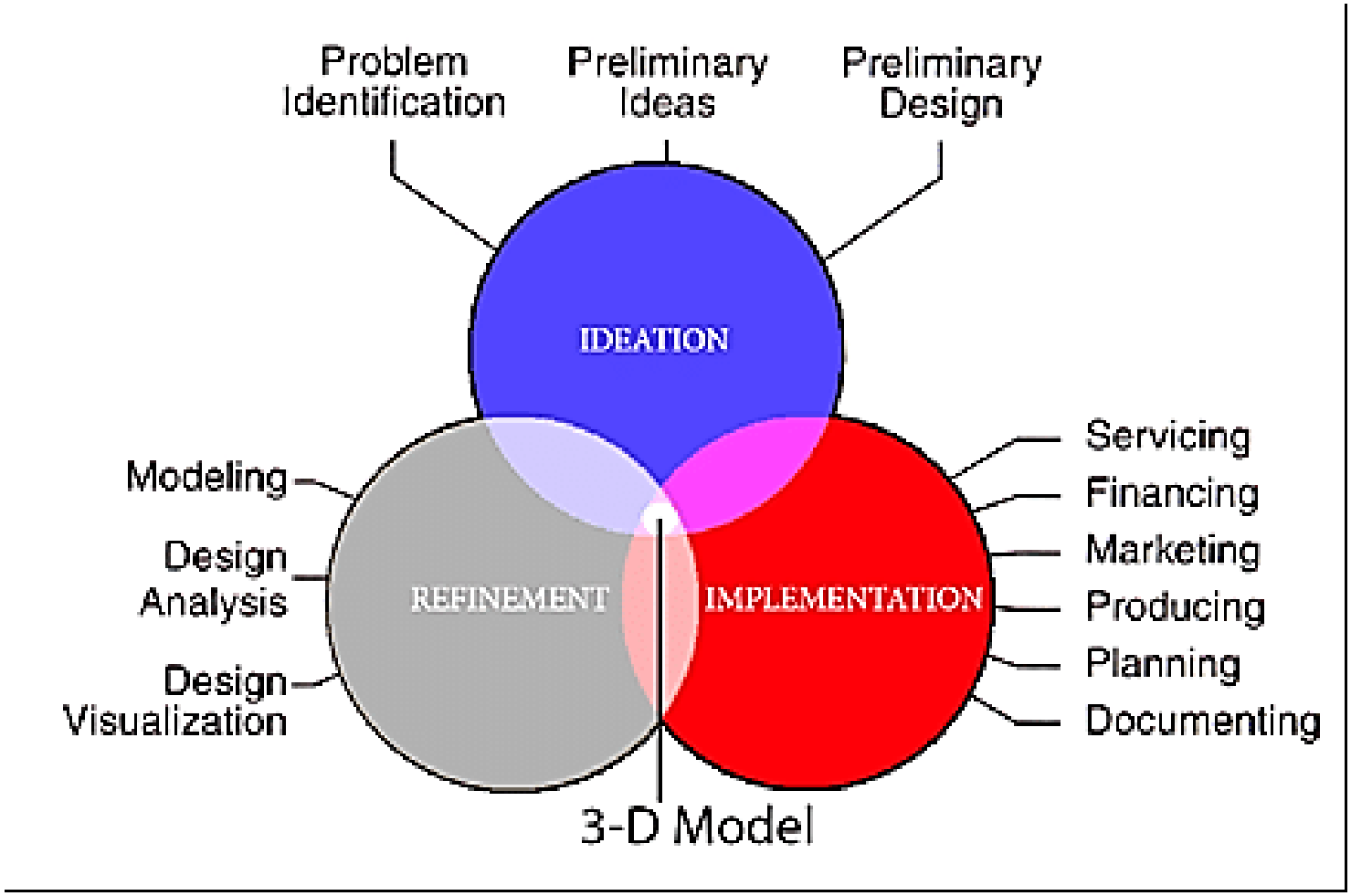
工业设计中心组织架构

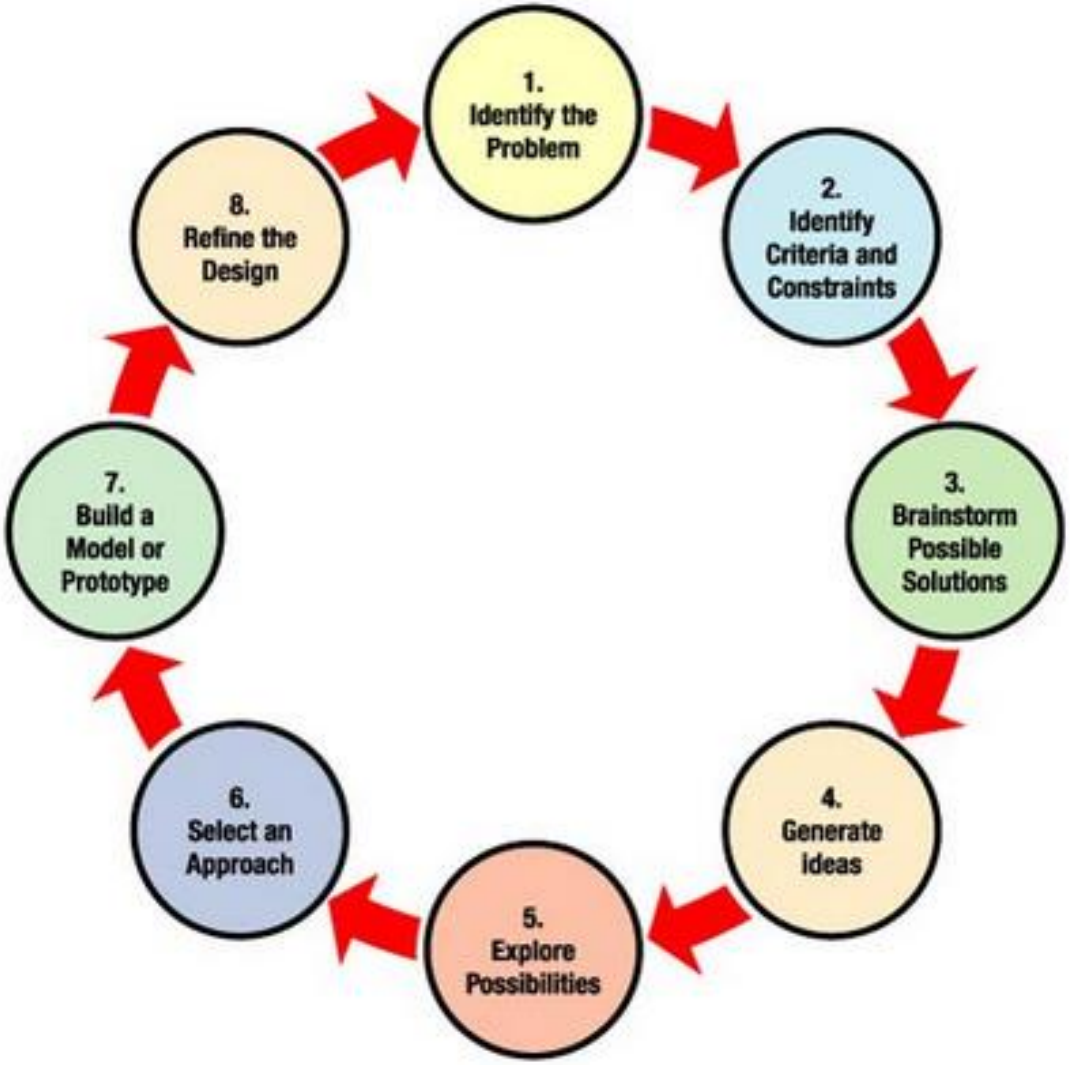
Introduction of the Industrial Design Center of Shanghai University of Engineering Science

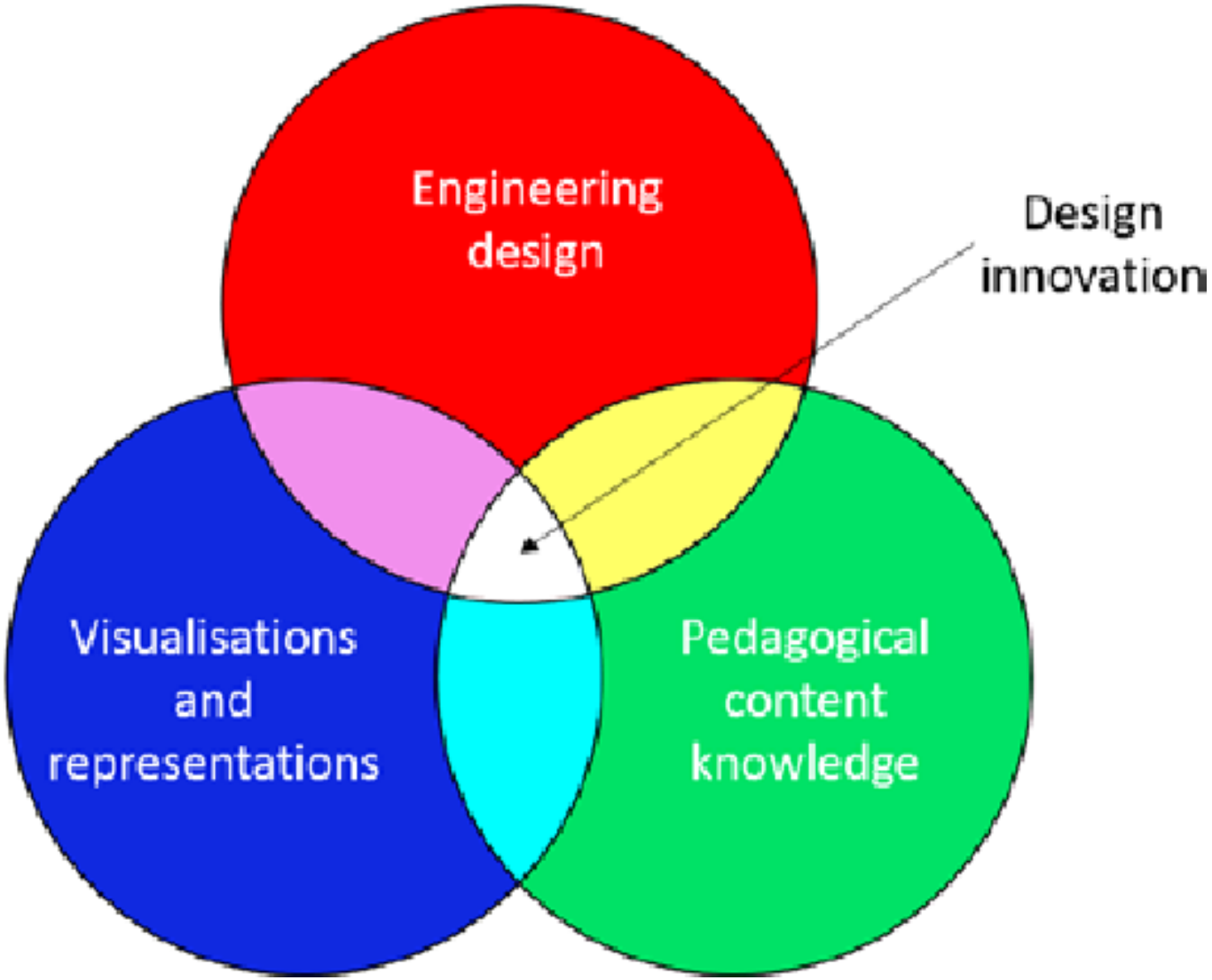


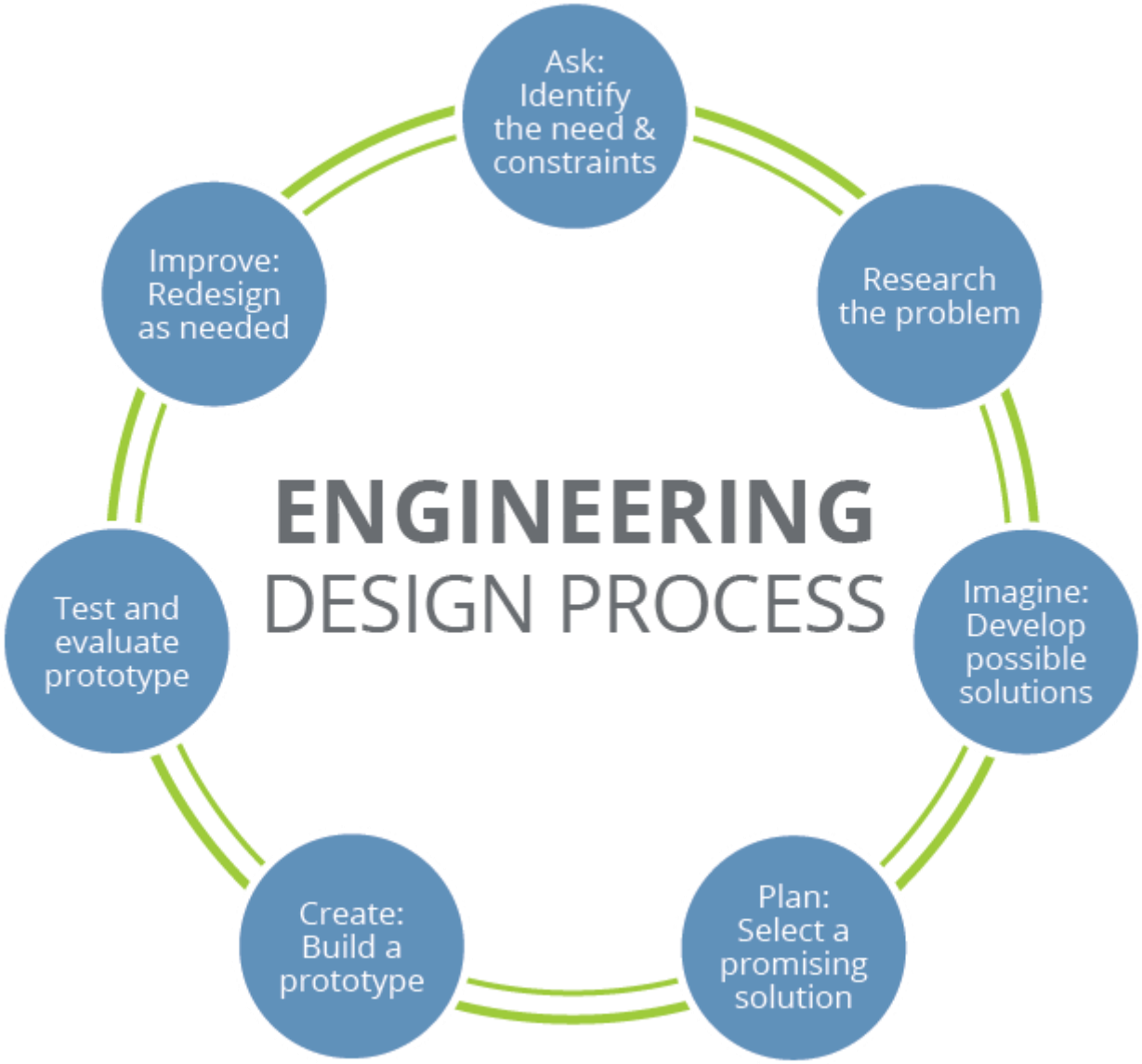

Design Thinking
Systems Thinking
Design Innovation
Design Engineering
Business Model Innovation

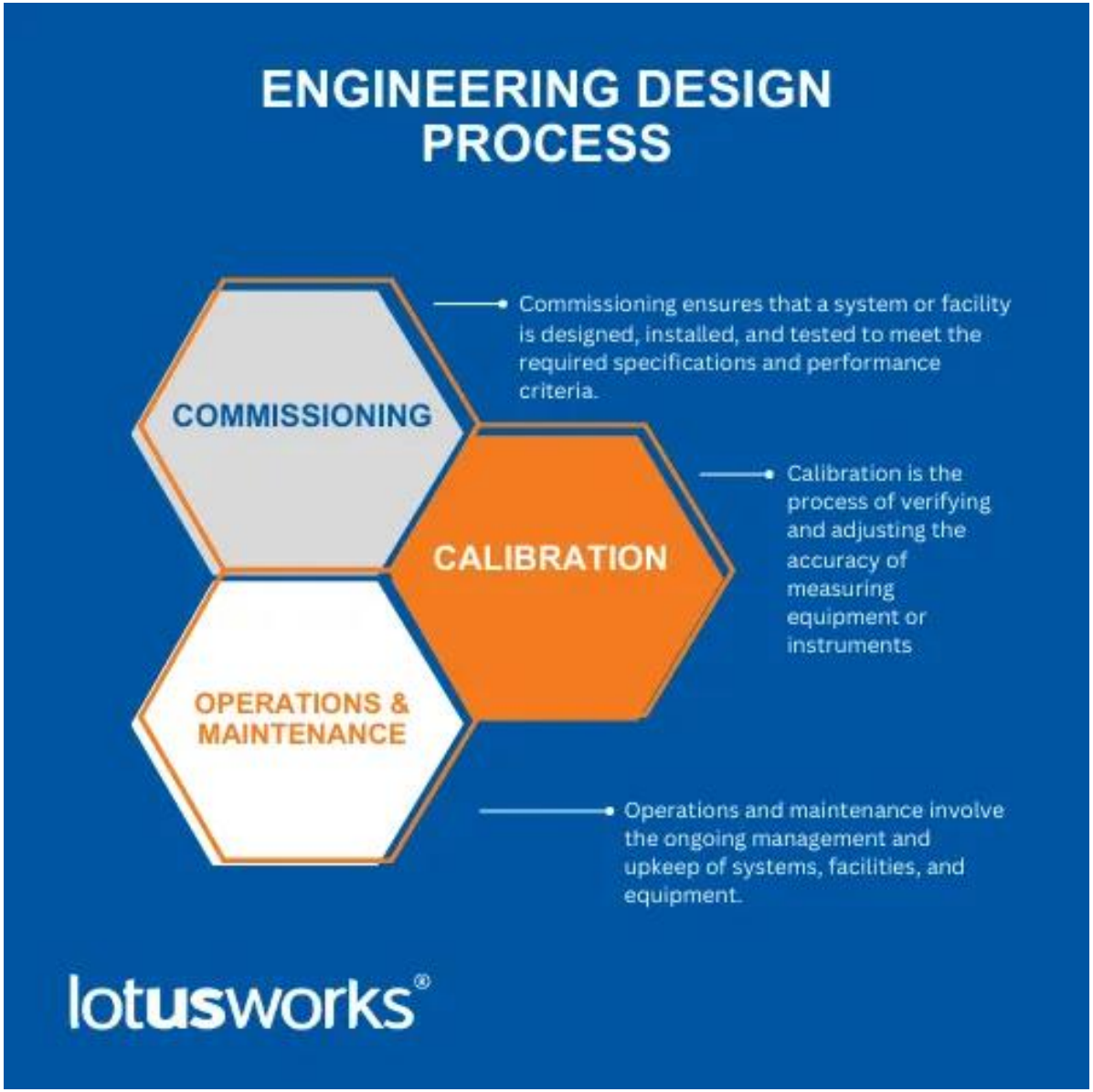

Ask
What's the problem?
Define constraints.
Imagine
Brainstorm!
Choose a solution.
Plan
Draw it!
Make a materials list.
Create
Make it!
Try it out.
Improve
Make it better!

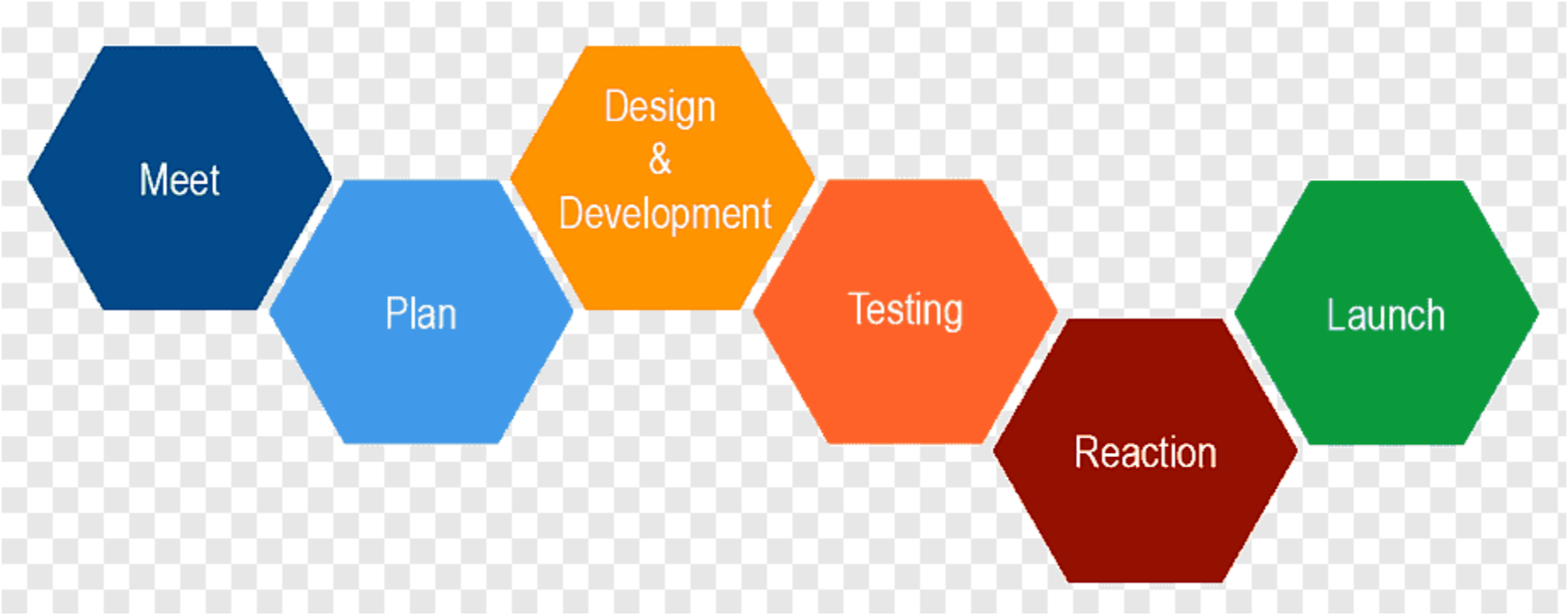

Problem Identification
Preliminary Ideas
Preliminary Design
IDEATION
Modeling
Design Analysis
Design Visualization
REFINEMENT
IMPLEMENTATION
Servicing
Financing
Marketing
Producing
Planning
Documenting
3-D Model


1. Identify the Problem
2. Identify Criteria and Constraints
3. Brainstorm Possible Solutions
4. Generate Ideas
5. Explore Possibilities
6. Select an Approach
7. Build a Model or Prototype
8. Refine the Design


Engineering design
Design innovation
Visualisations and representations
Pedagogical content knowledge

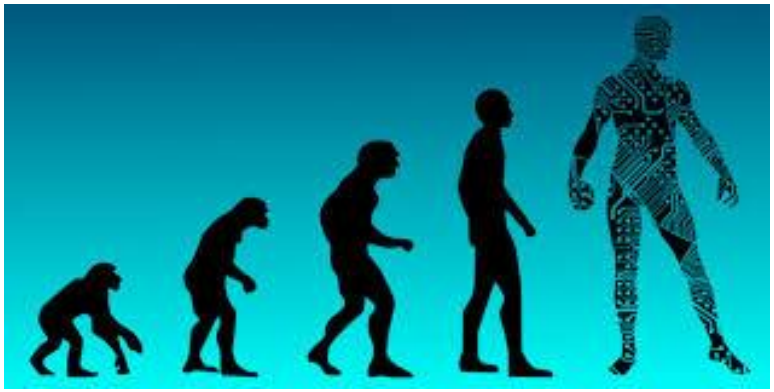

ENGINEERING
DESIGN PROCESS
Ask: Identify the need & constraints
Research the problem
Imagine: Develop possible solutions
Plan: Select a promising solution
Create: Build a prototype
Test and evaluate prototype
Improve: Redesign as needed


ENGINEERING DESIGN PROCESS
COMMISSIONING
CALIBRATION
OPERATIONS & MAINTENANCE
Commissioning ensures that a system or facility is designed, installed, and tested to meet the required specifications and performance criteria.
Calibration is the process of verifying and adjusting the accuracy of measuring equipment or instruments
Operations and maintenance involve the ongoing management and upkeep of systems, facilities, and equipment.
lotusworks®


Meet
Plan
Design
&
Development
Testing
Reaction
Launch

- Artificial Intelligence
- Robotic Process Automation
- Natural Language Processing
- Block Chain
- Augmented Reality and Virtual Reality
- Cloud Computing

Innovation



Innovation - What is it?

- Innovation is the introduction of new ideas, goods, services, and practices which are intended to be useful.

Bill Ford on Innovation

- "..if we want to succeed as a company – and as an industry – we must drive innovation into everything we do: into technology, into safety, into design and into real-world solutions for environmental issues, like the impact of energy usage on our world."

Types of innovation

1. Product innovation
2. Process innovation
3. Marketing innovation
4. Organizational innovation
5. Business Model

Portrait of a Innovative Person

- "Innovative people pay attention to their world, see things differently, challenge assumptions, take risks, are not afraid to fail, and strive to generate multiple solutions to problems. They are passionate about creativity and seek opportunities to innovate."
  - **Everyday Creativity: Principles for Innovative Design.** Dr. Larry G. Richards

5 Tips To Help You Enhance Your Creativity

1. Open Your Mind
2. Diversify
3. Relax
4. Stop Looking For *the* Right Answer
5. Health Makes Wealth

by Padi Selwyn, M.A.

What is innovation?

- **Innovation** is the process and outcome of creating something new, which is also of value.

- Innovation involves the **whole process** from opportunity identification, ideation or invention to development, prototyping, production marketing and sales, while entrepreneurship only needs to involve commercialization (Schumpeter).

What is innovation?

- Schumpeter argued that innovation comes about through new combinations made by an entrepreneur, resulting in
  - a new product,
  - a new process,
  - opening of new market,
  - new way of organizing the business
  - new sources of supply

Drivers for innovation

- Financial pressures
- Increased competition
- Rising customer expectations regarding service and quality
- Greater availability of potentially useful technologies

What is innovation?

- Gary Hamel –
  - Developing new products and services
  - Redefining market space
  - Redrawing industry boundaries

The Innovation Process

1. The work environment
2. Brainstorming
3. Divergent thinking

Traits of innovative people

- Simply believing you're creative
  - Curiosity
  - Confidence
  - Courage
  - Constancy
- They understand the creative process itself

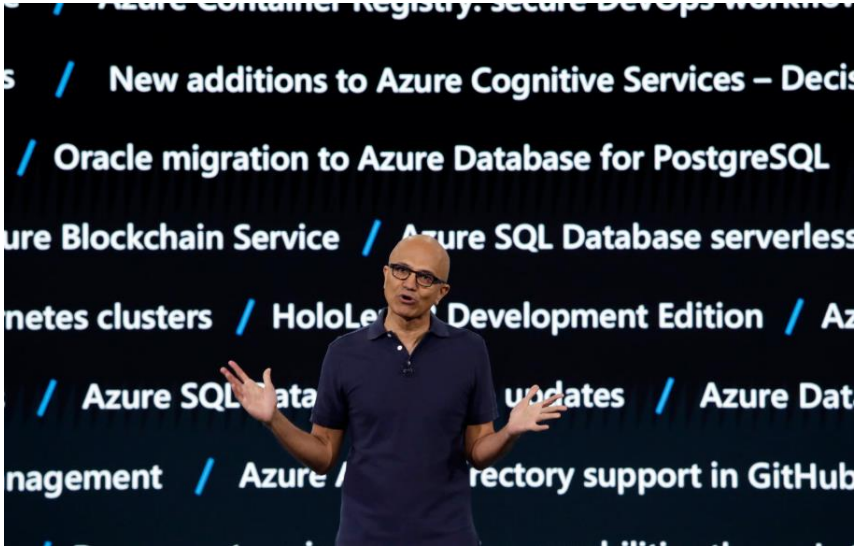
The 4-step Innovation Process

1. Preparation
2. Incubation
3. Inspiration
4. Verification

Technology Innovation

1. Artificial Intelligence & Robotic Process Automation & Natural Language Processing & Block Chain
2. Augmented Reality and Virtual Reality
3. Cloud Computing
4. Block Chain

Microsoft in AI US$1billion (2019)



Microsoft invests $1 billion in Elon Musk-founded OpenAI

The companies will work to build new Azure AI supercomputing technologies.

https://www.engadget.com/2019/07/22/microsoft-invests-openai-azure-supercomputing/

AlphaZero (Dec 2018)

Alphabet Inc.
Multinational conglomerate company

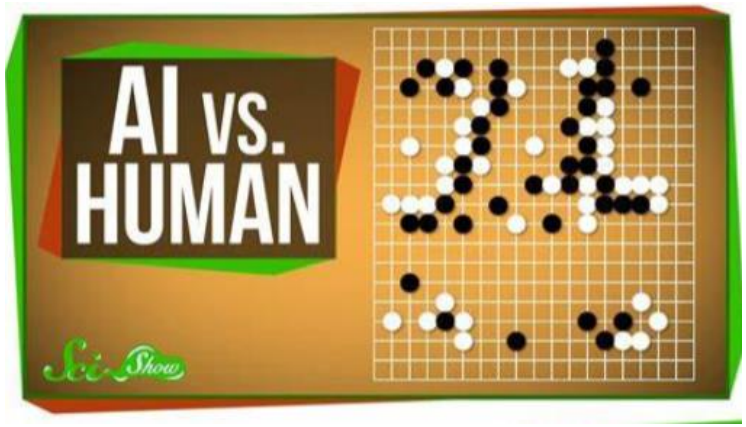
Alphabet

Google

DeepMind Technologies
Computer programs company

https://deepmind.com/research/alphago/

AI vs Human



At the 2017 AlphaGo Master beat Ke Jie, the world No.1 (the even more powerful AlphaGo Zero already existed)

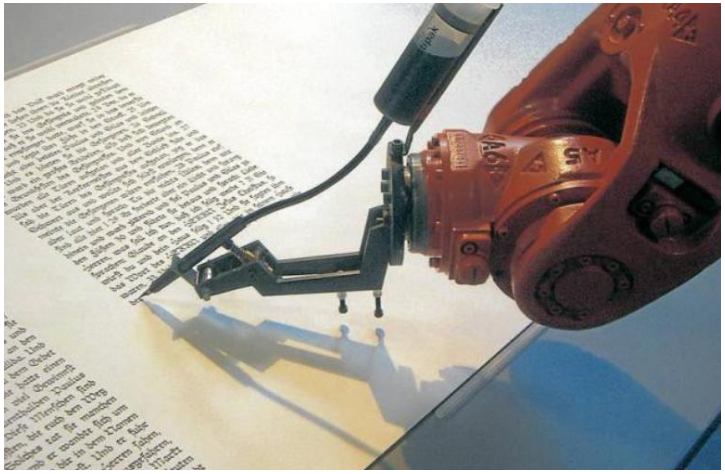
AlphaZero was trained solely via "self-play" using 5,000 first-generation to train the neural networks

AI vs Human

2011 IBM Watson competed on Jeopard against legendary champions Brad Rutter and Ken Jennings winning the first place prize of $1 million

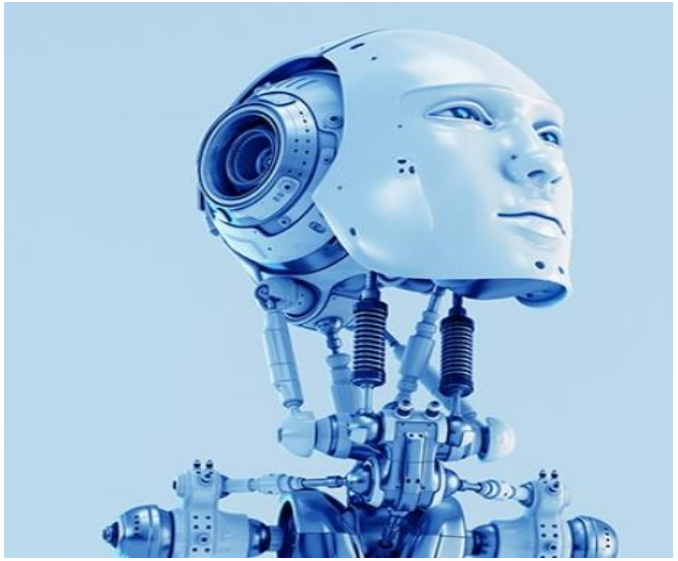
最强大脑

Will machine replace human

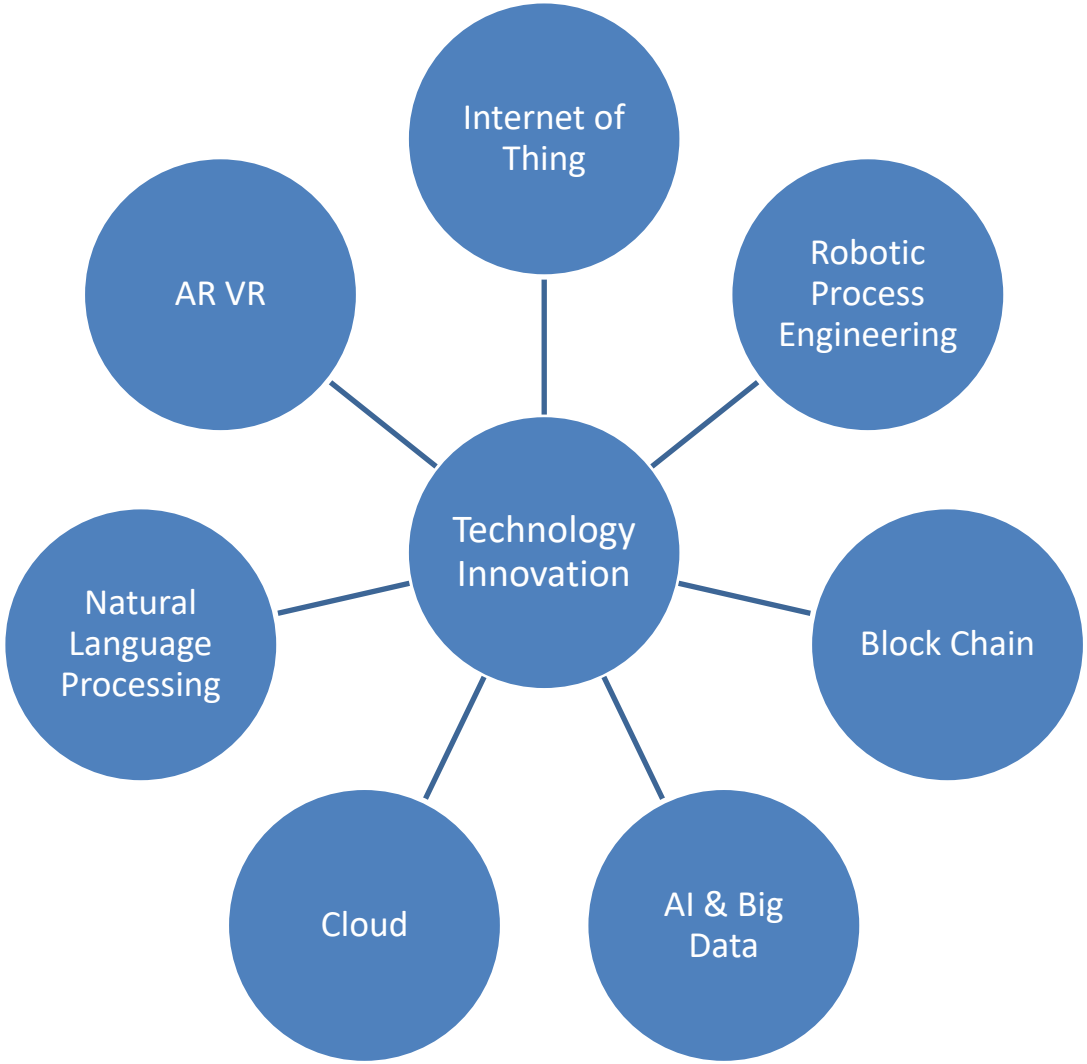


Evolution

- Steam Engine
- Car
- Computer
- Internet
- AI, Blockchain?



Technology Innovation



27th June 2019

A humanoid robot working side by side with employees at a factory in Japan. A report by UK-based research firm Oxford Economics says about one in three robots worldwide is in China, which accounts for around one-fifth of the world's total stock. But Japan – formerly the world leader in automation – has reduced its active stock of robots by around 100,000 units since 2000, it says. PHOTO: REUTERS

Robots to wipe out 20m jobs by 2030: Study

Lead author says Singapore, with a supportive regulatory structure, is well-placed to benefit from new robotics

Chong Koh Ping
Technology Correspondent

Up to 20 million manufacturing jobs will be lost globally to robots by 2030, a new study has found.

And the displacement of jobs will not be evenly spread around the world, or within countries, according to the study published yesterday by Oxford Economics, a UK-based research firm.

Lower-skilled regions are much more vulnerable to the job losses, it said after surveying seven economies – the United States, Germany, Britain, France, Japan, South Korea and Australia.

Since 2000, some 1.7 million manufacturing jobs have been lost to robots, including around 400,000 in Europe, 260,000 in the US, and 550,000 in China.

The study noted that the rate at which robots were replacing jobs had been rising steadily, with the global stock of industrial robots more than doubling since 2010.

"The robotics revolution is rapidly accelerating... The result will transform what robots can do over coming decades – and their ability to take over tasks that humans do now," said Mr James Lambert, associate director at Oxford Economics and a lead author of the study. He added: "The number of robots is also set to multiply rapidly. We expect the number in use to reach 20 million by 2030 – about 10 times the number now."

The study noted the centre of gravity in the world's robot stock has shifted towards new manufacturers, mainly in China, Korea, and Taiwan but also to India, Brazil and Poland. About one in three robots worldwide is in China, which accounts for around one-fifth of the world's total stock, up from just 0.1 per cent in 2000. By 2030, China could have as many as 14 million industrial robots, dwarfing the rest of the world's stock of them.

In contrast, the combined robot inventory of the US and Europe has fallen to under 40 per cent of the global share from its peak of close to 50 per cent in 2009.

And Japan – formerly the world leader in automation – has reduced its active stock of robots by around 100,000 units since 2000.

The study predicted that the use of robots in services industries would accelerate sharply in the next five years. This would particularly affect the logistics sector but should spread to other industries, including healthcare and retail.

"The implications are huge. We will see a significant boost to productivity and economic growth and some new types of job we can't even yet foresee," said Mr Lambert.

The report predicted that a 30 per cent rise in robot installations above its baseline forecast for 2030 would add US$4.9 trillion (S$6.6 trillion) to the global economy that year, equivalent to an economy greater than the projected size of Germany's in that year.

"But at the same time business models will be disrupted or upturned and millions of existing workers will be displaced – and the impact will affect lower-skilled and poorer economies... most," he cautioned. "Governments, policymakers, business and individuals need to think hard now about this wave of tech-driven change and we all need to prepare for what amounts to a new industrial revolution."

When asked about the impact of robots in Singapore, Mr Lambert said it was well positioned to benefit from this new generation of robotics as it has a modern and upgradeable infrastructure, a supportive regulatory framework and a strong investment environment.

"Those workers in Singapore that are displaced by technology will have to adapt their skills to the evolving demands of the future economy but the government already has put in place schemes to help to retrain workers displaced by technology," he said.

"Singapore also has an ageing population (more so than most) and restraints on inward migration, so robots may be particularly helpful in keeping the economy growing."

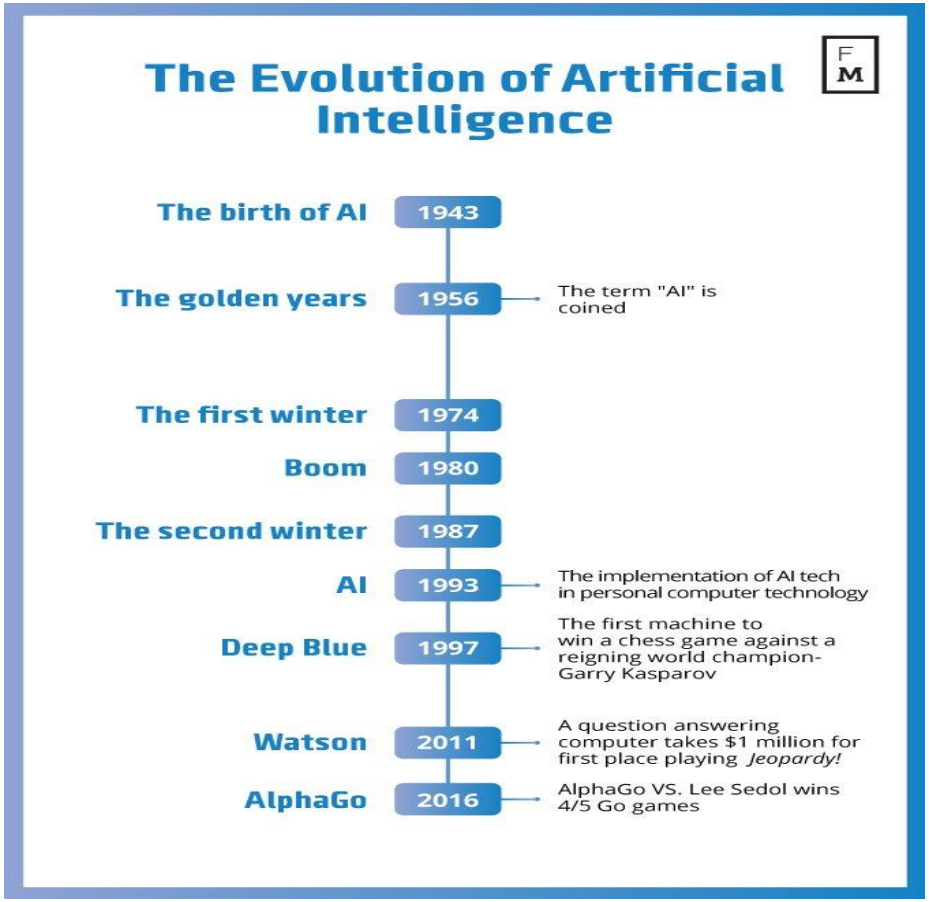
kohping@sph.com.sg

20m
Number of robots expected to be in use by 2030 – about 10 times the number now.

1.7m
Number of manufacturing jobs that have already been lost to robots since 2000, including around 400,000 in Europe, 260,000 in the US, and 550,000 in China.

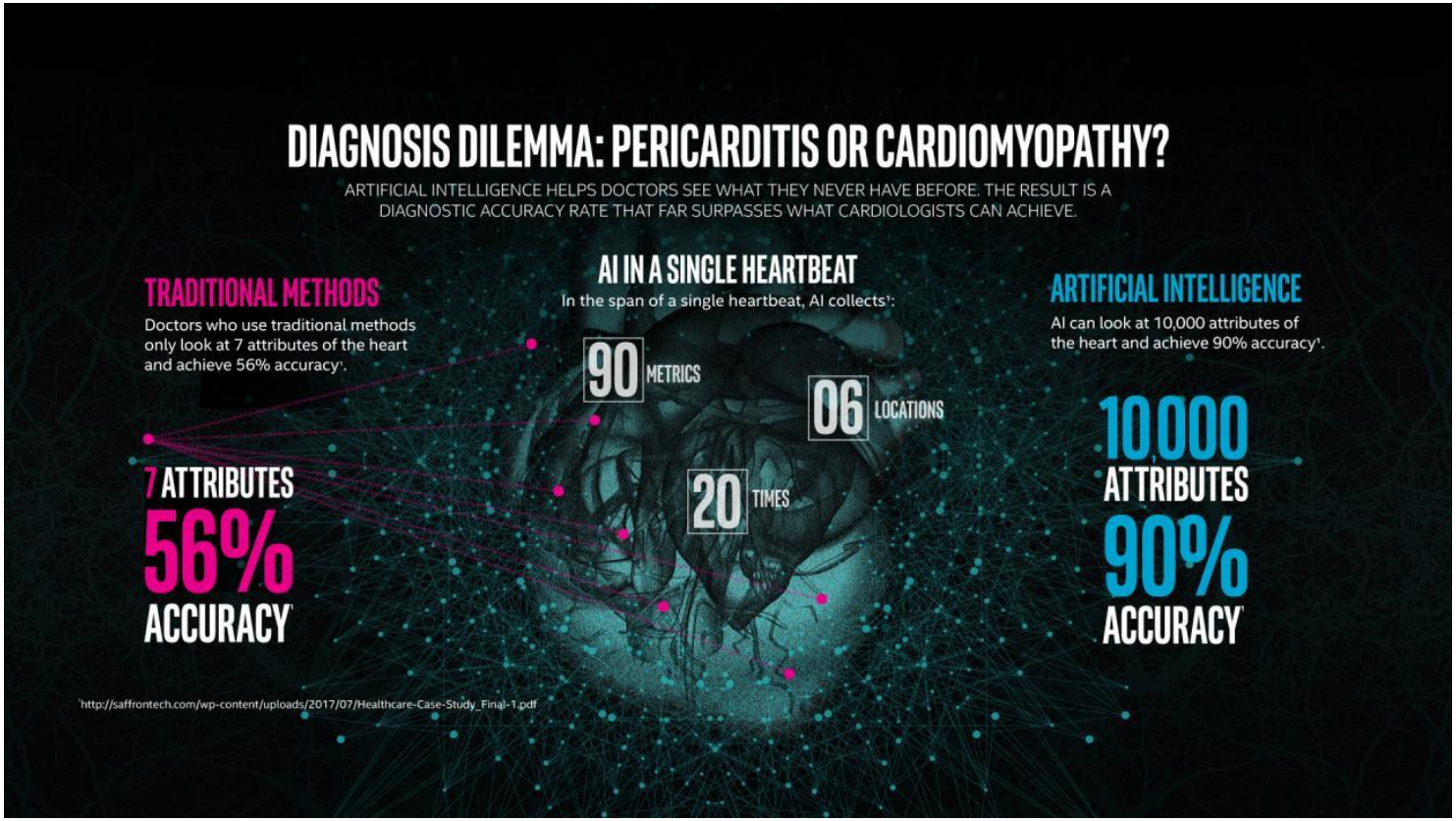
14m
Number of industrial robots in use in China by 2030, dwarfing the rest of the world's stock of them.

Evolution in AI



Source: https://davidlecea.wordpress.com/2016/11/10/robots-on-the-rise-how-ai-can-change-the-financial-world/

Cardiologist vs AI



Source: https://www.intelcom.com/en/www/us/en/healthcare-it/article/improved-diagnosis.html

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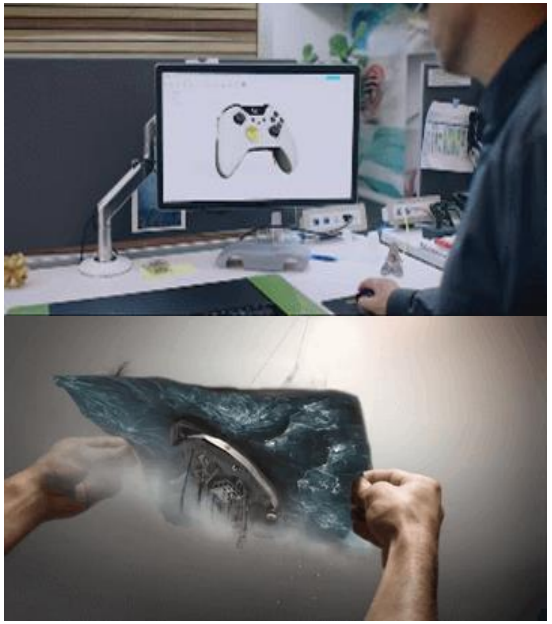
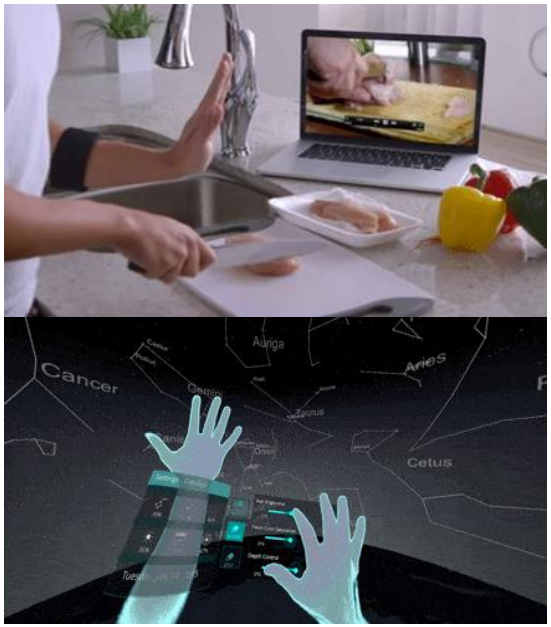
AR/VR

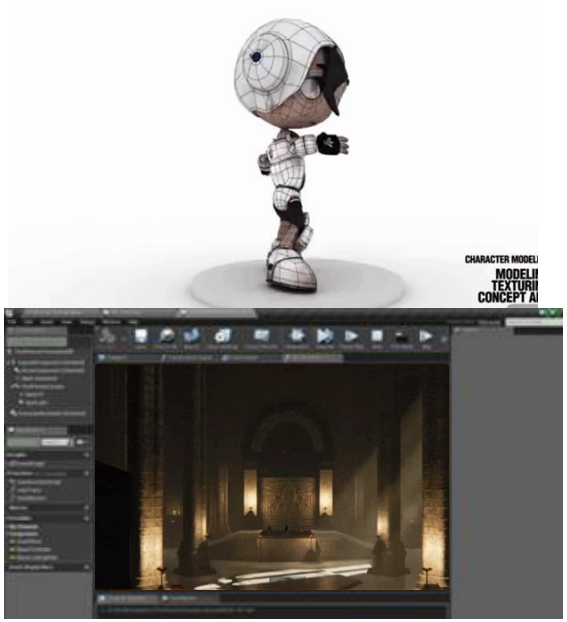


Augmented Reality

Virtual Reality



Hardware



Software

Current AR Applications

- Instagram Stories Filters
- Pokémon Go
- iOS Measure App
- Google Search

What is Virtual Reality (VR)?

- **Three-dimensional, computer generated environment** which can be explored and interacted with by a person using input devices
- Users becomes part of this virtual world or is immersed within this environment and whilst there, is able to **manipulate objects or perform a series of actions**.

Industries' Usage of AR & VR

- Healthcare
- Architecture
- Entertainment
- Sports
- Business
- Education
- Military
- Media
- Rehabilitation
- Arts

3. Cloud Computing

"A Cloudy History of Time"

1940

1950

1960

1970

1980

1990

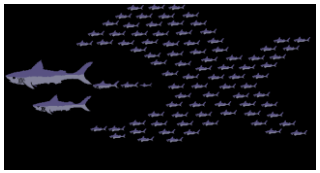
2000

2012

IBM

xerox

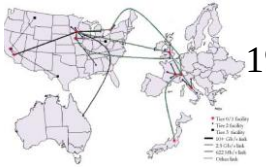
Honeywell



CRAY

THE SUPERCOMPUTER COMPANY

Open Science Grid



Lime wire

KaZaA

BitTorrent

Clouds

First large datacenters: ENIAC, ORDVAC, ILLIAC
Many used vacuum tubes and mechanical relays

Berkeley NOW Project
Supercomputers
Server Farms (e.g., Oceano)

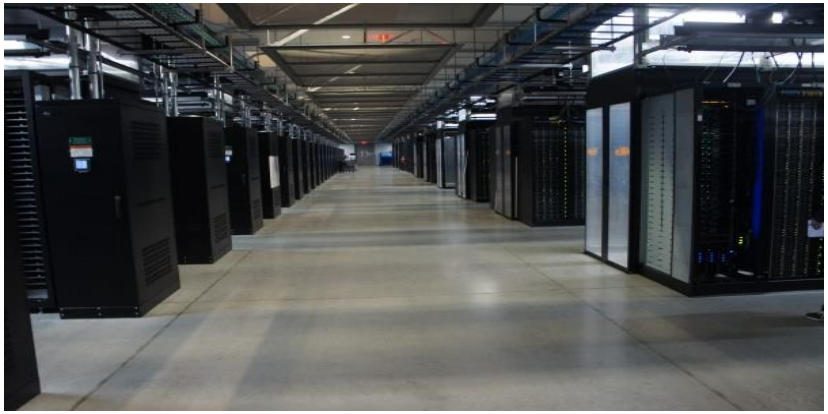
P2P Systems (90s-00s)
•Many Millions of users
•Many GB per day

Data Processing Industry
- 1968: $70 M. 1978: $3.15 Billion

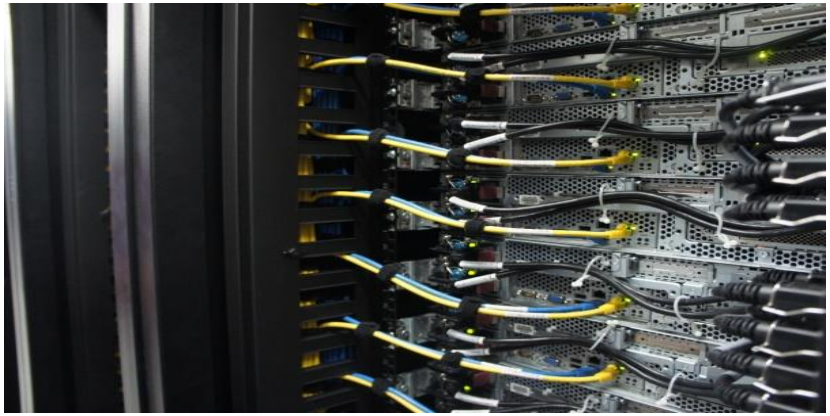
Timesharing Industry (1975):
•Market Share: Honeywell 34%, IBM 15%,
•Xerox 10%, CDC 10%, DEC 10%, UNIVAC 10%
•Honeywell 6000 & 635, IBM 370/168,
Xerox 940 & Sigma 9, DEC PDP-10, UNIVAC 1108

Grids (1980s-2000s):
•GriPhyN (1970s-80s)
•Open Science Grid and Lambda Rail (2000s)
•Globus & other standards (1990s-2000s)

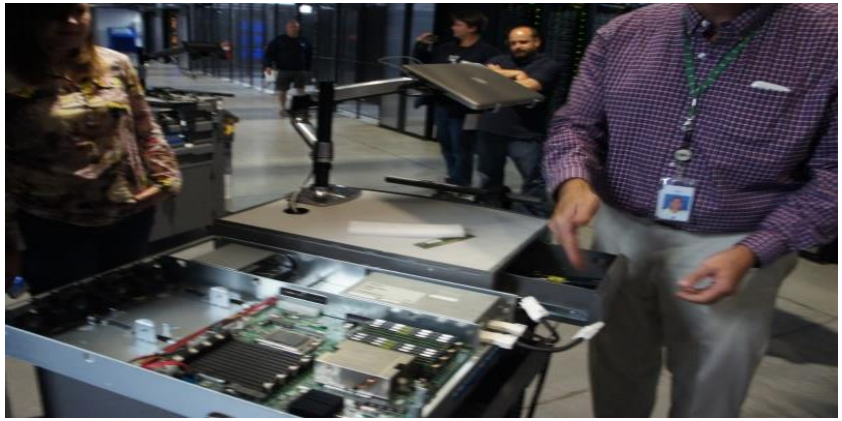
Servers



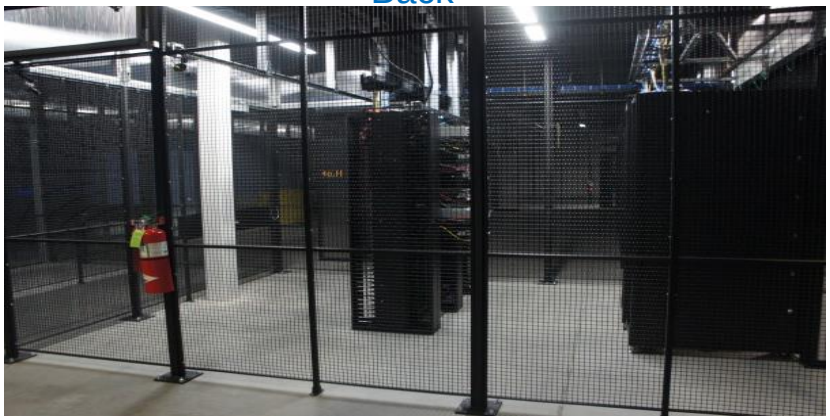
Front



Back



In



Some highly secure (e.g., financial info)

Common Tools

- Amazon AWS
- Google app Engine
- Windows Azure

4. Block Chain

CHINA TECH

China triples US in blockchain patent filings

Alibaba and compatriots push for domination in fast-growing field

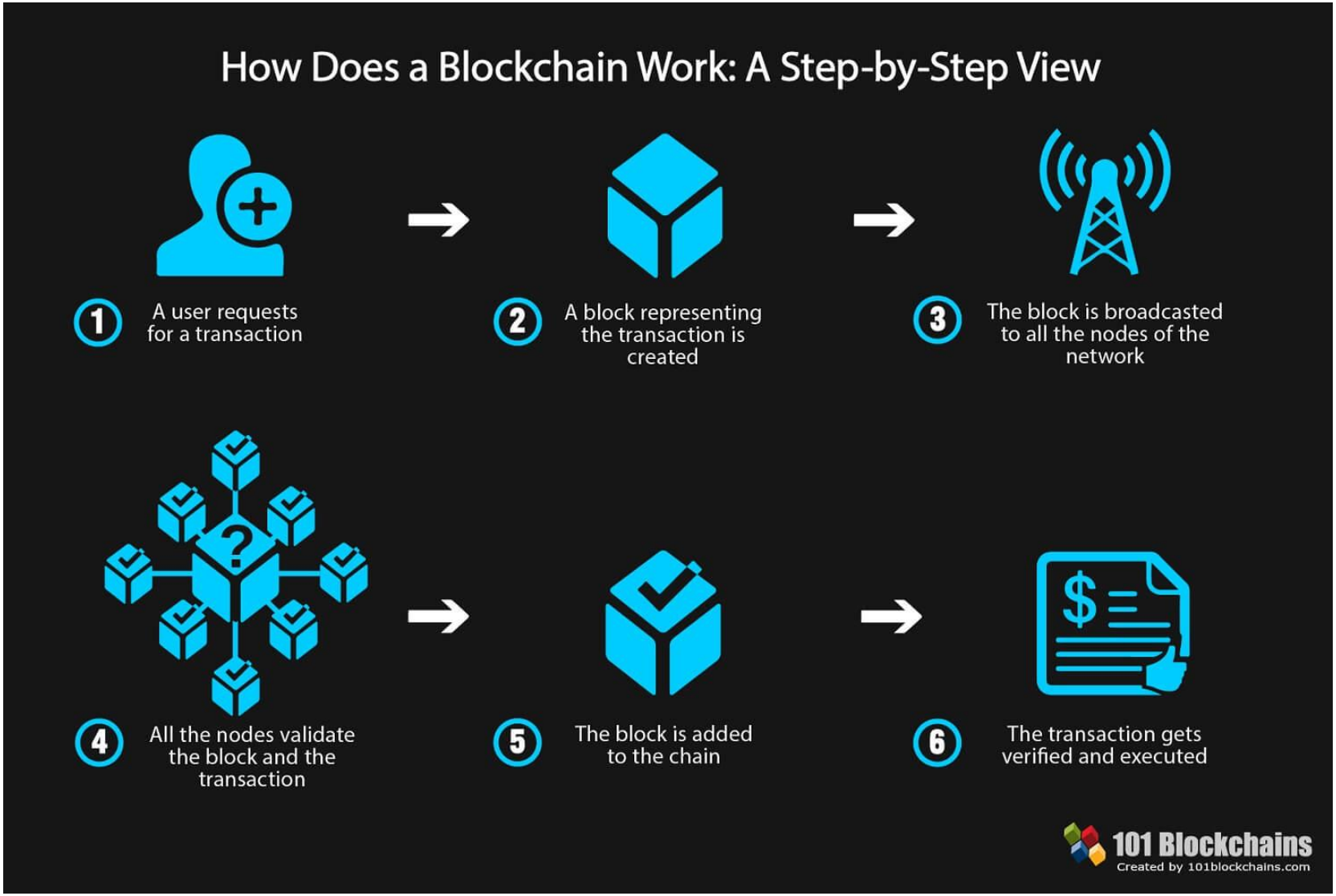
TAKESHI HASHIMOTO and YUSHO CHO, Nikkei staff writers
NOVEMBER 21, 2019 02:01 JST

OCT 9, 2018

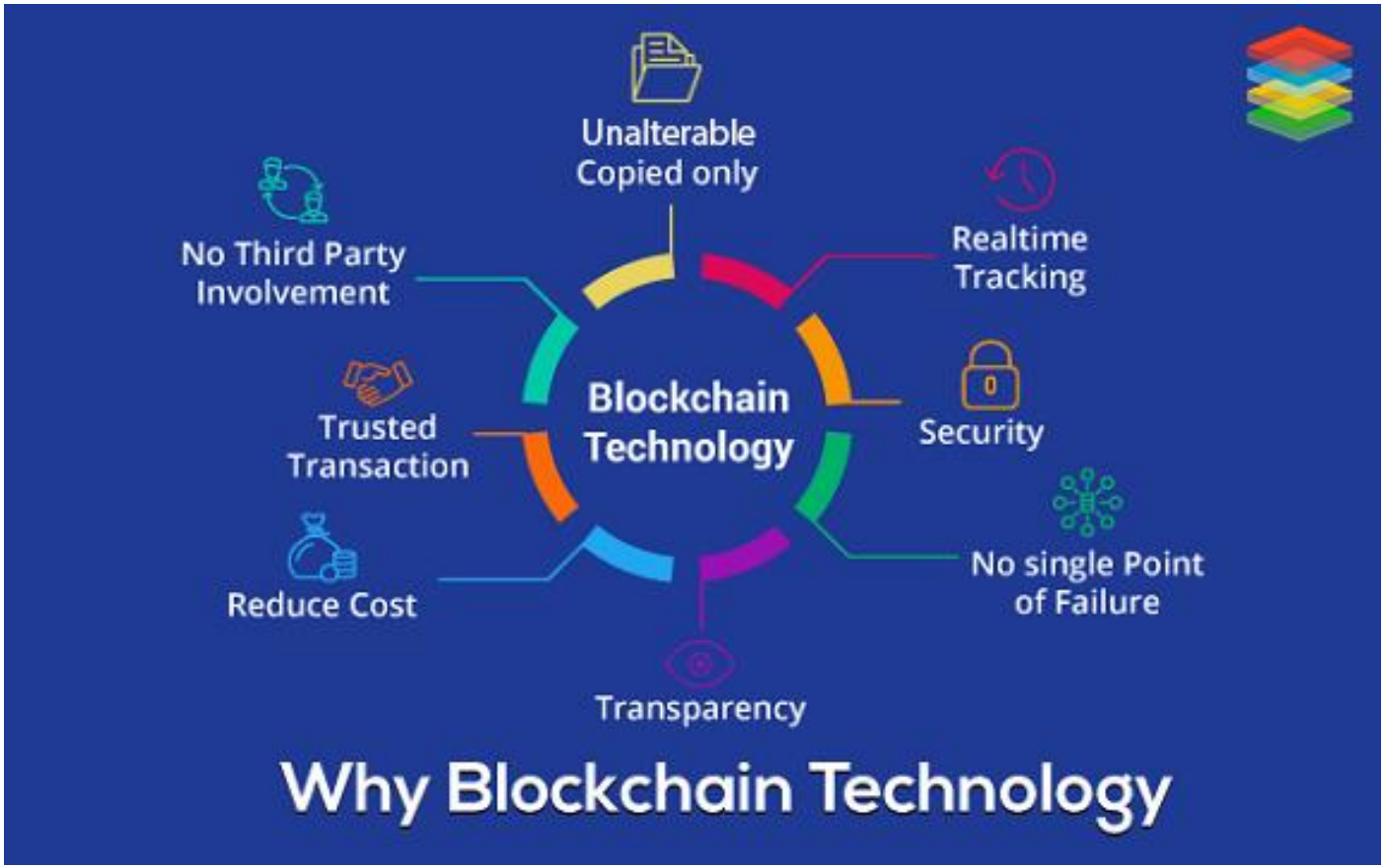
Getting Married and Divorced on the Blockchain

by Spencer Neale Twitter

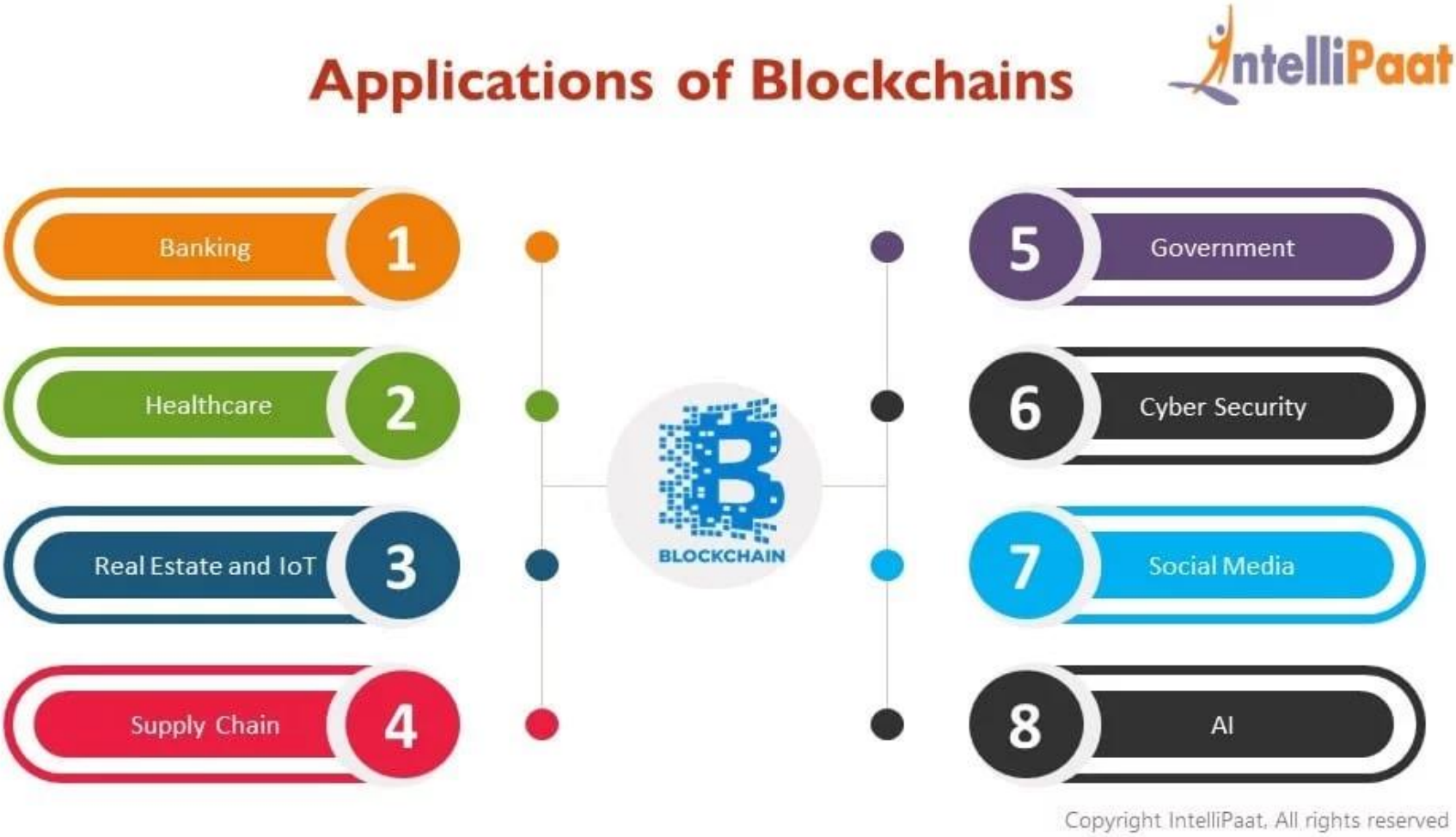
"Life is not eternal and death can separate us, but the Blockchain is forever." - David Mondrus and Joyce Bayo on their blockchain wedding


How Does a Blockchain Work: A Step-by-Step View
1
A user requests for a transaction
2
A block representing the transaction is created
3
The block is broadcasted to all the nodes of the network
4
All the nodes validate the block and the transaction
5
The block is added to the chain
6
The transaction gets verified and executed
101 Blockchains
Created by 101blockchains.com

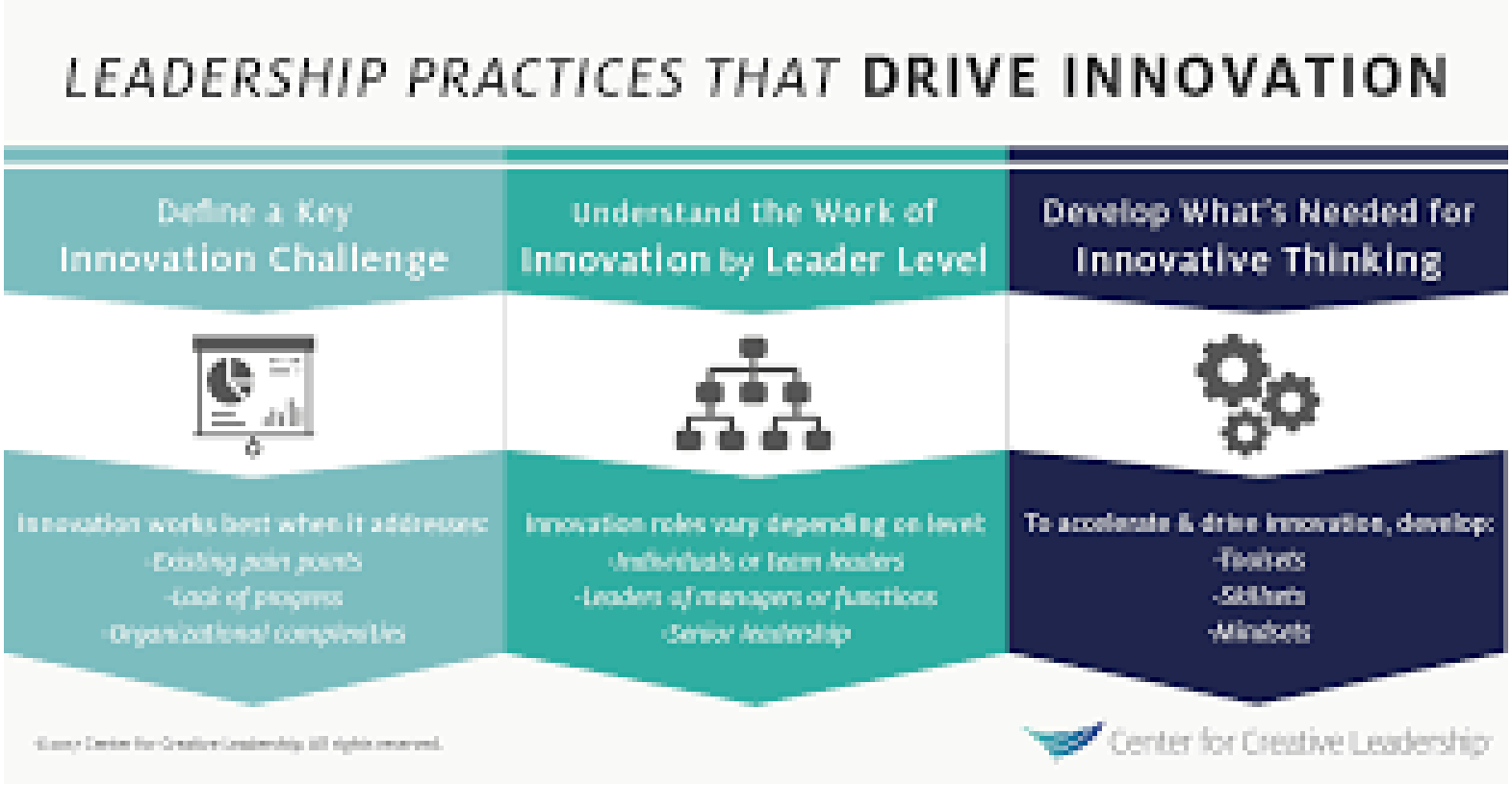
Why Block Chain



Application



Innovative & Leadership



Thank You